

FILE NAME: Exxon (EXX)

DATE: 1993 Sept 27

DOC#: EXX054

DOCUMENT DESCRIPTION: Legal - Deposition of James Hammond with  
BC Notes

2 Rice Hotel + Shamrock  
on 1/4 1948-1959 300 people

27 (1947) tried to substitute  $\phi$  or eliminate exp. to it.

30 Ex. P-3 is Hammond's history of O control  
written in 1991 by him

31 Ex p. 4 1935 Dir Labor Stds. publ  
32 Ex p. 5 1938 on 39 " "

32 Q 10-5 1938 or 39 " " " " NSC-193(uD-6

33 Exp-7 1946, 1948, 1956 MCA Chem. Data Sheets &

44-81 precautions he rec in 1948: first, education of the worker

45' (1948): med exam at here & after suspicious exposures  
111: respirator in unit

46 " respirator air monitoring

48 Knew Dr. Hunter at Mass. General in 1941 Knew of  $\phi$  article

49. Mauro Etzyl Browning's 1937 book is, 1941, still in Boston

50 Newton taught him in Boston, SH agreed only safe exp. was 0-

54 P-12 Harrison 1950 Principles of Internal Medicine

55 Chapter on chemical agents by Marshall Clinton, fellow student at Haver  
56 P-15 Esso Toxgram 1958

56 P-15 Esso Texgram 1958

insidious because it's inoffensive (small) at harmful levels

58 Toxgram said only abs. safe level is zero

59 only safe level zero also expressed by WCH by implication 1942

02 H'also'attended WCH's APHA spec' noted by Clyde Berry, 1998

68 NY State Cancer Comm. 1949 incl. ADI doc, WCH, Gschmann Ex P-16

69 JN accepted also in 1949 that D was an established carcinogen

16-19 3rd 1912, 1950 docs. (letter says I have "care properties")

78 SA said no living in his 1948 program

84 API 8/30/60 revision of 1948 & API to 10

P-21 1970 Cities Service memo to customer.

85 P-22 is 1955 JH memo on practices then used

86 looked for Dexp. in working exp. to petrol. streams w  $\geq 2.5\%$   $\phi$

37 and mos. winery parents  
11/10/10 11/10/10 11/10/10

Walsh: Heavy duty. Knowledge of procedures 100%  
... structure of classroom training, enforceable. Exon

194-95 HFF did refinery studies for Std Oil Co in late 1940's p-23

76 Odor threshold exceeded TLVs of 35, 50 ppm

100 zero exp. to protect susceptible workers - SH didn't accept TLV as acceptable  
 - it's a limit that could be reached (MA 1944)

100-105 TLV/MAC limited by what can be enforced on industry (100-110)

104.1

Blue

-----  
JOSEPH L. HEBERT AND  
MARIE HEBERT

] 14TH JUDICIAL DISTRICT

vs. No. 92-6203

] PARISH OF CALCASIEU

HIGMAN BARGE LINES  
INC., ET AL

] STATE OF LOUISIANA  
-----

VIDEOTAPE DEPOSITION OF

**PROFESSOR JAMES HAMMOND**

Between the hours of 9:50 a.m. and 1:50 p.m.

September 27, 1993

Marriott, Houston Intercontinental Airport

Houston, Texas

**RECEIVED OCT 1 1993**

Shawn Kelley, Texas CSR No. 3448

Nell McCallum & Associates Inc.

2900 Smith, Suite 104

Houston, Texas 77006

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**NMA  
COPY**

SHAWN KELLEY, TEXAS CSR 3448  
NELL MCCALLUM & ASSOCIATES, INC.

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APPEARANCES

For the Plaintiffs:

William B. Baggett

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Kenneth R. Spears

Attorney at Law

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For the Defendant Higman Barge Lines, Inc.:

Mark Freeman

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For the Defendant Koch Industries:

Robert T. Myers

Attorney at Law

1515 Energy Centre

1100 Poydras Street

New Orleans, Louisiana 70163

Also present:

Jeff McClain, Videographer

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1 VIDEOGRAPHER: On the record, it's 12  
2 minutes before 10 o'clock, September 27, 1993,  
3 92-6203, Joseph L. and Marie Hebert versus Higman  
4 Barge Lines, Inc., et al, 14th Judicial District  
5 Court, Parish of Calcasieu, State of Louisiana.  
6 We're here for the deposition of Professor James  
7 Hammond. If the court reporter will swear in the  
8 witness, we'll have counsel state their  
9 appearances and we'll begin with this deposition.

10 [The witness was sworn]

11 MR. BAGGETT: This is William B.  
12 Baggett, and I represent the Plaintiffs Joseph  
13 Hebert and his wife.

14 MR. FREEMAN: This is Mark Freeman, and  
15 I represent Higman Barge Lines.

16 MR. SPEARS: This is Kenneth Spears, and  
17 I represent all of the oil company defendants in  
18 this case with the exception of Koch Industries.

19 MR. MYERS: And my name is Robert Myers.  
20 I represent Koch Industries.

21 MR. BAGGETT: Ken, for the -- for the  
22 record, I really think I need you to -- here's  
23 a list of the companies that are involved in the  
24 litigation, and I'd like for you to state for  
25 the record -- here's some more of them -- your

1 appearances.

2 MR. SPEARS: All right. Again, this  
3 is Ken Spears, and I'm listing the oil company  
4 defendants whom I represent in connection with  
5 the Joseph Hebert case. First of all is Amoco  
6 Oil Company; Atlantic Richfield Company; Oxy  
7 Oil & Gas USA, Inc.; Canadian Oxy Offshore  
8 Production Company; Coastal Corporation;  
9 Crown Central Petroleum Corporation; Gulf Oil  
10 Corporation; Koch Industries; Marathon Oil  
11 Company; Mobil Corporation; Phillips Petroleum  
12 Company; Shell Oil Company; Sun Oil Company;  
13 Texaco, Inc.; Union Oil Company of California;  
14 Conoco, Inc.; Monsanto Company; ARCO Chemical  
15 Company; with the understanding that these names  
16 may have changed since we filed the pleadings,  
17 and I'm not verifying that these are -- these are  
18 the correct names of these companies as they are  
19 known.

20 MR. BAGGETT: Fine.

21 MR. SPEARS: Okay.

22 MR. BAGGETT: Thank you.

23 Gentlemen, is this deposition -- can we  
24 agree that this deposition is being taken pursuant  
25 to notice and that it's to be governed under the

1 rules of the Louisiana Code of Civil Procedure,  
2 and can we stipulate that -- that in accordance  
3 with those rules that all objections are reserved  
4 except those relative to the form of question or  
5 the responsiveness of the answer?

6 MR. MYERS: That's agreed on behalf of  
7 Koch.

8 MR. FREEMAN: That's fine.

9 MR. SPEARS: That's fine with me.

10 MR. BAGGETT: And I ask that a copy of  
11 the notice of the deposition marked Plaintiff 1  
12 for identification be attached and made a part  
13 of the deposition.

14

15

16 PROFESSOR JAMES HAMMOND,

17 being first duly sworn or affirmed, testified as  
18 follows:

19

20 EXAMINATION BY MR. BAGGETT

21

22 Q. Professor Hammond, state your full name,  
23 please, sir.

24 A. James William Hammond, Sr.

25 Q. And where do you reside, sir?

1           A.    I live at -- in Houston, Texas, and  
2   that's located 1010 Townplace.

3           Q.    And what is your profession, sir?

4           A.    I'm an industrial hygienist.

5           Q.    Would you tell us, if you would, what is  
6   an industrial hygienist?

7           A.    An industrial hygienist is a scientist  
8   that recognizes potential hazardous materials in  
9   industry, and then he developed methods of  
10   evaluating the degree of hazard and then designs  
11   the control measures that may be required to  
12   protect employees that are handling these  
13   substances or materials.

14          Q.    Would you tell the Court or jury how old  
15   you are today, sir?

16          A.    Well, I am over 80 years of age.

17          Q.    All right, sir. And where were you born?

18          A.    I was born in Winona, Mississippi.

19          Q.    You're retired, are you not, sir?

20          A.    I am retired, yes, sir.

21          Q.    Did you ever teach?

22          A.    Yes, I have taught for many years.

23   Beginning back with the university system, I was  
24   teaching as early as 1936.

25          Q.    And could you tell us some of the places

1 where you taught?

2 A. Well, for the University of Tennessee and  
3 University of South Carolina, Georgia Tech, and I  
4 taught then at Baylor School of Medicine here in  
5 Houston, I taught in Oklahoma at the University of  
6 Oklahoma at Norman, and I taught at Wichita State  
7 University.

8 Q. That's in Kansas?

9 A. That's in Kansas, yes, sir. And then I  
10 retired and began teaching for nine years in the  
11 Medical Center at the University of Texas in  
12 Houston. And I retired from there in 1987, I  
13 think.

14 Q. You retired from the University of Texas,  
15 Medical Center teaching in 1987?

16 A. That was my memory, yes, sir.

17 Q. And that was preceded by nine years as  
18 a teacher there?

19 A. Yes, because I retired from the Humble  
20 Company in 1978.

21 Q. All right, sir. Now, if you would,  
22 and I'm not going to make this long as I could,  
23 because of your distinguished past, but if you  
24 would, would you tell us something about your  
25 education and training, Professor?

1           A.     Yes.   Well, I have two degrees from  
2   Mississippi State University.   One of them's in  
3   the field of physics and chemistry, the other  
4   one's a chemical engineering degree.   Then I have  
5   a masters degree in biochemistry and toxicology  
6   from LSU.   Then I did graduate work at MIT and I  
7   did graduate work at the University of South  
8   Carolina, Rice University, University of Houston  
9   and probably one or two other universities that  
10   I've forgotten the names, which ones.

11          Q.     Well, did you do any -- did you have --  
12   further your education at Harvard?

13          A.     Yes, I did.   I never registered as a  
14   full-time student there, because I was working  
15   an internship under the teachers of the Harvard  
16   University, particularly I recall Harvey Elkins,  
17   Dr. Elkins, and also Wesley Hemeon, and they both  
18   taught at -- and also I took courses at -- in -- I  
19   sat in courses that were taught by Phil Drinker,  
20   among others.

21          Q.     Phil Drinker, is he recognized in any  
22   particular field as one of the leading experts?

23          A.     Yes, he was -- really started degree  
24   giving in the University of -- Harvard University  
25   in the field of industrial hygiene, and he himself

1 was a chemical engineer. He's most noted, I  
2 guess, worldwide because he developed the  
3 artificial lung for polio victims. It was his  
4 department that did it.

5 Q. Professor, after your education period,  
6 when did you begin work?

7 A. Yes, I did -- I began work for the  
8 chemical engineering department of the University  
9 of Tennessee July the 1st, 1936.

10 Q. Okay. And what was the nature of that  
11 work?

12 A. That work was associated with the toxic  
13 gases and fumes that were being produced by the  
14 Muscle Shoals operation under the Tennessee Valley  
15 Authority in their electric furnace decomposition  
16 of apatite, which is one of the forms of the  
17 phosphates that was being converted into soluble  
18 and edible materials, and they lost to the air  
19 fluorine, particularly was the hazardous  
20 materials, and I was working on a method of  
21 capturing those materials as well as protecting  
22 the employees in the plant, to remove it from the  
23 air because it was -- it was harmful to vegetation  
24 that came downwind from that plant. It would  
25 cause --

1           Q.    So your first employment commenced in  
2   1936 and to -- would you, if you could, briefly,  
3   and I know this is covered in your resume, which  
4   I'm going to ask be attached to the deposition,  
5   but would you carry us briefly through your  
6   employment after you had worked -- went to the  
7   University of Tennessee to work?

8           A.    Yes, after being there five years I  
9   accepted a commission in the United States Health  
10  Department and went to the Institute of Health at  
11  Bethesda, Maryland, and started in the Division of  
12  Industrial Hygiene there under the public health  
13  service activities and with -- associated with the  
14  people that were working industrial hygiene there,  
15  and then they shortly assigned me to the Division  
16  of Occupational Diseases in the Department of  
17  Labor for Massachusetts, where I spent 1941 and  
18  1942, and that gave me an opportunity to work  
19  for and with the teachers at Harvard, such as  
20  Dr. Elkins and Hemeon and Drinker and so forth.

21          Q.    Now, was that -- Harvard University in  
22  the early 40's, was that the seat of industrial  
23  hygiene engineering and industrial hygiene  
24  training in the United States?

25          A.    Yes, it was recognized as one of the

1 pioneers, if not the outstanding pioneering school  
2 worldwide. It was the school that all of us had  
3 ambition to attend if we wanted to make a career  
4 in this field.

5 Q. Did you -- did you further your education  
6 then under recognized experts such as Hatch and  
7 Drinker?

8 A. I did. Hatch had already left there as a  
9 professor at the time, but I had many associations  
10 and contact with him, because he moved into the  
11 army development of controlled conditions and  
12 tanks and army equipment, and that's where he  
13 spent the next four or five years during the  
14 world war, but then later on I met him up again  
15 when he began to teach at the University of  
16 Pittsburgh and worked for the -- that school and  
17 university as well as Malone School of Technology.

18 Q. Sir, how did you get into the petroleum  
19 industry?

20 A. Well, I was the associate director of  
21 industrial health in the state of Georgia in the  
22 Department of Public Health there in Atlanta, and  
23 I was called one day by a medical director of  
24 Exxon, which was then Humble Oil & Refining  
25 Company, and asked -- and that was the last of

1 March of 1947, and he asked me to come over here,  
2 Dr. Baird, and he was a member of the medical  
3 advisory committee, and I came over in the first  
4 part of April of 1947 and then accepted the  
5 position that he offered me.

6 Q. And that was at --

7 A. Humble.

8 Q. -- Humble Oil over here in Houston where  
9 you went to work as an industrial hygienist and  
10 sanitary engineer?

11 A. I did.

12 Q. I think that you have heretofore  
13 furnished everybody with your curriculum vitae or  
14 resume. And for the -- because it's customarily  
15 done and because it will complete the record, I  
16 ask that this be marked Plaintiff's Exhibit No. 2  
17 for identification and attached to the deposition.

18 Sir, in this resume is there a list of --  
19 list of all of the articles that you've written  
20 over the years?

21 A. It's a list of almost all of them, but  
22 there were some that are missing from that, and  
23 sometimes they were like the lack of publication  
24 publicly, but I had all of my publications with me  
25 at the School of Public Health at the University

1 of Texas here, and I left them there after I  
2 retired, because I had about 18 boxes of them and  
3 I didn't have time to remove them. I went back a  
4 few months later to get them and move them to my  
5 home where my office was, and somebody had found  
6 those and over the bookcase that I had them on and  
7 taken every one of the publications, so I don't  
8 have any other than the ones that are listed off.  
9 I don't even have all the copies of those maybe.

10 Q. How many -- about how many articles, just  
11 for completeness of the record, have you written  
12 over the years?

13 A. In counting them, I believe I've  
14 estimated that I've written more than -- well --

15 Q. It's over a hundred?

16 A. Well, a hundred. I would say that I have  
17 surely written more than 80 that's available, have  
18 been available, but it was more than that, but I  
19 don't remember how many more, but we'll say over  
20 80.

21 Q. Sir, you served at Humble Oil, what, in  
22 the capacity as industrial hygienist and sanitary  
23 engineer from about '47 to '57 -- or '59, rather?

24 A. Before I was promoted?

25 Q. Yes, sir.

1           A.    Yes, and I -- yes, and then I was made  
2 director of the division --

3           Q.    Now, could you just --

4           A.    -- for the last --

5           Q.    -- briefly tell us about the history  
6 of Humble and Exxon and bring us up to your  
7 retirement? What was the -- what was your job  
8 with those companies?

9           A.    I inherited these other companies that  
10 were affiliates of Standard of New Jersey when  
11 the name became -- well, Humble for a while. In  
12 1960 or '61 we became countrywide -- nationwide  
13 as Humble, and I inherited all of the staffs that  
14 were with these other companies as well as the  
15 responsibility for the health exposure or the  
16 occupational exposure problems that were  
17 associated with the manufacturers in these other  
18 refineries and --

19          Q.    At some --

20          A.    -- chemical plants.

21          Q.    At some point in time is it correct that  
22 you became the head of the industrial hygiene  
23 program and chief industrial hygienist for Exxon  
24 USA?

25          A.    Yes, in all 50 states.

1 Q. And how many facilities, roughly, were  
2 there in that -- in Exxon USA?

3 A. I'd have to estimate. One time we had  
4 well over 60,000 employees. I don't remember the  
5 number of employees. There were more than  
6 60,000. And they represented so many plants and  
7 so forth I just couldn't estimate for you the --  
8 with any accuracy the number of actual plants  
9 there were.

10 Q. All right, sir. And one of them was  
11 over in Baton Rouge, was it not, sir, that was  
12 in your --

13 A. The Baton Rouge refinery, yes. And then  
14 there were several gas plants and other plants of  
15 that nature that were out -- scattered throughout  
16 the production area in Louisiana as well as  
17 Mississippi and Alabama and Florida and Texas and  
18 Oklahoma.

19 Q. Sir, when was it that -- did you hire for  
20 that plant in Baton Rouge an industrial hygienist  
21 to go to work there?

22 A. Yes, I did, and he was a graduate of  
23 Harvard school under Phil Drinker, and his name  
24 was Fred Venable.

25 Q. And what year did you do that?

1           A.     Well, I had to wait on him until after I  
2     had located him and he was with the Texas State  
3     Department of Health, and he was obligated to work  
4     for them for so many years after he had finished  
5     his graduate work at Harvard, and so he came  
6     onboard about 1950 or '51.

7           Q.     And one of the -- one of the facilities  
8     that was under your supervision was over at the  
9     Baytown refinery in this area?

10          A.     Yes, it was.

11          Q.     Sir --

12          A.     Beginning in 1947 I had the  
13     responsibility over Baytown and all the other  
14     plants that Humble Oil & Refining Company had  
15     throughout Texas.

16          Q.     Sir, to move on, you were a member of  
17     the American Petroleum Institute, were you not?

18          A.     I was a member of the medical advisory  
19     committee and never had a membership as such  
20     individually in the API, but I began to attend  
21     the medical advisory committee as advisor and  
22     consultant to my member, which was Dr. Baird in  
23     1947.

24          Q.     All right, sir. Now, I'll show you a  
25     document that I've marked 2-A for identification

1 and ask you if that reflects your American  
2 Petroleum Institute assignments, this first one  
3 from 1947 to 1965, and then the second page covers  
4 it from 1965 to '67? Does that reflect your  
5 memberships in the American Petroleum Institute?  
6 I ask that that be attached to the deposition as  
7 2-A for identification.

8 A. I recognize all of these.

9 Q. As positions that you held?

10 A. Operations that I participated in, yes.

11 Q. Sir, tell me this, Professor, and just  
12 briefly what are some of the professional  
13 associations that you belong to?

14 A. I belong to the Texas Public Health  
15 Association here in Texas, and we joined it in  
16 1947. I belong to the National Public Health  
17 Association from earlier than that. I had joined  
18 that in 1942. And I had membership, of course, in  
19 the American Industrial Hygiene Association from  
20 beginning in 1942 -- 3, I'm not clear right now  
21 which of those years, but anyway, from that time  
22 on. Then, of course, I was medical advisory  
23 committee of the API group and -- as you see,  
24 and then I was also representative on the  
25 Chemical Manufacturing Association for

1     precautionary labeling, and I represented the  
2     company beginning -- and attended those meetings  
3     as early as 1950 to '55, and beginning in 19 --  
4     associated with the representative from the Esso  
5     group. I was -- also became the company  
6     representative on the Manufacturing Chemical  
7     Association for writing a manual on precautionary  
8     labels in 1958 and remained in that capacity for  
9     the rest of my career.

10        Q.     Professor, your resume that's attached to  
11     the deposition marked Plaintiff's Exhibit No. 2  
12     for identification, sets forth, does it not, the  
13     professional associations that you belong to?

14        A.     It does.

15        Q.     Does it also set forth the awards and  
16     honors that you received in your professional  
17     work?

18        A.     It does.

19        Q.     Just briefly, the Henry Case award, what  
20     is that, sir?

21        A.     Henry K. Smith award, well, that -- he  
22     was an outstanding authority in the field of  
23     industrial hygiene from the University of  
24     Pennsylvania back in the early 1920's, nine,  
25     twenty -- I'm not sure which year he began, but

1 in that range of the late 1920's. And he actually  
2 did a survey of the Baton Rouge refinery. I've  
3 seen copies of his survey made in 1928 or '29 for  
4 the Baytown -- for the Baton Rouge refinery. So  
5 he would then join the University of Pittsburgh  
6 school and taught industrial hygiene there and was  
7 a -- also a consultant to the Malone School of  
8 Technology in this field.

9 Q. Sir, is there any -- the Henry F. Smith --

10 A. And then -- yes, and that was the  
11 association of -- American Industrial Hygiene  
12 Association recognized him as one of the  
13 pioneering authorities, so they established an  
14 award for him, and I was fortunate enough to be  
15 selected to receive that award, the second one  
16 given in the nation, and that year was in  
17 eighty --

18 Q. Your -- your resume says '82.

19 A. In '82.

20 Q. Was that --

21 A. That's the second one.

22 Q. In your opinion is that the greatest  
23 honor that you can receive as an industrial  
24 hygienist in America?

25 A. It is, in my profession.

1           Q.    Now, after your teaching career here at  
2   the University of Texas School of Public Health,  
3   did you -- did they establish a James W. Hammond  
4   award to the outstanding graduate of Texas A&M or  
5   the University of Texas public school in your  
6   honor?

7           A.    They did, and it's continued on, even  
8   this year. That award is presented every year by  
9   the Gulf Coast section of the American Industrial  
10  Hygiene Association.

11          Q.    The reference has been made to the  
12  American Petroleum Institute during this earlier  
13  testimony. Could you tell the Court or jury what  
14  is the American Petroleum Institute?

15          A.    Well, that is a member of all of the  
16  companies that are concerned with the commercial  
17  production of gas and oil, and many of the other  
18  companies that have joined or are eligible are the  
19  people who manufacture equipment or methods that  
20  are used by that industry.

21          Q.    Is that recognized as a trade association  
22  for the petroleum industry?

23          A.    It is, and the affiliate companies would  
24  be concerned with making -- supplying either  
25  materials or mechanical equipment or chemicals to

1 the production and operation of the petroleum  
2 industry.

3 Q. Sir, have you participated extensively  
4 throughout your professional career in educational  
5 seminars, lectures in an effort to spread the word  
6 about industrial hygiene?

7 A. Yes, beginning in 1947 I was invited to  
8 be on an advisory board to the Houston Chamber of  
9 Commerce Industrial Committee, and the interest  
10 was in both the air and water pollution as well as  
11 in industrial health and safety, and so I was  
12 elected to be the chairman of a committee that put  
13 on a program beginning 1948 at the Rice Hotel and  
14 invited all of the people that are concerned with  
15 the industry throughout this area that ran a --  
16 the publicity went out all the way from we'll say  
17 New Orleans and as far north as Chicago and as  
18 far west as old Mexico. And we had 11 of those  
19 conferences annually along about this time of year  
20 or a little later, in October, that met first at  
21 the Rice and then later at the Shamrock that ran  
22 for 11 years, and we'd have an average attendance  
23 of 300 people. Most of these persons were  
24 concerned with either occupational health and  
25 medicine and hygiene, and they were also concerned

1 with public health. They were concerned primarily  
2 as safety, industrial safety, and they were  
3 members of the -- of the -- and they were all  
4 invited, and they usually came. And in addition  
5 there was an organization of personnel managers  
6 and nurses as well as doctors. They were all  
7 invited, and that made up about an average of  
8 the 11 years for three -- attendance, 300. It  
9 ran generally from Thursday, Friday and Saturday,  
10 three days a week, and we invited the best  
11 authorities nationwide and even we had them to  
12 come from the Department of Labor and from England  
13 and visited our -- visited our conference more  
14 than once. It would be what would be the  
15 equivalent of our Secretary of Labor.

16 MR. BAGGETT: Gentlemen, I tender  
17 Professor Hammond as an expert in the field of  
18 industrial hygiene with extensive experience in  
19 the petroleum industry.

20 MR. SPEARS: Well, this is Ken Spears. I  
21 deposed Mr. Hammond, and we've been involved with  
22 him on several cases, and I accept his  
23 qualifications. I think he's very well respected  
24 as a former industrial hygienist in the petroleum  
25 industry.

1 MR. BAGGETT: Thank you, sir.

2 Anybody else have any questions?

3 MR. FREEMAN: It's my understanding we're  
4 reserving all objections except as to form and  
5 responsiveness, so I'll abide by that agreement.  
6  
7  
8

9 VOIR DIRE EXAMINATION BY MR. MYERS  
10

11 Q. I'll just have a couple of questions.  
12 Professor Hammond, did you ever receive your  
13 Ph.D.?

14 A. No, I never did. I had the three degrees  
15 I had, and I had a certificate from MIT, and I had  
16 a certificate from Rice University, but never  
17 actually concentrated on getting a Ph.D.

18 Q. Have you been out of the field of  
19 industrial hygiene since your retirement?

20 A. No, since my retirement I taught for nine  
21 years industrial hygiene, I taught about a hundred  
22 graduate students. There were 130, I believe,  
23 attended my course and classes. And then I -- as  
24 I am involved today, I kept up with the  
25 developments of the field.

1 Q. You have testified as an expert  
2 previously in this particular field?

3 A. Several times, yes, sir.

4 Q. When was the last time you testified in  
5 court?

6 A. I've given depositions recently, but I  
7 think most of the cases I've been involved in have  
8 not reached court stage. Most of them have been  
9 settled outside of court, I believe.

10 Q. Have you ever been denied qualification  
11 in a field of expertise for which you have been  
12 tendered? And I realize you said you've been  
13 qualified as an expert in industrial hygiene, but  
14 have you ever been tendered as an expert in  
15 chemistry or any other field?

16 A. I have never been accepted as an expert  
17 in that field, no.

18 Q. All right. I take it that you've been  
19 tendered as an expert in and you hold yourself out  
20 as an expert in industrial hygiene?

21 A. I do. I remember a court -- a case that  
22 John O'Quinn brought against Monsanto in 1987 or 6  
23 or somewhere like that, and I did testify in that  
24 particular case, I recall.

25 MR. MYERS: Okay. That's all I have.

1 Thank you.

2

3

4 CONTINUED EXAMINATION BY MR. BAGGETT

5

6 Q. Professor Hammond, in the conduct of the  
7 industrial hygiene program that you participated  
8 in with your first employer starting in the 40's,  
9 did you have a goal to develop a program designed  
10 to eliminate any benzene exposure?

11 MR. FREEMAN: Objection as leading.

12 MR. BAGGETT: That objection is --

13 MR. SPEARS: I object to the form of the  
14 question.

15 MR. MYERS: Join in.

16 MR. BAGGETT: Fine.

17 Q. You can go ahead, Professor, and tell us  
18 when you first started to work, what did you do,  
19 if anything, about the industrial hygiene program  
20 as relates to bone -- to benzene exposure.

21 MR. SPEARS: Again, I object to the form  
22 of the question. You're talking about where,  
23 Bill?

24 MR. BAGGETT: I'm talking about when he  
25 said he started to work in 1947 and in his

1 capacity as an industrial hygienist. So I wanted  
2 to know what he did, if anything, with reference  
3 to benzene -- the benzene program, exposure  
4 program.

5 MR. SPEARS: At Exxon or Humble we're  
6 talking about?

7 MR. BAGGETT: Yeah, at Humble.

8 A. In 1947 I was clearly sat upon a program  
9 to eliminate any exposures at all to our employees  
10 in the Humble Oil & Refining Company and  
11 substitute other materials where possible or those  
12 that did have necessary exposure to control them  
13 carefully to come up with the zero level of  
14 occupational exposure.

15 MR. BAGGETT:

16 Q. Professor, how did you -- how did you  
17 accomplish -- accomplish a -- accomplish a program  
18 that was designed to eliminate exposures to  
19 benzene to zero?

20 A. First and foremost, there were many  
21 operations that were commonly used in both the  
22 laboratory and also associated with purification  
23 of petroleum products in which we could substitute  
24 other materials, nonasbestos -- nonbenzene and get  
25 rid of the potential exposures completely as we

1 did in many places. And then next was that we  
2 enclosed all operations that they have to use it,  
3 for example, as a chemical process in the  
4 laboratory by enclosing and putting it under the  
5 hood that was well-exhausted with adequate air  
6 flow-through to protect the employees. And when  
7 we couldn't do that, the short-term exposure  
8 outside we used an approved type of respiratory  
9 protection such as respirators and gas masks or  
10 air supplies to supply them.

11 Q. All right, sir. Sir, you have prepared  
12 a report for me, have you not, or at my request  
13 that's been furnished to opposing counsel that's  
14 dated back in January 16th, 1991, entitled, "The  
15 history of recognition, evaluation, control,  
16 chemistry of industrial toxicology of hazards of  
17 benzene (benzol) vapors and liquids in the  
18 petroleum, petrochemical and related industrial  
19 activities," have you not, sir?

20 A. I have.

21 Q. And, Professor, in connection with that  
22 report, did you review some of the safety, labor  
23 and industrial hygiene literature that was used  
24 early on in your professional career?

25 A. Yes, in a way, but I didn't find it

1 necessary to review any extensive literature,  
2 because this was my program, and I had had a  
3 part in developing the program with the various  
4 agencies I had been associated with beginning  
5 1941 with the Division of Occupational Diseases  
6 with the Department of Labor up in Boston, and  
7 I was familiar with all of the knowledge and  
8 foundation that had been prepared at that time.  
9 And so I wrote this more or less from my own  
10 knowledge as I have of the field.

11 Q. Sir, could you tell us whether or not  
12 by 1947 when you went to work with Humble there  
13 was extensive literature available in medical,  
14 safety, industrial hygiene, labor, governmental  
15 and occupational medicine fields that concerned  
16 the relationship between benzene exposure and  
17 disease?

18 MR. SPEARS: I'd object to the form of  
19 the question as being -- not only is it vague,  
20 it's compound. I'm not sure what he's going to  
21 answer to.

22 MR. BAGGETT:

23 Q. Well, I'll repeat it, Doctor --  
24 Professor, subject to that objection, so that  
25 there's no misunderstanding. By 1948 was there

1 extensive literature available in medical, safety,  
2 industrial hygiene, labor, governmental and  
3 occupational medicine that concerned the  
4 relationship between benzene exposure and disease?

5 A. There was.

6 Q. And did that -- did that literature  
7 address such things as the toxicity and the  
8 precautions that should be taken to protect  
9 one from -- who had potential exposure to  
10 benzene vapors?

11 A. It did.

12 Q. And in your report, which I will mark  
13 as P-3 for identification and ask that it be  
14 attached to the deposition, this is the report  
15 dated January 16th of 1991 --

16 MR. MYERS: I'm going to make an  
17 objection to the attachment of the report to the  
18 deposition in that I believe he's going to testify  
19 on it, and his testimony will be the best evidence  
20 of his opinions.

21 MR. SPEARS: I'd join in that objection,  
22 Bill. I'd like to ask the professor a question  
23 about this report before you introduce it.

24 MR. BAGGETT: Well, you'll have an  
25 opportunity on cross-examination. I just ask that

1 it be attached in case somebody -- as part of the  
2 record. And if you want to ask him questions  
3 about it, whether or not it goes into evidence,  
4 that objection has been preserved by Mr. Myers.

5 MR. SPEARS: Right. I preserve my  
6 objections, and I do object to it being attached  
7 to the deposition.

8 MR. BAGGETT: Fine.

9 Q. Professor, to substantiate your statement  
10 about 1948, that there was literature available  
11 that concerned the relationship between benzene  
12 exposure and disease, have you not furnished us  
13 with a report from the Division of Labor  
14 Standards, Department of Labor, dated 1935?

15 A. I have.

16 Q. I ask that this -- is this a copy of the  
17 report that I will mark as P-4 for identification?  
18 Is that a copy of the report that you have  
19 furnished to us?

20 A. It is.

21 Q. Also, to illustrate the availability of  
22 literature, did you furnish us with a report dated  
23 1938 from the Industrial -- from the Division of  
24 Labor Standards, U. S. Department of Labor, which  
25 I will mark as P-5 for identification and ask you

1 if that is the document that you supplied us?

2 A. Yes, this is the document, and I think  
3 the date may be 1939.

4 Q. All right, sir. Fine. Sir, also did  
5 you furnish us with the National Safety Counsel  
6 pamphlet No. 14 that I will mark as P-6 for  
7 identification, and this is dated in 1931 that  
8 concerns benzol, and ask you if that's a copy of  
9 the document that you furnished us to illustrate  
10 the type of literature that was available at that  
11 time set?

12 A. Yes, and this seemed to be a very  
13 comprehensive discussion of the problems  
14 associated with handling benzene and the medical  
15 surveillance and the other matters that were  
16 associated with it.

17 Q. All right, sir. P-7 for identification  
18 can best be described as a Chemical Safety Data  
19 Sheet SD No. 2 dated -- well, adopted '46, revised  
20 '48, second edition revised 1956, entitled  
21 properties and essential information for safe  
22 handling and use of benzene published by the  
23 Manufacturers Chemical Association, Inc. I've  
24 marked that P-7 and ask you if that is one of  
25 the types of literature that was available that

1 concerned the relationship between benzene  
2 exposure and disease?

3 A. It is.

4 Q. Sir, these -- these documents that have  
5 just been described and are marked P-4, 5, 6 and  
6 7, did they have a common thread running through  
7 each of them, and that is that they address the  
8 toxicity of benzene, the nature of the disease and  
9 precautions to be taken to limit exposure?

10 MR. SPEARS: Object to the form of the  
11 question. The documents are going to speak for  
12 themselves, and it's a compound question again,  
13 Bill.

14 MR. FREEMAN: Same objection.

15 MR. MYERS: Join in.

16 MR. BAGGETT: Fine. Gentlemen, I'll  
17 agree with y'all that objection by one is  
18 considered to be objection for all, and we can  
19 then avoid that.

20 A. Yes, it did, and they usually all  
21 stressed the importance of recognizing exposures  
22 and responses by certain individuals was based  
23 upon susceptibility to this material, and that was  
24 one of the bases that I decided that in early  
25 times, 1940's, it was necessary to have zero

1 concentration for everybody, because of its  
2 susceptibility --

3 MR. SPEARS: I object to the answer now  
4 as being nonresponsive to the question.

5 MR. BAGGETT:

6 Q. Sir, was there literature such as this  
7 widely known and commented upon in the petroleum  
8 industry when you went to work with the company?

9 A. It was.

10 Q. Was this literature by the Chemical  
11 Manufacturing Association, the National Safety  
12 Counsel and the Department of Labor, were those  
13 easily acceptable and available to anyone desiring  
14 to obtain that information -- type of information?

15 A. They were readily available.

16 Q. Sir, these documents that have -- these  
17 are copies of them that have been attached to the  
18 deposition. When you rendered your report and  
19 when you testified in the Ellis case, these same  
20 documents were identified, were they not, sir?

21 A. They were.

22 Q. And at that time you had the originals of  
23 those documents that had been maintained in your  
24 files, did you not, sir?

25 A. I did.

1 Q. And these are copies of them?

2 A. They are.

3 MR. MYERS: I will make a general  
4 objection to the attachment of those documents.  
5 Granted I'll probably be able to see some other  
6 documents that will change my position, but at  
7 this point, since I haven't seen them before.

8 MR. BAGGETT: Gentlemen, I'll assure  
9 you that any document that's produced will either  
10 be authenticated in this production or will be  
11 authenticated before trial.

12 Q. Professor, is there any -- to your  
13 knowledge is there any publication that is more  
14 circulated or certainly -- let's put it this way,  
15 is not the Journal of the American Medical  
16 Association one of the most widely circulated  
17 medical journals or journals in the world?

18 A. It is.

19 Q. I want to show you a document that I will  
20 mark as P-8 for identification, which purports to  
21 be an editorial from the Journal of the American  
22 Medical Association dated November 1944, and ask  
23 you if you would -- dealing with environmental  
24 cancer, and ask you if the statement that is  
25 contained here that the agents known or suspected

1 to cause occupational cancer are arsenic,  
2 chromates, nickel, carbon, radium, mesothorium,  
3 asbestos, crude and possessed mineral oils and,  
4 on over up at the top here, benzene?

5 A. Yeah.

6 Q. Substances -- this was an early  
7 recognition by the AMA in 1944 that benzene could  
8 cause occupational cancer --

9 MR. SPEARS: I object to the form of the  
10 question.

11 MR. BAGGETT:

12 Q. -- is it not, sir?

13 A. It is true.

14 MR. BAGGETT: I ask that that be attached  
15 to the deposition as P-8.

16 MR. MYERS: Same objection as previous.

17 MR. BAGGETT:

18 Q. Sir, moving on, P-9 for identification  
19 can best be described as the API toxicological  
20 review on benzene dated September of 1948. Have  
21 you seen and studied that document before, sir?

22 A. I have.

23 Q. Actually in -- after your employment  
24 could you tell us whether or not that -- that  
25 publication was widely circulated within the

1 petroleum, safety and health community?

2 A. It was available and publicity was given  
3 to its availability, because the API medical  
4 advisory committee was commissioned at Harvard  
5 under Dr. Drinker's supervision to prepare these  
6 reports. And benzene was just one of many  
7 different substances that were --

8 Q. Professor, I -- at the time that this  
9 is displayed to the Court or the jury, I'm going  
10 to either have a blowup or have it on video, the  
11 forward here, and I'd like for you to read that  
12 into the record here, the forward on P-9.

13 A. All right. "This review summarizes the  
14 best available information on the properties,  
15 characteristics and the toxicology of benzene.  
16 It offers suggestions intended to recommendation  
17 pertaining to medical treatment, medical  
18 examination and precautionary measures for workers  
19 who are exposed to benzene. It was prepared at  
20 the Harvard School of Public Health, Boston  
21 Massachusetts, under the direction of Professor  
22 Phil Drinker. The review has been accepted for  
23 publication by the medical advisory committee of  
24 the American Petroleum Institute. Anyone desiring  
25 to submit additional information or proposed

1 changes for consideration prior to reissuance of  
2 this review is requested to send them to the  
3 American Petroleum Institute. This review was  
4 prepared by Marshall Clinton, M.D."

5 Q. Did you know this is the Phil Drinker  
6 that you studied under and worked with at Harvard?

7 A. Yes, and also happened to know Marshall  
8 Clinton as a friend, associate, peer.

9 Q. Sir, in this document that we've just  
10 referred to, would you please tell me, sir, if  
11 at the time that this was published was it known  
12 within the safety and health community of the  
13 industry that you were involved in that chronic  
14 benzene poisoning resulted from repeated or  
15 continuous exposure to relatively low  
16 concentrations of benzene vapors?

17 MR. SPEARS: Object to the form of the  
18 question if you're asking this man to testify  
19 about what somebody else knew other than himself.

20 MR. BAGGETT: Well, fine. Your objection  
21 is noted, sir.

22 A. It was well accepted by me as well as  
23 others in the field as being a very hazardous  
24 material.

25 MR. BAGGETT: Professor, what, if

1 anything, did this document or did the -- strike  
2 that. Let's go off the record just a minute.

3 VIDEOGRAPHER: Off the record, 20 minutes  
4 before 11 o'clock.

5 [Discussion off the record]

6 VIDEOGRAPHER: On the record, 15 minutes  
7 before 11 o'clock.

8 MR. BAGGETT:

9 Q. Professor Hammond, the American Petroleum  
10 Institute toxicological review on benzene that was  
11 published in September of '48, while the document  
12 will speak for itself, for the record would you  
13 tell us whether or not that document addressed the  
14 properties and characteristics of benzene?

15 A. It did.

16 Q. Was one of those characteristics that it  
17 had a pleasant odor?

18 A. It did.

19 Q. Sir, the toxicology of it, the acute  
20 effects and the chronic effects, was that also a  
21 matter of information that was passed along by  
22 this review?

23 A. They were.

24 MR. SPEARS: Object to the form of the  
25 question.

1 MR. BAGGETT: Y'all keep objecting to the  
2 form of the question. If you would, would you  
3 please articulate what's wrong with the form of  
4 my question so I can try to correct it?

5 MR. SPEARS: The question was vague. I  
6 didn't understand it.

7 MR. BAGGETT:

8 Q. Okay. Sir, when your dealing with  
9 chronic affects of an exposure to benzene, what  
10 influence of the -- what part of the organs of  
11 the body did the benzene have effect upon, if any?

12 A. The chronic effects were generally  
13 associated primarily with the bone marrow.

14 Q. And in that would be a part of the  
15 blood-forming organs of the body?

16 A. Yes, that is the organ that forms the  
17 blood.

18 Q. Okay. Sir, did -- is there any  
19 characteristic of benzene and its health effects  
20 that relates to individual susceptibility?

21 A. It is related to susceptibility on the  
22 part of the employees or the persons exposed to  
23 it, yes.

24 Q. And was that any factor that you  
25 considered in adopting an industrial hygiene

1 program or enforcing one with your employer  
2 starting in '47?

3 A. It certainly was.

4 Q. Did you recognize in your practice the  
5 statement that is obtained -- that is contained  
6 on page 4 of P-8 at the bottom, left-hand side,  
7 "Inasmuch as the body develops no tolerance to  
8 benzene and there is a wide variety in individual  
9 susceptibility, it is generally considered that  
10 the only absolutely safe concentration for benzene  
11 is zero"?

12 MR. SPEARS: I object to that question,  
13 Bill, as being vague, and also the document speaks  
14 for itself. Now you're asking him to read --  
15 repeat into the record what's already printed in  
16 those documents.

17 MR. BAGGETT: I think the objection is  
18 wrong, because what I asked him is if in his  
19 practice and in the program at your company or  
20 with your employer did you recognize this in  
21 trying to put in a program?

22 A. I did.

23 MR. BAGGETT:

24 Q. Sir, even at that time, what if  
25 anything -- and, here again, the document does

1 speak for itself, but I want you to state for the  
2 record, because I will have this section No. 3  
3 dealing with safe limits shown to the Court, if  
4 you will, please read what it says here in  
5 paragraph 3 under safe limits.

6 MR. FREEMAN: What exhibit is that,  
7 please?

8 MR. BAGGETT: This is P --

9 THE WITNESS: 9.

10 MR. BAGGETT: P-9, yeah.

11 MR. SPEARS: That's the API tox review?

12 MR. BAGGETT: Yeah, uh-huh.

13 MR. MYERS: Let me make a general  
14 objection to him repeating whatever the exhibit  
15 is itself as not being a form of basis of his  
16 opinion, but yet an opinion of someone else.

17 MR. BAGGETT:

18 Q. Would you go ahead and read for the  
19 record paragraph 3 entitled "Safe limits"?

20 A. "The American Standards Association and  
21 most of the states has set an arbitrary limit of  
22 100 parts per million as a maximum permissible  
23 benzene concentration to workers exposed to this  
24 substance during an eight-hour period.  
25 Massachusetts and Oregon has set limits of" --

1 it's a blank here -- "parts per million, whereas  
2 New York considers 50 parts per million as the  
3 highest permissible level. Inasmuch as the body  
4 develops no tolerance to benzene and as there is a  
5 wide variation in individual susceptibility, it is  
6 generally considered that the only absolutely safe  
7 concentration for benzene is zero. The inadequacy  
8 of a limit of a hundred parts per million are  
9 indicated by well authenticated reports of at  
10 least two cases of benzene poisoning following  
11 exposure to only 75 parts per million. A limit  
12 of 50 parts per million or less is strongly  
13 recommended, particularly where exposures are  
14 recurrent. Skin contact should be avoided."

15 Q. All right, sir. Professor, tell me  
16 what -- at this time what did you consider that  
17 the API Toxicological Review was recommending so  
18 far as medical examinations?

19 A. It seemed to be fairly adequate and would  
20 be what I would recommend primarily even today.

21 Q. And that was preemployment physicals and  
22 also regular examinations of those people with  
23 potential exposure to benzene?

24 A. A regular basis or periodic reexamination  
25 of the people.

1           Q.     What precautionary measures were  
2     recognized in your profession by people in  
3     petroleum industry, precautionary measures  
4     were recognized to assist in limiting benzene  
5     exposure?

6           MR. FREEMAN:   I'm going to object to  
7     the form of the question as the term petroleum  
8     industry -- do you, by that term, refer to marine  
9     transportation industry as well?

10          MR. SPEARS:   I join in that objection and  
11     add to that another objection is I'm not sure if  
12     you then indicated what time frame he's talking  
13     about.

14          MR. BAGGETT:

15          Q.     I'm talking about in 1948 when this  
16     bulletin came out, sir, what were the  
17     precautionary measures that were recommended be  
18     taken to limit or prevent the exposure to benzene  
19     poisoning that -- that were utilized in your  
20     profession as an industrial hygienist?

21          A.     I would start out by listing first  
22     education of the workers as to the hazards  
23     associated with benzene.

24          Q.     Would the -- would the fact that there is  
25     a latency period involved in the development of

1 disease following long exposure to low dosages be  
2 one of the facts that you think would need to  
3 be -- the employee would need to know about?

4 A. That should be emphasized, yeah.

5 Q. Would one of the safety measures that --  
6 that was recognized in 1948 be that for the  
7 prevention of benzene poisoning that the -- all of  
8 the measures should be designed to prevent the  
9 inhalation of benzene vapors?

10 A. That would be the only method that could  
11 be used to protect the employees, yes.

12 Q. And how would you do that? Would that  
13 involve engineering, sir?

14 A. That would involve the enclosure and  
15 preventing of escaping of any gas into the  
16 breathing zone of the employee.

17 Q. If excessive concentrations were  
18 unavoidably encountered in any operation, what  
19 was done by -- recommended by your company that  
20 you worked for in the period 1948?

21 A. By both preemployment examination of each  
22 employee that was going to be potentially exposed  
23 and then reexamination whenever they had a  
24 suspicious, supposedly exposure that came to the  
25 employee.

1 Q. All right, sir. Was there a respiratory  
2 protection program in place or recognized in the  
3 40's where you might have an excessive exposure?

4 A. To prevent any exposure to the employee,  
5 then respiratory protection of approved  
6 respirators and approved masks would be used  
7 thoroughly and enforced.

8 Q. Sir, in the -- in the 30's and the  
9 40's would you tell us whether or not there  
10 was equipment available that could measure the  
11 concentrations of benzene vapors in the air?

12 A. There were analytical procedures that  
13 could be used and were being used by evaluation  
14 of these concentrations in the air.

15 Q. When you went to work in 1947, was that  
16 equipment available to measure the concentrations  
17 of benzene vapors in the air?

18 A. It was.

19 Q. Was it used at your facility where you  
20 worked?

21 A. We did.

22 Q. And that way were you able to keep up  
23 with the -- well, is there any way that you can --  
24 strike that.

25 Was there any way, without measuring the

1 concentrations of benzene vapor in the air, that  
2 you could determine the level of exposures?

3 A. Yes, we used that biological testing of  
4 the urine by determining the urinary sulfate ratio  
5 in the urine, and that was directly related to the  
6 concentration of benzene in the air that he had  
7 been exposed to, whether he knew he was being  
8 exposed or not. But we could detect that, and  
9 we used that until 1960's, and then it became a  
10 more -- an easier and more accurate procedure to  
11 use the phenolic concentration in the urine for  
12 that evaluation.

13 Q. Was that medical examination in addition  
14 to the measuring of benzene vapors in the air?

15 A. It was.

16 Q. Sir, attached to this report from the  
17 American Petroleum Institute is a bibliography of  
18 some 25 articles. I assume that that summarizes  
19 the best -- that is the best available information  
20 on the properties, characteristics and toxicology  
21 of benzene as referred to in the forward of this  
22 document. Do you recognize any of the authorities  
23 that are cited in this bibliography?

24 A. Of the Americans, I recognize  
25 approximately 50 percent of these people that I

1 knew personally.

2 Q. E. T. Hunter, Chronic Exposure, 1939 in  
3 the Journal of Industrial Hygiene, which is item  
4 No. 11 on this bibliography, were you familiar  
5 with that? Did you become familiar with that in  
6 your professional work in the 40's?

7 A. I knew Dr. Hunter. He was an internist  
8 that worked in the Massachusetts General Hospital  
9 in 1941 and 2 when I was there, and I got to know  
10 him personally and knew about this article as  
11 well.

12 Q. Okay. In the bibliography, article No. 1  
13 by E. Browning, "Toxicity of industrial organic  
14 solvents," published in the Industrial Health  
15 Research Board report No. 80 in London in 1937,  
16 was that a document or the type of document that  
17 you would have reference -- have reference to in  
18 the performance of your work?

19 A. Yes, and Ethyl Browning was an English  
20 physician, and she published a book which  
21 contained this information about benzene, and  
22 it was available to me back in 1941, too.

23 Q. Sir, as a result of this report published  
24 by the API, did you consider that it was essential  
25 in -- strike that. Not as a result of this

1 report, but even by the time this report came out  
2 in 1948, did you consider that it was essential  
3 that you try to maintain absolutely safe  
4 concentration of benzene at a zero level?

5 A. That was my goal throughout my career,  
6 beginning in 1941.

7 MR. BAGGETT: Sir, do you, in connection  
8 with -- I ask that P-9 be attached to the  
9 deposition.

10 MR. MYERS: Same objection as previously  
11 noted.

12 MR. BAGGETT:

13 Q. Sir, P-10 for identification can best  
14 be described as the article referred to in the  
15 bibliography by Francis T. Hunter entitled  
16 "Chronic exposure to benzene, benzol," No. 2,  
17 "The clinical affects," published in the Journal  
18 of Industrial Hygiene and Toxicology in 1939.  
19 Were you familiar with this work that I'll show  
20 you that's marked P-9 for identification, sir?

21 MR. FREEMAN: P-10?

22 MR. BAGGETT:

23 Q. P-10, I'm sorry. Were you familiar with  
24 that when you started your practice in '47 at  
25 Humble?

1           A.    Oh, yes, I was familiar with it after  
2 I met him and was associated with some of his  
3 coworkers, daily almost, in 1941.

4           Q.    Well, this was published, it shows here,  
5 in July of 1939. Do you know whether or not  
6 Dr. Hunter was of the opinion that the only safe  
7 exposure -- safe concentration to benzene was  
8 zero?

9           MR. MYERS: Object to the form of the  
10 question. Asking for an opinion of someone else.

11           MR. BAGGETT:

12           Q.    Well, I ask you then to look at page  
13 344.

14           A.    He gave that in his papers.

15           Q.    On page 344 of this report, "Since the  
16 respired benzene is carried by the bloodstream and  
17 reaches the marrow before going to the liver, it  
18 would seem that the only really safe concentration  
19 is zero." That was an opinion that you shared,  
20 was it not?

21           A.    Yes, it was. He was one of my teachers.

22           Q.    That's P-10 for identification. P-12  
23 for identification -- I'm sorry, P-11 for  
24 identification, I want to show you is entitled  
25 "Occupational Tumors and Allied Diseases," by

1 W. C. Hueper, M.D., dated 1942. Are you familiar  
2 with that piece of literature, sir?

3 A. I am.

4 Q. Is it not correct that -- that this is  
5 the same Dr. Hueper who was a member -- worked  
6 with the American Petroleum Institute?

7 A. He did. He also was with the United  
8 States Public Health Service, of which I was  
9 associated.

10 Q. Sir, I'd like for you to look at page  
11 598. This was the type of literature, and this  
12 shows on the front of it that it came from the  
13 library of the American Petroleum Institute, a  
14 document dated in 1942, and I will want this to  
15 be shown to the Court or jury by a blowup;  
16 therefore, I ask that you read, if you will, for  
17 their benefit, from page 598, this paragraph that  
18 I will point to here, sir, on --

19 A. The second paragraph on this page says,  
20 "The combined clinical and experimental evidence  
21 presented concerning the causative  
22 interrelationship between occupational exposure  
23 of benzol and the development of leukemia seem to  
24 indicate that such a connection is merely" --

25 Q. Is not.

1           A. "Is not merely possible, but a great  
2 probability and even an actuality. There occurs  
3 evidently a marked variation in the individual  
4 susceptibility and reactivity to benzol. This  
5 fact may account in part for the different types  
6 of hemopoietic tissue response to this substance.  
7 The dose, the duration of exposure and interval  
8 between the individual exposure are obviously of  
9 great significance."

10           Q. For the benefit of the court, would you  
11 go ahead and read the next paragraph dealing with  
12 preventive, precautionary, technical and sanitary  
13 effects, the first sentence or two?

14           MR. MYERS: Let me make a general  
15 objection as to him reading from another report if  
16 he has not adopted it and to the authenticity of  
17 the report. Go ahead, subject to the objection.

18           A. "From the evidence presented and the  
19 conclusion drawn, the indication for strict  
20 medical supervision of a large group of workers'  
21 occupational exposure to benzol is inescapable.  
22 This surveillance should be constant and  
23 unremitting and should include periodic blood  
24 examination for the presence of quantitative  
25 and qualitative changes of the various blood

1 consistencies. It may be advisable to examine  
2 the urine for the presence of ethersulfates  
3 or benzol utilizing the Obermayer method for  
4 indication and determining the inorganic sulfate  
5 portion according to the procedure Schrenk, Yant  
6 and Sales."

7 MR. BAGGETT:

8 Q. Thank you, sir. Sir, what I want to ask  
9 you is was the recommendations that are contained  
10 in the American Petroleum Institute 1948  
11 Toxicological Review on benzene consistent with  
12 what Dr. Hueper was recommending in this paper or  
13 periodical back in 1942?

14 A. They were comparable.

15 Q. And did you recognize and carry out these  
16 preventive, precautionary, technical aspects  
17 that -- of surveillance, medical surveillance on  
18 the workers at your refinery that had potential  
19 benzene exposure?

20 A. With the cooperation of my medical staff  
21 we were able to accomplish all of this as a team.

22 Q. Fine.

23 MR. FREEMAN: Could I see that last  
24 exhibit, please?

25 MR. BAGGETT: Yeah.

1           Q.    Sir, P-12 for identification can best be  
2 described as portions of a book from Principals of  
3 Internal Medicine in which T. R. Harrison was the  
4 editor in chief published in 1950 and will be  
5 authenticated as coming from the University of  
6 Buffalo library. I'll show you this. Have you  
7 seen this before, sir?

8           A.    I have.

9           Q.    P-12? If you will, Professor, would you  
10 turn to page -- the section dealing with page 731  
11 of that book, chemical agents, page 92 -- chapter  
12 92 by Marshall Clinton?

13          A.    Yes.

14          Q.    Who was Marshall Clinton?

15          A.    Well, he was a student at Harvard when  
16 I was there, and he was the one that prepared the  
17 review for the API on toxic -- toxicity of benzene  
18 and that we have now in the exhibits.

19          Q.    Sir, on page 738 under the subject  
20 benzene poisoning, if you would, look at that  
21 section and tell me if you accepted this principal  
22 in the performance of your duties, and that was  
23 that benzene is cheap and is an excellent solvent,  
24 it has been used extensively in the rubber, paint  
25 and printing industry and may be present in motor

1 fuels. Did you understand that?

2 A. I do.

3 Q. And did you also understand that and  
4 accept that the hazards that benzene presents  
5 were now well-known and its use curtailed or  
6 controlled by statute; unfortunately, however,  
7 occasional cases of benzene poisoning continue to  
8 occur? You recognized that, did you not, sir?

9 A. I practice that in my own program, to  
10 prevent that type of exposure.

11 Q. On down on page 738, he comments on  
12 chronic benzene poisoning. Is it not correct  
13 that this is another authority that at that time,  
14 in 1950, stated, "Inasmuch as the body develops no  
15 tolerance to benzene, it is generally considered  
16 that the only absolutely safe concentration for  
17 benzene is zero"?

18 A. Yes, and that's in agreement with his  
19 earlier publication with the API.

20 Q. And that's in agreement with your  
21 practice as an industrial hygienist at -- at  
22 Humble and at Exxon, is it not, sir?

23 A. It is.

24 Q. Sir, in that -- in that connection, is it  
25 correct that in 1958 that Exxon issued a -- or

1 Esso issued a Toxigram on benzene, which has been  
2 heretofore identified by you? And I'll mark this  
3 as P-13 and ask you if you recognize that exhibit,  
4 sir?

5 A. I do.

6 Q. Professor, does -- is this -- were you  
7 involved in any way in the approval or -- of this  
8 Toxigram?

9 A. I was given the opportunity to review it  
10 and make comments before it was published, yes.

11 Q. Among other things, you were -- you were  
12 aware when this was published in 1958 that the  
13 greatest hazard associated with benzene exposure  
14 is an insidious destructive effect on blood and  
15 blood-forming organs?

16 A. I did.

17 Q. And that's reported here, is it not?

18 A. Yes, it is.

19 Q. What was meant by insidious as used with  
20 benzene in reporting on its toxicity or chronic  
21 toxicity?

22 A. There are several factors, physical  
23 characteristics of it, such as the fact that it is  
24 very volatile, it can be in concentrations without  
25 easy detection that would be very harmful to the

1 employee. It has no -- and physiologically it has  
2 no particular offensive odor or irritating effect  
3 on the worker, and he's quite satisfied to work in  
4 concentrations that could be very dangerous and  
5 very harmful to him.

6 Q. Unless he knows that he is being exposed  
7 to it and has been educated on this characteristic  
8 of it; is that correct?

9 A. That's right.

10 Q. Did you -- in the performance and  
11 adoption of a benzene control program in 1940's  
12 and early 50's, did you recognize this insidious  
13 nature of the benzene?

14 A. I did.

15 Q. And this was recognized in your training  
16 programs?

17 A. It was.

18 Q. Sir, this document -- incidentally, what,  
19 to your knowledge, was the Toxigram which is  
20 marked P-13? How was it utilized by Esso?

21 A. Primarily to educate our purchasers or  
22 our clients that were buying the products from us.

23 Q. Was this -- was this the -- was it the  
24 custom and practice as you know it of Esso to send  
25 this Toxigram along with any purchase of benzene?

1           A.     It was, and actually it was usually sent  
2 prior to the time in which we sent it, enclosed it  
3 at the time of a quotation of a purchase price  
4 before we sold it to them.

5           Q.     Sir, as a part of this, was this Toxigram  
6 consistent in your opinion with the 1948 API  
7 toxicological review on benzene?

8           A.     It is.

9           Q.     Did you also still continue to report in  
10 1958 that most authorities agree that in light of  
11 the present knowledge the only level which can be  
12 considered absolutely safe for prolonged exposure  
13 is zero?

14          A.     I did.

15               MR. BAGGETT: I ask that P-13 be attached  
16 to the deposition. I ask that all of the exhibits  
17 up to this point that have been identified and  
18 numbered be attached to the deposition, if I  
19 haven't previously asked that.

20               MR. MYERS: And I'll make a general  
21 objection to all of those as previously mentioned  
22 as to authenticity of the documents.

23               MR. SPEARS: Same objection.

24               MR. BAGGETT:

25           Q.     Professor, so that there's no

1     misunderstanding, we have Exhibit No. 9  
2     recognizing that the only safe concentration for  
3     benzene exposure was zero. That was confirmed  
4     by Hunter in 1939, it was confirmed by Hueper in  
5     1942, it was confirmed in the Clinton Marshall in  
6     his article in '50, and it was also confirmed by  
7     Esso in your Toxigram; is that correct, sir?

8             MR. SPEARS: I object to the form of the  
9     question. That's not what he said, and that's not  
10    what you asked him earlier. Your question earlier  
11    was the only absolute safe concentration was  
12    prolonged exposure to the benzene, not just -- you  
13    forgot to mention prolonged.

14            MR. BAGGETT: The record will speak for  
15    itself.

16            Q.     Doctor, were these -- Professor, were  
17    these authorities, Hunter, Hueper, Clinton  
18    Marshall and the Esso Toxigram consistent with  
19    the API recommendation, and that is that -- that  
20    in light of the present knowledge the only level  
21    which can be considered absolutely safe for  
22    prolonged exposure is zero?

23            A.     They are consistent.

24            Q.     All right, sir. Now, Professor, the --  
25    who was Clyde Berry?

1           A.     Clyde Berry was a peer of mine, and he  
2     was an associate -- he worked with Exxon -- Esso  
3     Eastern Petroleum Division of the same company,  
4     the Standard of New Jersey, and he also was an  
5     associate of mine in periods when I was -- we were  
6     both commissioned in the United States health  
7     public -- Public Health Service and in the  
8     Division of Industrial Hygiene together.

9           Q.     Was he an industrial hygienist that you  
10    knew to be associated with the American Petroleum  
11    Institute?

12          A.     He was.

13          Q.     Who was Dr. Woody?

14          A.     Dr. Woody was the medical director that  
15    he reported to in the area or the particular  
16    division called the Esso Eastern.

17          Q.     Sir, I want to show you a document that's  
18    marked P-14 for identification, which can best be  
19    described as a memorandum dated November 22nd of  
20    1948, subject, paper read by Dr. W. C. Hueper on  
21    the subject of occupational cancer before the  
22    APHA. The letter is from Clyde M. Berry,  
23    Industrial Hygienist, to Dr. Woody, and ask you,  
24    sir, if you've seen that document before?

25          A.     Yes, I have.

1 Q. Sir, I ask you to assume that this was  
2 authenticated by the deposition of Dr. Eula  
3 Bingham, who has testified in the Allen case and  
4 the -- and authenticated the minutes and records  
5 of the Medical Advisory Committee of the American  
6 Petroleum Institute, and subject to that  
7 authentication I'm going to ask you some questions  
8 about this. Would the delivery by Dr. Hueper of a  
9 paper before the 76th annual meeting of the APHA --

10 A. That's the American Public Health  
11 Association.

12 Q. This reports, does it not, that there  
13 was an audience of 200 to 300 people were in  
14 attendance in November of '48, does it not?

15 A. It does.

16 Q. And, sir, at that time is not -- 1948, is  
17 not the industrial hygienist Clyde Berry writing  
18 to Dr. Woodard reporting on -- Woody reporting on  
19 this speech by Dr. Hueper and recognizing that  
20 there was a strong link between environmental and  
21 cancer incidents?

22 A. That's his report, uh-huh, Dr. Hueper's  
23 paper.

24 Q. And among other things, does he point  
25 out the idealistic approach to the control of the

1 problem and set out the points that should be  
2 utilized in the industry, the petroleum industry,  
3 to help control the problem of benzene exposure?

4 MR. MYERS: I'm going to make an  
5 objection. I don't believe he's ever identified  
6 when he saw that paper, whether he saw it last  
7 week or last year, whether or not he saw that  
8 paper in 1948, whether or not it was transferred  
9 among members in 1948.

10 MR. BAGGETT: Fine.

11 Q. Professor, you saw this yesterday, did  
12 you not?

13 A. Yes, I had seen it in 1948.

14 Q. All right, sir.

15 A. And possibly I was present, because I had  
16 heard Dr. Hueper give this paper, and I might have  
17 been present at that same meeting, but I don't  
18 recall for sure.

19 Q. The point that I want to make, sir, is  
20 that in November of 1948 these controls that he  
21 mentions in this paper, in this letter that is  
22 confirming what Hueper had reported in the  
23 presence of two or three hundred people, are the  
24 type of controls that you recognized in setting  
25 up a benzene exposure control program at Exxon?

1           A.     They do.

2           MR. BAGGETT:   I'd ask that that be  
3 attached as P-14.

4           MR. MYERS:   Same objection.

5           MR. BAGGETT:

6           Q.     Incidentally, sir, I'll show you another  
7 document that -- a series of pages of documents  
8 that I will mark P-15 for identification, which  
9 could best be described as a letter to members and  
10 associates of the Medical Advisory Committee on  
11 American Petroleum Institute letterhead dated  
12 January the 18th, 1949, from D. V. Stroop,  
13 S-t-r-o-o-p, Director, with copies going to the  
14 safety committee of the board of directors and  
15 naming one, two, three, four, five, six, seven,  
16 eight such people, attached to it bearing -- this  
17 document bears Bates number 000997 through 01302,  
18 and ask you if this is not a document that you saw  
19 yesterday for the first time?

20          A.     I did see this yesterday, but I don't  
21 recall whether I saw it when it was issued in  
22 1949.

23          Q.     All right, sir.

24          A.     Because I was active in this organization  
25 at that time.

1 Q. Professor, what I'd like for you to do is  
2 tell us out of -- I ask you to assume that this  
3 document was authenticated in the deposition of  
4 Dr. Eula Bingham in the Hicks and Allen case  
5 pending in Jefferson County as the custodian of  
6 the American Petroleum Institute minutes of the  
7 Medical Advisory Committee. Sir, attached to  
8 this is a list of different physicians, different  
9 industrial hygienists that were membership -- that  
10 had membership on the Medical Advisory Committee  
11 of the American Petroleum Institute in the years  
12 1949, 1950 and 1959. Did you know many of the  
13 members of that Medical Advisory Committee?

14 A. I did, a majority of them.

15 Q. Dr. Bill Crookshank from Lake Charles,  
16 did you know him?

17 A. I knew him well.

18 Q. Burt Delon, a safety man from Lake  
19 Charles, did you know him?

20 A. I didn't know him personally, but I knew  
21 of him.

22 Q. Dr. W. O. Armstrong from Continental Oil  
23 Company, did you know him?

24 A. Well.

25 Q. Dr. Clinton Marshall, Sohio Vacuum out of

1 Buffalo, did you know him?

2 A. I did. He prepared that report from  
3 Harvard.

4 Q. Did you know Dr. T. J. Kelly from Shell  
5 Oil in Wood River, Illinois?

6 A. I did.

7 Q. Sir?

8 A. Yes.

9 Q. Did you know Dr. W. R. Levis with Sun Oil  
10 out of Pennsylvania?

11 A. I didn't know him very well, but I knew  
12 he was on the committee.

13 Q. Did you know a doctor J. W. Long from  
14 Gulf Oil Corporation in Port Arthur?

15 A. I did.

16 Q. Did you know Dr. W. A. Morrison, an M.D.  
17 From Union Oil Company in California?

18 A. I don't remember him, but -- I don't  
19 recall him.

20 Q. Did you know a Dr. Allan E. Dooley from  
21 The Texas Company?

22 A. I did. I knew his background, field of  
23 industrial hygiene.

24 Q. Sir, consistent with your knowledge of  
25 the customs and practices that prevailed in the

1 American Petroleum Institute concerning  
2 distribution of relevant documents, such as the  
3 API 1948 Toxicological Review on Benzene, do you  
4 know of any reason why members of the Medical  
5 Advisory Committee wouldn't have been furnished  
6 with those type of documents?

7 A. No, I -- it's my impression they were  
8 all furnished that was members of any of these  
9 committees that you've named and the persons on  
10 them were -- all received a copy when they were  
11 published.

12 Q. Sir, in the field of safety, occupational  
13 medicine and industrial hygiene was it well  
14 recognized by 1948, by the time of that review,  
15 that there was a causal relationship between  
16 exposure to benzene and a serious disease or  
17 injury to the blood-forming organs?

18 A. In all cases wherever the people in my  
19 category or the medical directors, yes, it was  
20 well available. How far down it went in the  
21 company, I wouldn't happen to have that  
22 information.

23 Q. Sir, I want to show you another document  
24 that I will mark as P-16 for identification, which  
25 could best be described as a New York State

1 Occupational Safety -- I'm sorry, New York State  
2 Occupational Cancer Committee paper entitled  
3 "Occupational Cancer, a Challenge to the  
4 Physician," copyrighted in '49 by the New York  
5 State Department of Health and ask you if back  
6 in that time set, in the 40's and 50's, were you  
7 familiar with, No. 1, that committee, and, No. 2,  
8 this particular type of literature?

9 A. I was familiar with it and the activities  
10 of this committee at that time, but I did not  
11 participate personally.

12 Q. Sir, the membership that is shown on  
13 page -- of the New York State Occupational Cancer  
14 Committee that's shown on page 5, if you would --

15 A. Yes.

16 Q. Did you happen to know Conrad Dobriner,  
17 D-o-b-r-i-n-e-r, an M.D. with the Sloan Kettering  
18 Institute?

19 A. What number is that? Dobriner? Sloan  
20 Kettering? I didn't personally know him, no.

21 Q. Okay. What about --

22 A. He was an authority on cancer, medical  
23 authority on cancer.

24 Q. What about Dr. G. H. Germen,  
25 Manufacturing Chemists Association?

1           A.     Yeah, he was at that time chairman of the  
2 Medical Advisory Committee to the Manufacturing  
3 Chemists Association, and Dr. Germen was  
4 associated with one of the major national  
5 petroleum -- no, excuse me, chemical manufacturing  
6 companies, but I don't recall which one he was.

7           Q.     All right, sir. What about Arthur E.  
8 Hogg, M.D., member of the American Petroleum  
9 Institute?

10          A.     Yes, and Dr. Hogg was medical director  
11 for one of the major oil companies, and I think it  
12 was Amoco.

13          Q.     What about W. C. Hueper, U.S. Public  
14 Health Service, that's the doctor we've referred  
15 to earlier, is it not?

16          A.     Yes.

17          Q.     Sir, at this -- at this time of  
18 publication, on page 9 they refer to a table as  
19 a guide to the physician who for purposes of  
20 prevention is interested in investigating the  
21 role of occupation in cancerous and precancerous  
22 lesions presented by a patient. They list two  
23 tables there. And table No. 2 lists  
24 alphabetically, for reference purposes, some of  
25 the more common substances or conditions in the

1 occupational environment which are recognized as  
2 being cancer producing or suspect. I ask you to  
3 look at -- they go ahead and point out there  
4 that those that are designated with an E are  
5 established relationship, and I ask you if you  
6 could tell me on page 13 if in table 2 -- not page  
7 13.

8 A. Yes.

9 Q. On page 14 under table 2, under benzol,  
10 do they not report that benzol is a substance that  
11 attacks the blood-forming organs or system and  
12 they report that as an E, which means established  
13 causal relationship?

14 A. Yes, and I see that same information on  
15 the bones and bone marrow diseases discourages  
16 benzol and derivative radioactives and so forth  
17 are causing blood dyscrasia.

18 Q. By the time that this article was  
19 published in 1950, sir, did you accept in the --  
20 '49, did you accept in your work at Exxon the fact  
21 that benzene was recognized to be an established  
22 carcinogen so far as damage to the blood-forming  
23 organs?

24 A. I did.

25 Q. And you enacted -- put in a benzene

1 control program consistent with that recognition?

2 A. I did.

3 Q. P-16 for identification, I'd ask that it  
4 be attached. Incidentally, attached to that, is  
5 it not, a bibliography of many articles to support  
6 these findings, is it not, sir?

7 A. There is a -- there's references.

8 MR. MYERS: Same objection as to the  
9 admissibility of the document.

10 MR. BAGGETT:

11 Q. Sir, the next document that I will  
12 present to you is Plaintiff's Exhibit No. 17 dated  
13 September the 7th, 1943, authored by M. H. Soley,  
14 University of California Medical School, entitled  
15 "Report to Shell Development Company on Benzene,  
16 Nitrobenzene, Anilines and Xylenes (They're Toxic  
17 Effects and Suggested Safeguards in Manufacturing  
18 Practices)." Page 2 bears the stamp "received,  
19 Shell Development Corporation, September 7th,  
20 1943." I ask you if you've ever seen that before  
21 yesterday, sir?

22 A. I don't recall this particular  
23 publication, having seen it, until yesterday.

24 Q. Subject to this document being  
25 authenticated by Shell Oil Company -- and for the

1 record, I can state that this was delivered to me  
2 and Herschel Hobson at a restaurant two years ago  
3 in Beaumont by Shell's attorney. This may have  
4 to be taken out of the deposition, but it was  
5 pursuant to considerable motions to compel.

6 MR. FREEMAN: Who was their attorney,  
7 Bill?

8 MR. BAGGETT: I think --

9 Q. Sir, this article is entitled, on the  
10 second page, "Report to Shell Their -- on Benzene,  
11 Their Toxic Affects and Safeguards," and it's  
12 labeled "confidential." I ask you if this  
13 article, as an industrial hygienist, to you, does  
14 it not support the recognition by this researcher  
15 in 1943 that exposure to benzene vapors is  
16 dangerous, particularly if the exposure is  
17 prolonged?

18 MR. MYERS: I'm going to make a general  
19 objection, since he did not rely on that at the  
20 time he was formulating his opinions many years  
21 ago. He just recently seen this -- had an  
22 opportunity to see the document.

23 MR. BAGGETT: Fine.

24 Q. Go ahead, if you will. I'm saying does  
25 not a review of this document indicate under

1 benzene --

2 A. Yes.

3 Q. -- that there is a recognition that  
4 exposure is particularly dangerous if it's  
5 prolonged? Sir --

6 A. This -- may I summarize by saying this  
7 paper is in agreement with what I know about it  
8 and have seen in many other publications.

9 Q. Okay. While you didn't rely on this  
10 paper in putting in your program, is this not a  
11 confidential -- indicated, if it's authenticated,  
12 to be a confidential communication to Shell  
13 recognizing the toxicity of benzene and reporting  
14 that while prolonged exposure to any concentration  
15 to benzene is dangerous, there is a marked  
16 variation in susceptibility of individuals so  
17 that some, for unknown reasons, are particularly  
18 resistant while others are quite susceptible?

19 A. This is in keeping with Hunter's and the  
20 other exhibits that we have before us and no  
21 conflicts.

22 Q. In fact, this article, this paper, this  
23 document, sites Hunter with approval, does it not?

24 A. It -- he's given as a reference.

25 Q. Sir, P-19 for identification, which can

1 best be described as a document dated April 28th,  
2 1950, on the letter -- having the letterhead of  
3 Shell Development Company, "To: K-r-e-d-l-u" --  
4 blank, blank, I can't make that out, "from C. H.  
5 Hine, M.D., Consulting Toxicologist, subject:  
6 Certain problems of environmental cancer in the  
7 petroleum industry." First let me ask you, did  
8 you know Charlie Hine?

9 A. I did, well.

10 Q. C. H. Hine?

11 A. Socially as well as professionally.

12 Q. Sir?

13 A. I knew him not only professionally but  
14 also socially.

15 Q. You have had an opportunity to review  
16 this document dated April the 28th, 1950, have  
17 you not, sir?

18 A. I have.

19 Q. And --

20 MR. MYERS: If I could ask when, sir.

21 THE WITNESS: Back in the early days of  
22 Dr. Hine came on the -- on the committee about  
23 1952, or 1 or 2, in that period, and he -- we  
24 discussed this paper at that time.

25 MR. MYERS: Okay. Thank you.

1 MR. BAGGETT:

2 Q. Sir, on the first page did you agree with  
3 his report that only relatively few instances can  
4 the origin of environmental cancer be traced to  
5 contact with well-defined chemical agents  
6 possessing established carcinogenic qualities.  
7 Among such compounds are arsenic, benzol and  
8 aromatic amines, in addition to radioactive  
9 elements?

10 A. Those were ones that were recognized  
11 as being directly related to workers' exposure.

12 Q. Sir, attached to this report --  
13 incidentally, he sites with approval -- on the  
14 second page of the report, he sites Hueper with  
15 approval, does he not?

16 A. He does.

17 Q. As an authority?

18 A. He does.

19 Q. And in a table attached to this, does  
20 he not present all of the known and commonly  
21 suspected chemical agents causing cancer that are  
22 presented in the oil industry?

23 A. He has that list.

24 Q. And in those tables attached do they not  
25 list benzol as a substance and benzol derivatives

1 as a substance causing damage to the blood-forming  
2 organs?

3 A. He does.

4 Q. And also attached to there is another  
5 table dealing with precancerous reactions, and in  
6 this table does he not indicate that benzol and  
7 derivatives could -- are responsible for blood  
8 conditions and disorders to the bone marrow that  
9 are precancerous lesions?

10 A. He does.

11 Q. Was this consistent with the state of the  
12 art knowledge that existed in the 1950 period in  
13 the field of toxicology, industrial hygiene and  
14 occupational medicine?

15 A. It was.

16 Q. Sir, the next document that I will mark  
17 as P --

18 MR. FREEMAN: I think you skipped 18.

19 MR. SPEARS: Do you have an 18, Bill?

20 MR. MYERS: Yeah, you skipped 18.

21 MR. SPEARS: The last one you're talking  
22 about is a Shell document. It was 19. I see a  
23 17.

24 MR. BAGGETT: Let's go off the record.

25 VIDEOGRAPHER: Off the record, 18 minutes

1 before 12.

2 [Discussion off the record]

3 VIDEOGRAPHER: Beginning of tape No. 2,  
4 we're on the record, 14 minutes before 12 noon.

5 MR. BAGGETT:

6 Q. Professor Hammond, I've renumbered the  
7 document from -- on Shell Oil Company from  
8 Charlie, C. H. Hine, M.D., with certain problems  
9 of environmental cancer in the petroleum  
10 industry. It should be P-18, and I ask that  
11 that be attached to the deposition.

12 P-19 for identification can best be  
13 described as a document dated January 1954  
14 entitled "Benzene Physiological Properties,"  
15 from Allan E. Dooley to Dr. W. E. Kuhn, K-u-h-n.  
16 Professor, you saw that yesterday for the first  
17 time, did you not?

18 A. I did.

19 VIDEOGRAPHER: Mr. Baggett, your  
20 microphone, please, sir. I'm hearing you fine,  
21 but let's hear you better.

22 MR. BAGGETT:

23 Q. Subject to this being authenticated as  
24 being a document of Texaco -- or Texas Company,  
25 you did know Allan E. Dooley to be a toxicologist

1 for --

2 A. He was the chief industrial hygienist  
3 for --

4 Q. Industrial hygienist.

5 A. For Texaco.

6 Q. Sir, this document that I've just  
7 presented to you, among other things, recognizes  
8 that chronic benzene poisoning can result from  
9 repeated and continuous exposure to relatively  
10 low benzene vapor concentrations, does it not,  
11 sir?

12 A. It does.

13 Q. Does it not also, among other things,  
14 recognize that you can have chronic poisoning by  
15 subthreshold exposure?

16 A. It does.

17 Q. I will want the Court or jury to see this  
18 as a blowup. Would you please read what Allan  
19 Dooley reports here to Dr. Kuhn concerning chronic  
20 poisoning by subthreshold exposure

21 MR. MYER: Object to this witness  
22 commenting on correspondence from one party to the  
23 other which he obviously did not see at the time  
24 that it was written.

25 MR. SPEARS: Same objection?

1           A.    "Threshold limit values represent the  
2 highest concentration of material to which groups  
3 of physiologically normal workers should be  
4 exposed for prolonged periods with reasonable  
5 expectation that as a group they would not suffer  
6 health damage. A threshold limit value does not  
7 imply warranty of a safe working environment. The  
8 difficulty is that there are no adequate means of  
9 determining who are the physiologically normal  
10 person insofar as exposure to a particular toxic  
11 material is concerned. Deviation from the  
12 physiological norm will constitute individual  
13 susceptibility." End of paragraph.

14           Q.    Do you agree and did you agree with and  
15 recognize this when you were in charge of the  
16 industrial hygiene program at Humble in '47  
17 through the years that you were employed by Esso?

18           A.    I took all of these characteristics into  
19 consideration when I established the zero limit as  
20 being the only safe one for all people.

21           MR. SPEARS: Object to that question -- I  
22 mean; object to the answer as not being responsive  
23 to the question.

24           MR. BAGGETT:

25           Q.    Well, let me ask the question again then.

1 Did you accept this principal that chronic  
2 poisoning by subthreshold exposures can occur in  
3 the adoption of your program at Humble and at  
4 Esso?

5 A. I did.

6 Q. Sir, this is a recognition, is it not,  
7 by Dooley and yourself that there's no warranty of  
8 safe working conditions simply because you comply  
9 with the threshold limit value?

10 MR. SPEARS: Objection. That question  
11 is -- now you're characterizing somebody else's  
12 statements as to Dooley, who I don't think this  
13 witness can testify to.

14 MR. BAGGETT: Would you read back my  
15 question, please, sir?

16 MR. SPEARS: My objection is based on the  
17 fact that you're asking him about Mr. Dooley.

18 MR. BAGGETT: Okay.

19 Q. Is that your interpretation of what  
20 Dooley is saying here?

21 A. I find no objection to what Dooley says,  
22 and I would say that this factor of many  
23 conditions were taken into consideration by myself  
24 regarding benzene as well as some other five or  
25 six hundred materials that we had to evaluate.

1 Q. Sir, looking -- well, let me ask you  
2 this. When you adopted a program that has been  
3 spelled out here early on in your deposition and  
4 in the Toxigram where you recognize that most  
5 authorities agree that in light of the present  
6 knowledge the only level which can be considered  
7 absolutely safe for prolonged exposure is zero,  
8 is one of the reasons because you can have chronic  
9 poisoning by subthreshold exposures?

10 A. I do.

11 Q. Now, the last paragraph of Mr. Dooley's  
12 letter or memo dated January of '54 refers to the  
13 API toxicological review on benzene, gives a good  
14 summary of the physiological affects of this  
15 material. I believe that sets of these reviews  
16 are at Port Arthur, at Beacon and in your library.  
17 I'm asking you this, at the time that these  
18 reviews were rendered by the American Petroleum  
19 Company, were copies of the reviews in your  
20 offices and in the offices of Humble Oil Company  
21 and Esso?

22 A. Yes, they were.

23 Q. And would one of the reasons be because  
24 that such articles as that were widely circulated  
25 in the American Petroleum Institute?

1           A.    They were available to the petroleum  
2 industry broadly.

3           Q.    Sir, does good -- skipping to another  
4 subject, but it may be referred to in this memo,  
5 does good employee education program involve  
6 educating them on the delayed effects that can  
7 result from chronic exposure?

8           A.    It's particularly important to do that  
9 for employees on insidious materials.

10          Q.    It's because they could be exposed at a  
11 time and not really if -- incidently, particularly  
12 one that is -- that the vapors are pleasant, their  
13 respiratory system doesn't act as an alarm to  
14 protect them from -- or set off an alarm that  
15 they're smelling an irritant, does it?

16          A.    That's true.   That's true.

17          Q.    And if they go through pleasant  
18 experiences with smelling benzene or a pleasant  
19 odor, they could be being injured and not even  
20 know it?

21          A.    They could.

22          Q.    And that is the reason why you felt it  
23 was important to educate your people to that fact?

24          A.    It was.

25          Q.    Sir, the -- one of the -- P-20 for

1 identification can best be described as a  
2 memorandum from E. W. Midlam, dated August the  
3 30th of 1960, to several people, one of which  
4 was W. M. Cock, the other one was J. W. Crookshank,  
5 another one was H. R. Smith, bearing Bates numbers  
6 EW 0037252 through EW 0037259, and I ask you if --  
7 well, I doubt that you've seen the first page of  
8 that before yesterday, but attached to that do you  
9 recognize the API toxicological review on benzene  
10 dated in 1960?

11 A. This was the second edition of the one  
12 we had in 1948, I believe, yes.

13 Q. Well, I'm not going to go into the  
14 contents of the second edition of the API, but  
15 basically did it also cover the toxicity, the  
16 toxicology, the chronic effects, the precautionary  
17 measures and the medical examinations that were  
18 recommended for benzene-potentially-exposed  
19 employees?

20 A. Yes, it did.

21 Q. Do you know who H. R. Smith was back in  
22 1960?

23 A. Yes, he was a medical investigator for  
24 the Kettering laboratory in Cincinnati, and we  
25 gave him remedial projects to review for us, some

1 of them which was a carry-forward from the work  
2 that was done by Harvard under Dr. Drinker and  
3 Dr. Clinton.

4 Q. Sir, I want you to know that evidence  
5 will show that H. R. Smith was the plant manager  
6 for Cities Service that was involved in other  
7 litigation that you've been in. Was there a  
8 Mr. Smith that was at the Kettering Institute?

9 A. No, it was a Dr. Smith that --

10 Q. Dr. Smith. This is an H. R. Smith. You  
11 did not know him?

12 A. I did not know him.

13 MR. BAGGETT: Okay. P-20, I ask that it  
14 be attached to the deposition.

15 MR. MYERS: Same objection.

16 MR. BAGGETT: Well, I don't understand  
17 what your same objection is.

18 MR. MYERS: Same objection is that the  
19 documents have not been authenticated. And I  
20 realize that you may have done it on another  
21 proceeding, but I'm not familiar with that.

22 MR. BAGGETT: Okay. Fine. Sir --

23 MR. MYERS: And that would hold true for  
24 all the objections that I've made on this.

25 MR. BAGGETT:

1           Q.     Sir, I want to show you a document I will  
2 mark P-21 for identification dated November 16th,  
3 1970, entitled "Essential Information for the Safe  
4 Handling and Use of Benzene by Operating,  
5 Maintenance and Laboratory Personnel," Cities  
6 Service Oil Company, Lake Charles Operation, bears  
7 Bates numbers EW 0009900 through EW 0009912. This  
8 is a document that's been authenticated in other  
9 litigation involving Cities. I ask you if you  
10 have not seen that document previously, maybe in  
11 connection with the Ellis case?

12           A.     I also saw this document yesterday.

13           Q.     All right, sir. Sir, the point that I'd  
14 like to ask you about is, is not this a document  
15 setting up a benzene exposure program in 1970 that  
16 was consistent with what was known and knowable by  
17 the mid, early 50's or by the mid-50's, insofar as  
18 safety and health was concerned?

19           A.     I did not find any new material in here  
20 that wasn't available in the early 1950's to the  
21 petroleum industry.

22           Q.     In fact, sir, I'll show you a document  
23 that you've heretofore identified and produced  
24 with your deposition in the Ellis case, a  
25 three-page document entitled "Benzene Exposure

1 Control" -- excuse me just a second. Let me get  
2 my --

3 MR. BAGGETT: Mr. Court Reporter, could  
4 you give me a stamp there?

5 MR. MYERS: 22, I think.

6 MR. BAGGETT:

7 Q. I'm going to mark this document P-22 for  
8 identification and ask you if you recognize that  
9 document entitled "Benzene Exposure Control"?

10 A. Yes, it was one that I or my assistant  
11 prepared, and it was distributed to all people  
12 involved.

13 Q. It says in the corner here, and it looks  
14 like that it might be --

15 A. That's my --

16 Q. -- your writing, "This control program  
17 was in operation by 1955 for Baytown Refinery of  
18 Humble Oil & Refining Company."

19 A. It was.

20 Q. Is that a fact, sir?

21 A. Yes, it is.

22 Q. And this program addressed control  
23 measures in the manufacturing units?

24 A. It did.

25 Q. They're spelled out and numbered in this

1 document, are they not, sir?

2 A. They are.

3 Q. It spelled out control measures for  
4 limiting exposure in the shipping areas?

5 A. It does.

6 Q. Did it also spell out in the refinery  
7 streams that you determined the benzene percentage  
8 in selected streams?

9 A. We did.

10 Q. Did you also, by 1955, determine for  
11 streams with 5 percent or more benzene that you  
12 recommended the control items that are set forth  
13 here for the benzene unit?

14 A. I did.

15 Q. Did you also for streams with 2.5 to 5  
16 percent benzene investigate and determine exposure  
17 potential?

18 A. We did.

19 Q. And then, of course, you directed -- as  
20 a part of this control you had routine control of  
21 samples in the laboratory, and you spelled out how  
22 you did that, did you not?

23 A. We did.

24 Q. When it came to medical and industrial  
25 hygiene, you spelled out, did you not, the

1 physical examinations, the preemployment and the  
2 periodic examinations afterwards?

3 A. All of those employees was on that list  
4 for a special examination.

5 Q. And that included urinary phenols and who  
6 was subjected to those type of regular studies?

7 A. They were.

8 Q. And also you had air monitoring in the  
9 different areas, and you covered the frequency  
10 that that would be done and how it would be done?

11 A. It was.

12 Q. Sir, I guess what I'm asking you is, is  
13 this, in your opinion -- did it represent a state  
14 of the art program for the control of benzene  
15 exposure that was in effect and that you had put  
16 in effect by 1955?

17 A. It did.

18 Q. Do you see anything -- a reason why or do  
19 you know of any reason why any person involved in  
20 the refinery business would not have been able to  
21 comply with those practices and standards that  
22 you've set out in that document?

23 MR. SPEARS: I object to that question,  
24 Bill. That's calling for speculation to what  
25 persons you're talking about. You're asking him

1 to speculate about what other companies could or  
2 could not do.

3 MR. BAGGETT:

4 Q. Well, based on the state of the knowledge  
5 that was available through the American Petroleum  
6 Institute and in the petroleum industry, do you  
7 know of any reason why any refinery wanting to  
8 protect their employees from benzene exposure  
9 could not have adopted a program as set forth  
10 there?

11 A. I do not know any reason why they  
12 couldn't have adopted it.

13 Q. Sir, in your opinion by 1955 was the  
14 type of program that you have set forth in this  
15 document -- did it comply with the industrial  
16 standards that were recognized in your profession?

17 A. Yes, those -- they did comply.

18 Q. Were they state of the art standards?

19 A. They were state of the art, yes.

20 Q. Now, is this -- this program that is set  
21 out there, in addition to that, did it involve  
22 education?

23 A. It did.

24 Q. And it certainly, as you said while ago,  
25 it involved measuring the concentrations of vapor

1 in the air, that that should be checked regularly  
2 in locations where the possibility of excess  
3 exposures may have been encountered?

4 A. Yes, it does.

5 Q. And in your opinion, sir, if a company  
6 did not educate its employees of the adverse  
7 health effects of benzene and the hazards of  
8 benzene by the mid-50's, did they fail to comply  
9 with the recognized health and safety standards  
10 of that time?

11 A. I do not know of any method they could  
12 have complied with this state of the art without  
13 being -- carrying out this much of a program for  
14 the control and education of the employees.

15 Q. All right, sir. If the -- if a company,  
16 in your opinion, did not do measuring of air  
17 concentrations of vapor in the -- I mean, of  
18 benzene vapor in the air regularly in locations  
19 where the possibility existed of excessive  
20 exposures, in your opinion were they -- did  
21 they fail to comply with the recognized health  
22 and safety standards of that time?

23 A. They were in -- yes, they were in fault  
24 or error not doing that. And also I would like  
25 to emphasize that it's necessary to do urinary

1 sulfate ratios or urinary phenols to be able to  
2 make sure that there wasn't some unknown sources  
3 of exposure.

4 MR. MYERS: I'm going to object to his  
5 comment as to fault and comment as to what he  
6 believes should be the standard. The fault is  
7 up to the trier of fact.

8 MR. SPEARS: I agree with that. The  
9 same objection, and I also object to the  
10 nonresponsiveness of the answer.

11 MR. BAGGETT:

12 Q. Well, let me just ask you this. You have  
13 set out what your benzene control program was in  
14 1959 at the Baytown Refinery, and that included  
15 design, that included determination of benzene  
16 percentage in selected streams, it included  
17 control measures for the laboratory, it included  
18 medical and industrial hygiene, which included  
19 the phenols and the air monitoring. Sir, in your  
20 opinion if any company did not do those things set  
21 forth in P-22 by the mid-55's were they failing to  
22 comply with the state of the art knowledge that  
23 existed in the petroleum industry?

24 A. They were deficient.

25 Q. Now, and by 1960 if a company were

1 subject to the Department of Health -- Department  
2 of Safety and Health regulations of the  
3 Walsh-Healey Act, if they were not complying with  
4 these benzene exposure controls that you had in  
5 1950, in your opinion were they failing to comply  
6 with the provisions of the Walsh-Healey Act?

7 MR. SPEARS: I'll object to that question  
8 as being extremely vague as to -- Bill, you're not  
9 indicating what part of the Walsh-Healey act is he  
10 talking about. You're not indicating that this  
11 man even knows what the Walsh-Healey Act is.

12 MR. BAGGETT:

13 Q. Sir, do you know whether or not the  
14 Walsh-Healey Act required air monitoring in places  
15 where people have potential exposure to benzene?

16 A. They required that you be completely  
17 aware of all exposures and the extent of the  
18 exposure which would require air monitoring.

19 Q. And if you didn't do air monitoring and  
20 didn't have the facilities or equipment to do it,  
21 didn't have the personnel to do it, then you  
22 couldn't comply in 1960 with those provisions of  
23 the Walsh-Healey Act, could you?

24 A. In my opinion I don't see how they could  
25 have.

1 Q. And the same thing would comply in 1972  
2 with the Walsh -- with the OSHA regulations, if  
3 you didn't have air monitoring of potentially  
4 exposed people, there was no way that you could  
5 know what they were being exposed to, could you?

6 A. There was no other method I could think  
7 of.

8 Q. Sir, did you warn business guests of the  
9 presence of benzene vapors in areas where they may  
10 be encountered at your facility?

11 A. We actually put them in the classrooms if  
12 they were going to come in to work for us as  
13 contract employees and gave them the same type of  
14 education that we gave our own employees. And our  
15 safety inspectors also enforced that type of  
16 action and safety precautions on that -- on the  
17 part of the contractor.

18 Q. This Toxigram dated in 1958 marked  
19 Plaintiff's Exhibit No. 13, was that the type of  
20 warning that you issued to purchasers of benzene  
21 product?

22 A. This was primarily made for the education  
23 of the purchasers that were inquiring about buying  
24 benzene from us.

25 Q. Finally, sir, I'd like your opinion based

1 on the American Petroleum Institute data, the  
2 safety data, the chemical manufacturing data that  
3 we've referred to, did you -- do you have an  
4 opinion whether or not those are notices that  
5 should have triggered warnings to the users and  
6 manufacturers of chemicals containing benzene that  
7 there was a hazard associated with those products?

8 A. It's very clearly pointed out by those  
9 organizations that it's -- as well as many others,  
10 such as governmental agencies, that it's a very  
11 dangerous operation.

12 Q. And back before 1955 that literature was  
13 readily accessible and widely distributed among  
14 the American Petroleum Institute members, was it  
15 not?

16 A. It was.

17 MR. BAGGETT: I have no further  
18 questions.

19 MR. FREEMAN: Are we going to get lunch,  
20 or what's you gentlemen's pleasure? It's 12:11.

21 MR. BAGGETT: We're off.

22 VIDEOGRAPHER: Off the record, 12 minutes  
23 after 12 noon.

24 [Discussion off the record]

25 VIDEOGRAPHER: On the record, 20 minutes

1 after 12 noon.

2 MR. BAGGETT: Gentlemen, I've got two  
3 other questions I need to ask the professor that  
4 I thought of before I --

5 Q. Professor, back in the 40's was  
6 industrial hygiene audits or surveys available to  
7 members of the American Petroleum Institute or to  
8 anyone, so far as that's concerned, that you know  
9 of?

10 A. I assume they would be consultant firms.

11 Q. Yes, sir.

12 A. Such as the Industrial Hygiene Foundation  
13 that was established at Malone Institute by  
14 Dr. Drinker, and they had some qualified people.  
15 One of my former teachers from Harvard, Wesley  
16 Hemeon, was there, and he headed up that group.  
17 And associated with him was several good  
18 industrial hygienists, and they did extensive  
19 surveys of the petroleum industry. For example,  
20 they did the surveys for the Standard Oil of New  
21 Jersey, not only for the American refineries,  
22 except for ours in Baytown. They did it for  
23 Baton Rouge and Bayonne and Everett and Charleston  
24 that I know about, and those publications are  
25 available. And some of them, the last one I

1     suppose that was done was in the year of 19 --  
2     Baton Rouge in 1949.

3           Q.     Sir, in that connection have you  
4     not previously furnished to us a copy of the  
5     industrial hygiene survey of the Baton Rouge  
6     refinery dated April of -- February and April  
7     1949 rendered by the Industrial Hygiene Foundation  
8     of America for your company?

9           A.     Yes, for the Esso Eastern Company.

10          Q.     I ask that that be marked P -- what's the  
11     next document?

12                 MR. FREEMAN: 23.

13                 MR. MYERS: 23.

14                 MR. BAGGETT:

15          Q.     P-23 for identification. You recognize  
16     that, sir, as being a voluminous --

17          A.     Comprehensive.

18          Q.     -- comprehensive industrial hygiene  
19     survey that was made before -- this was probably  
20     before you were able to hire or had a resident  
21     industrial hygienist at --

22          A.     This was before Mr. Venable reported  
23     there. Now, the individual who came down because  
24     they were friends as well as peers of mine, Hemeon  
25     and Morgan, they came down and spent two or three

1 weeks with me regarding industrial hygiene  
2 problems that I had uncovered in the Baytown  
3 refinery and how I was handling them before they  
4 started out in 1948, to make the survey.

5 Q. Sir, the point I want to make is, is  
6 that anybody -- was it known by you that the  
7 services of industrial hygiene audits or surveys  
8 was available through -- through the American  
9 Petroleum Institute?

10 A. The Medical Advisory Committee discussed  
11 these individual surveys from time to time.

12 Q. All right, sir. Sir, finally in  
13 connection with the insidious nature of benzene  
14 as a toxic product, is there a recognition on  
15 your part as an industrial hygienist that even  
16 utilizing a TLV, whether it be -- that the odor  
17 threshold before one can even begin to detect the  
18 presence of benzene, that the odor threshold is  
19 higher than the TLV's were, say, in the 50's when  
20 they were 35 parts per million or 50 parts per  
21 million?

22 A. Yes, that was true, that they were  
23 dangerous exposures without the workers being  
24 in any way alerted to the fact that they were  
25 being exposed to dangerous concentrations.

1 MR. BAGGETT: Thank you. I have no  
2 further questions.

3 MR. FREEMAN: Before we start, can you  
4 read back that last answer? I had a little  
5 difficulty following it, please.

6 [The record was read as requested]  
7  
8  
9

10 EXAMINATION BY MR. SPEARS  
11

12 Q. Professor Hammond, I introduced myself  
13 earlier. I'm Ken Spears. I represent several of  
14 these oil companies in connection with this case.  
15 First of all, Professor Hammond, let me -- let's  
16 go back a bit in your work history. I'd like to  
17 ask you some questions. And I have -- I've read  
18 all the depositions that you've given before,  
19 Professor Hammond, so I'm somewhat familiar with  
20 your work history, but I want to ask you in  
21 Massachusetts, when you worked in Massachusetts,  
22 what year was that?

23 A. '41 and '42.

24 Q. And who were you working for?

25 A. I was working for the Division of

1 Occupational Diseases in the state labor  
2 department.

3 Q. All right. And in connection with  
4 working for that company, there was established --

5 A. It was a state organization.

6 Q. I'm sorry. In connection with working  
7 for that state organization at that particular  
8 time, there was established, was there not, a TLV  
9 for benzene of a hundred ppm; is that correct?

10 A. That was suggested, yes, by an  
11 organization of the American Standards Association  
12 and others that had looked at the these values.  
13 And particularly down in Connecticut there was a  
14 fellow by the name of Warren Cook and you'll find  
15 that he had issued a list of chemical substances  
16 and suggested TLV for them, and that -- that was  
17 the prevailing value.

18 Q. For the benefit of the Court, the jury or  
19 the Court, would you tell us what a TLV is, sir?

20 A. TLV stands for threshold limit value that  
21 is described as being the concentration of vapor  
22 in the air that should not ever be exceeded by --  
23 to exposure to any employee.

24 Q. Okay. And it's your testimony that when  
25 you went to work for this agency in Massachusetts,

1 the general recognized TLV in the industry as such  
2 among people like yourself was 100 ppm for  
3 benzene; is that correct?

4 A. That was the goal that we had in working  
5 there. I was just telling you that it was hard to  
6 get the industry to attain those levels.

7 Q. All right.

8 A. Even then.

9 Q. Okay.

10 A. At that time.

11 Q. Nevertheless, that was your goal and the  
12 goal of the agency that you worked for, to get to  
13 a TLV of 100 ppm; is that correct?

14 MR. BAGGETT: Jim, we're talking about in  
15 1937.

16 MR. SPEARS: When he went to work --

17 A. 1941.

18 MR. SPEARS:

19 Q. '41?

20 A. No, because my supervisor was Dr. Harvey  
21 Elkins, and he had made enough measurements both  
22 in terms of air concentrations and also the  
23 urinary sulfate ratio that he was suggesting a  
24 maximum of 75 parts per million. And also  
25 Dr. Hunter worked with us and because we did some

1 of his field work investigating exposure, and he  
2 was already written that for susceptible people  
3 it had to be down to zero to protect them. I  
4 was aware of it, and that is when I formed my  
5 foundation and my position on concentrations. So  
6 I didn't accept the TLV value as being acceptable.

7 Q. All right. Professor Hammond, just for  
8 clarification, when you went to work in the 1940's  
9 for this agency in Massachusetts, am I correct in  
10 stating that the agency's position on acceptable  
11 TLV's for benzene was a hundred ppm; is that  
12 correct?

13 A. That was the lowest value that the state  
14 department of labor could enforce.

15 Q. All right, sir. And someone you  
16 mentioned had indicated in an article that a  
17 hundred ppm was too high and perhaps 75 ppm would  
18 be more acceptable; is that correct?

19 A. Yeah, just from reasoning that they had  
20 seen some -- he had seen some cases where in  
21 measuring the concentration in the plants he had  
22 also seen some damage that had occurred where the  
23 average concentration had only been 75 parts per  
24 million, but he saw -- Dr. Harvey Elkins and  
25 his -- and I was one of his members of his team --

1 had actually measured 75, but we also found some  
2 medical cases where there had been injury by that  
3 concentration.

4 Q. All right, sir. And when -- again, for  
5 the benefit of the court and for laypeople on the  
6 jury, when you're talking -- when we're talking  
7 about a hundred ppm TLV or 75 ppm TLV, we're  
8 talking about an eight-hour work exposure; is that  
9 correct?

10 A. That's a concentration that's really  
11 valued on an average throughout a 40-hour week.

12 Q. All right. It's based on a 40-hour week  
13 of continuous exposure of a certain ppm; is that  
14 correct?

15 A. Not to exceed that amount. Now, this  
16 exposure, as you know, in practice would vary up  
17 to 75 and then also wave on down so that your  
18 average -- we found that if you should analyze it  
19 average would be about 60 percent, would be more  
20 likely the actual 40-hour week.

21 Q. Okay.

22 A. Because of the variation in the  
23 concentration.

24 Q. Again, and I guess I'm not making myself  
25 very clear, Professor Hammond, but correct me if

1 I'm wrong, it's true, is it not, that when we're  
2 discussing threshold limit values, TLV's and ppm's  
3 for workers in the workplace, we're talking -- at  
4 least in the 40's when you were working in  
5 Massachusetts we're talking about individuals who  
6 came into contact with benzol on a regular basis  
7 for a 40-hour week; is that correct?

8 A. That's right.

9 Q. All right, sir. In other words, even  
10 in 1947 when you were working in Massachusetts,  
11 whatever year that was --

12 A. '42.

13 Q. '42. Thank you, sir.

14 A. Yeah.

15 Q. A person such as myself or you or any  
16 ordinary individual, if he happened to walk --  
17 walk near an area where there had been a benzol  
18 spill and for one or two minutes was exposed to  
19 say a hundred ppm and then walked off and did the  
20 rest of his job, that was not the type of exposure  
21 that would give you any concern, was it?

22 A. It would not have if he had no further  
23 exposure.

24 Q. Okay. In other words, the TLV and the  
25 ppm deals with chronic exposure, as opposed to

1 acute exposure; is that correct?

2 A. Ordinarily the chronic exposure produces  
3 this irreversible damage to bone marrow, whereas  
4 you don't get that effect in just one short-term  
5 exposure.

6 Q. Okay. After you left the agency in  
7 Massachusetts, is that when you went to work at  
8 Humble?

9 A. No, I didn't go there. I was a  
10 commissioned officer in the United States Public  
11 Health Service, and I served during the years  
12 of -- the war years at assignment, and usually I  
13 was assigned to some state or some agency such  
14 as that to enforce -- help them enforce the  
15 regulations that they had pertaining to control  
16 of exposure.

17 Q. All right, sir. Can you tell me -- tell  
18 the Court, please, how the TLV of benzene evolved,  
19 please, from a hundred ppm when you went to work  
20 in Massachusetts to what it was when you -- what  
21 was accepted in the industry, what was the  
22 standard when you went to work for Humble?

23 MR. BAGGETT: Excuse me, Ken. This may  
24 be of help to you, this document, but you're  
25 referring to a TLV in '46 and in the 40's when

1     there was no such thing.  It was a maximum  
2     allowable concentrate, I believe.

3             THE WITNESS:  Well, maximum is what  
4     I'm speaking of, because that was a maximum  
5     concentration.

6             MR. BAGGETT:  This may be of some help  
7     to you if you want to use it.  It sets out the  
8     history of the threshold limit values.

9             MR. SPEARS:  But -- thank you, Bill.

10            MR. BAGGETT:  And I'm sorry if I'm  
11     interrupting you.

12            MR. SPEARS:  That's okay.

13            MR. BAGGETT:  I'm just trying to be of  
14     help.

15            MR. SPEARS:

16            Q.     And when I asked you the question about  
17     in Massachusetts, when I used the term TLV, that's  
18     how you understood it in Massachusetts in the  
19     40's, is it not?

20            A.     No, I answered more M.A.C., maximum  
21     allowable concentration.  That was what we --  
22     now, this is very important, because the state  
23     department of labor could not enforce a  
24     concentration less than what they have there,  
25     and it was therefore -- the importance was in

1 pollution -- I mean, in enforcement, such as  
2 you would have with setting a speed limit and  
3 enforcing it as being one or another. Now, they  
4 might -- as you know, it might be that you  
5 wouldn't be able to drive as fast as your -- as  
6 the speed limit would be, but they couldn't --  
7 and if you drove faster than what was actually  
8 safe, but they couldn't enforce that patrol, and  
9 that's the same way with the state department of  
10 health.

11 Q. Well, Professor Hammond, when you went to  
12 work with Humble --

13 A. 1947.

14 Q. -- what was the generally accepted TLV or  
15 M.A.C. for benzene among your peers, any agency  
16 that you recognize among your peers? What was  
17 that?

18 A. Does that not show you the year that it  
19 was reduced to 35?

20 Q. I'll show you the document.

21 A. Let's see, I think it's taken from the  
22 TLV.

23 MR. BAGGETT: I'll ask that this be  
24 marked P-24 for identification.

25 MR. MYERS: Let's identify what it is.

1 MR. SPEARS:

2 Q. Do you recognize that document?

3 A. Threshold limit values, TLV's, and  
4 this was the Occupational Safety and Health  
5 Administration, and it was established by the  
6 American Conference of Governmental Industrial  
7 Hygienists.

8 Q. All right, sir.

9 A. And in 1947 it would have been 50 parts  
10 per million, and 1948 it was cut to 35 parts per  
11 million.

12 Q. All right, sir. The document that's been  
13 marked 24, I believe, by Mr. Baggett makes  
14 reference to the ACGIH, does it not?

15 A. American Conference of Government  
16 Hygienists, yes.

17 Q. All right. The American Conference of  
18 Governmental Industrial Hygienists, also known as  
19 the ACGIH, is a very well-respected organization,  
20 is it not?

21 A. It was the best -- best of the industrial  
22 hygiene group organizations, yes.

23 Q. In other words, this organization was  
24 made up of people like yourself. Weren't you a  
25 member?

1           A.    Yes, I was a member after I had gone to  
2   teaching in the last -- so that would have been in  
3   the year of 19 -- I became eligible, and these  
4   were all governmental or educational, nonindustry  
5   members, and I became eligible in 1978 and took  
6   part in it.

7           Q.    Okay, sir. But when was the American  
8   Conference of Governmental Industrial Hygienists  
9   formed?

10          A.    It was formed in 1936, I think, or '37.

11          Q.    All right, sir. And those -- those  
12   individuals who formed that agency and today, up  
13   until today, are industrial hygienists; is that  
14   correct?

15          A.    Along with -- let me supplement to say  
16   there a lot of physicians that are members of  
17   that, and they're looking at it from a medical  
18   standpoint, and there are a lot of strictly  
19   toxicologists who are experimenting and they are  
20   not industrial hygienists inasmuch as they do not  
21   go out into plants and fields and make tests.  
22   They actually work with animals primarily.

23          Q.    Is it safe to say that the ACGIH was  
24   composed of individuals who were dedicated to  
25   informing industry about the dangerous

1 propensities of various chemicals or toxic agents?

2 A. They were the best authorities we had.

3 Q. All right. And this 100 M.A.C. that we  
4 referred to when you were working in Massachusetts  
5 in the 40's, that was established based on input  
6 from the ACGIH, was it not?

7 MR. BAGGETT: Well, I think to be precise  
8 we would have to refer to 1946. And this is a  
9 document that will be authenticated by Frank  
10 Parker.

11 MR. SPEARS:

12 Q. Well, my question, Doctor -- Professor  
13 Hammond, you understood what I was asking you, do  
14 you not?

15 A. Not in terms of -- you were giving them  
16 certain authoritative -- giving them authoritative  
17 type of government enforceable limits, and these  
18 are the limits that would be enforceable by the --  
19 a state agency, whether it's the department of  
20 health in some states and department of labor in  
21 some states, that they could actually take an  
22 employer to court and force him to reduce the  
23 concentration if it didn't come down to a hundred  
24 parts per million, and that was for that  
25 particular year. Then as it came on down, the

1 more restrictive, then that was what the  
2 inspectors from the government agency could  
3 enforce, and that's where it came about.

4 Q. Professor Hammond, what I'm trying to  
5 emphasize, and correct me if I'm wrong, but the --  
6 either the threshold limit value or the maximum  
7 allowable concentration for benzene vapor for a  
8 worker in a 40-hour week has evolved downward  
9 since 1941, has it not?

10 A. It surely has, down to zero now.

11 Q. All right, sir. Well, I want to ask you  
12 that, sir. What does the American Conference of  
13 Governmental Industrial Hygienists recommend as of  
14 today, sir, for threshold limit value ppm for  
15 benzene on an eight-hour day?

16 A. In the 1993 booklet it's one part per  
17 million.

18 Q. All right. So it's not zero, is it?

19 A. Well, you've got --

20 Q. Is it zero?

21 A. Well, it's not zero, because that cannot  
22 be detected in -- normally in the air such as this  
23 room or out there in the street we're going to  
24 have around one part per million.

25 Q. The fact of the matter, Professor

1 Hammond --

2 A. It's the least detectable amount.

3 Q. The fact of the matter, you cannot reduce  
4 benzene exposure to zero in any work environment,  
5 can you, sir?

6 A. No more than the fact that we still have  
7 some cases of leukemia and people don't have any  
8 record of having ever worked in benzene exposures.

9 MR. SPEARS: I object to the answer as  
10 not being responsive.

11 Q. I'm going to ask you again, Professor  
12 Hammond. In the workplace, and I'll give you the  
13 Exxon refinery as the workplace that you're very  
14 familiar with, is it possible to reduce benzene  
15 exposure to zero to every worker in that work  
16 place, based on the technology that you know of?

17 A. You have just stated a basic fact, and  
18 the other answer to that is that's the reason  
19 you have to have medical surveillance of these  
20 employees, because there's so much difference in  
21 their susceptibility, and if you find a person  
22 that has none detectable exposure as far as the  
23 instrumentation is concerned, and he shows changes  
24 in the blood picture and he's an employee where  
25 he might have some benzene around, unusual, then

1 you have to remove him to some other position, and  
2 we did that regularly.

3 MR. MYERS: Let me object to the  
4 responsive nature of the question.

5 MR. SPEARS: With all due respect, sir, I  
6 would object to the responsiveness of the  
7 question. I'm going to ask you --

8 MR. BAGGETT: Well, gentlemen, I've got  
9 to say if y'all are going to put that type of  
10 comment onto the record, I think it is responsive  
11 and I think he's entitled to explain his answer.

12 MR. SPEARS:

13 Q. Professor Hammond, I'm going to ask you  
14 to give me a yes or no.

15 MR. BAGGETT: You don't have to do that.

16 A. I can't do that. I can't do that.

17 MR. BAGGETT: I want to object to that  
18 instruction.

19 A. I can't do it.

20 MR. BAGGETT: He can give a yes or no and  
21 then explain it, and that's just what he did.

22 MR. SPEARS: Well, let me explain it --  
23 let me get this on the record. Are you telling  
24 this witness not to answer me yes or no, Bill?

25 MR. BAGGETT: I'm saying that he doesn't

1 have to, that he can answer you yes or no and then  
2 explain it.

3 MR. SPEARS: Under what provision of the  
4 Louisiana Code of Civil Procedure are you telling  
5 me that this witness cannot answer yes or no?

6 MR. BAGGETT: I didn't say that he  
7 doesn't have to answer you yes or no.

8 MR. SPEARS: Thank you.

9 MR. BAGGETT: I'm saying that he's  
10 entitled to explain it.

11 MR. SPEARS:

12 Q. Professor Hammond, if the question is  
13 capable of a yes or no answer, will you give me  
14 a yes or no answer, sir?

15 A. If that's the only thing required without  
16 an explanation.

17 Q. All right, sir.

18 A. The jury must understand what we are  
19 discussing and what the problems is, and I'm  
20 trying to think of them and --

21 Q. Well, Professor Hammond, you just answer  
22 my questions, please, and we'll let the jury  
23 decide what they want to be decided. Try not to  
24 be an advocate, if you would. Just answer the  
25 questions.

1 MR. BAGGETT: I'm going to object to your  
2 comments.

3 MR. SPEARS: All right.

4 Q. Professor Hammond, when you went to work  
5 at Exxon -- and what year, sir, was it?

6 A. 1947.

7 Q. All right, sir. Was there benzene  
8 present in the Exxon operations when you went to  
9 work at Exxon?

10 A. There was.

11 Q. All right, sir. Tell me every place that  
12 benzene was in at the Exxon facility when you went  
13 to work. List them for me.

14 A. When I went through making a  
15 reconnaissance survey, which is a walk-through, I  
16 discovered that the benzene was being used in  
17 dewaxing of oils, and that was the method at the  
18 ketone benzene procedure that had been developed  
19 by Texaco. And to do that, use their method, we  
20 had to use whatever they recommended or else they  
21 wouldn't guarantee it. So, but I immediately saw  
22 it, and I went directly to my management and said  
23 we cannot use that benzene as a product, because  
24 we're not going to be able to control it.

25 Q. All right, sir.

1           A.    And so, let me tell the you the rest of  
2 the story.  It's real important.  They began in  
3 research and they found out that toluene would do  
4 just as effective as benzene and even better.

5           Q.    I'm going to stop you now, Professor  
6 Hammond, because my question --

7           A.    And we never --

8           Q.    Professor Hammond, listen to me.

9           A.    I'm just saying --

10          Q.    No.  No, sir.

11          A.    I'm giving you the answer.

12          Q.    I understand.  My question to you was  
13 where in the Exxon refinery was benzene?  I'm not  
14 asking you about toluene or what you did.  Do you  
15 understand my questions?

16          A.    I told you.

17          Q.    Am I -- am I not being clear when I ask  
18 you?  Tell me if it's not clear.  Okay, sir?  
19 Where was benzene present at the Exxon refinery  
20 when you came to work?

21          A.    I've already answered you.

22          Q.    You said the dewaxing unit?

23          A.    That's right.

24          Q.    Is that the only place, sir?

25          A.    That's the only place that was

1 detectable.

2 Q. All right, sir. Did Exxon refine crude  
3 oil, sir?

4 A. They did.

5 Q. Was there benzene in crude oil when you  
6 went to work for Exxon, sir?

7 A. I'm sure that there was. It depended on  
8 the particular field you produced it from.

9 Q. How would you know if there was?

10 A. Well, we measured and we developed  
11 techniques to measure it everywhere.

12 Q. When you went to work at Exxon, were  
13 you aware that there was benzene in crude being  
14 refined by Exxon?

15 A. Not in any concentration that would be  
16 where it -- because it was internal and inside or  
17 enclosed equipment it wasn't vented out in the  
18 air.

19 Q. I didn't ask you whether it was vented in  
20 the air, sir. I'm asking you were you aware when  
21 you went to work for Exxon for the first time that  
22 Exxon crude oil products contained benzene, yes or  
23 no? Were you aware of it?

24 A. Oh, I was.

25 Q. How were you aware of it, sir?

1           A.    Because I talked to the laboratory people  
2           that were making an analysis of these crudes, and  
3           they could tell me --

4           Q.    All right, sir.

5           A.    -- which one was higher and which one was  
6           lower or which one was negative.

7           Q.    And what was the benzene content of the  
8           crude oil being used by Exxon at the refinery,  
9           say, in Baytown?

10          A.    I don't have any answer to that. We used  
11          crude from hundreds of fields and foreign crude as  
12          well as domestic crude, and you'd have to ask me  
13          which particular field, which particular -- and if  
14          that record would be back in the laboratory, I  
15          would refer you to go back there.

16          Q.    Well, do you recall what percent of  
17          benzene was contained in any particular crude  
18          being used by Exxon at the time that you started  
19          working there?

20          A.    It would never be measured in percent.  
21          It would be measured in terms of parts per  
22          million.

23          Q.    All right, sir. Do you recall any of  
24          those?

25          A.    No, I do not.

1 Q. Would a -- when you went to work for  
2 Exxon, did you consider an individual working in  
3 the refinery who may be handling the crude oil as  
4 being a person potentially exposed to benzene,  
5 sir?

6 A. Not unless I was aware of the area he was  
7 working in, how he could have been working with  
8 fractions of the crude oil and all that, but we  
9 went through the refinery and analyzed all that  
10 and you'll find it in my -- my publication there  
11 that I summarized.

12 Q. Well, I looked at your publication, but  
13 that's dated 1955.

14 A. I say we were doing that already in 1955  
15 and before, but I just brought it together in  
16 about that time to say these are definitely what  
17 we wanted all employees to know and all management  
18 to know at that time. That was for their  
19 education, not for mine.

20 Q. All right. There was -- when you went  
21 to work at Exxon, Exxon was using benzene as a  
22 solvent?

23 A. Never been used as a solvent except for  
24 this patented process that Texaco put in, and we  
25 didn't do it after I went in and went through the

1 plant. We didn't buy any more benzene.

2 Q. When you arrived at Exxon --

3 A. That's right.

4 Q. -- you determined that Exxon was using  
5 benzene as a solvent in its operations and you  
6 eliminated it, is that what you're saying?

7 A. Yeah, and that was a brand new unit,  
8 probably hadn't been operating over a month or so  
9 when I got there.

10 Q. So the people that -- the people that  
11 initiated that process of using benzene as a  
12 solvent before you got there were doing something  
13 that you thought was dangerous; is that correct?

14 A. I put a stop to it, too.

15 Q. So Exxon was acting dangerously before  
16 you got there; is that what you're saying?

17 A. Well, yes, and I contribute that to the  
18 people who developed the process, which is Texas  
19 Company, Texaco.

20 Q. But who was the industrial hygienist that  
21 was there when you got there, sir?

22 A. There was none. I started the first  
23 industrial hygiene program in the world in the  
24 petroleum industry.

25 Q. Well, who was acting as that, as an

1 industrial hygienist?

2 A. E. Q. Camp had a group of chemical  
3 engineers and chemists that worked on these  
4 problems, because during the war we produced a  
5 lot of toluene, we produced a lot of xylene and  
6 synthetic rubber and so forth and all of those  
7 people had a potential exposure to aromatics, and  
8 to cover the case they were all included in the  
9 same program that we had now for benzene, because  
10 they thought all aromatics, such as toluene and  
11 xylene and related materials, were as dangerous as  
12 benzene.

13 Q. All right, sir.

14 A. And I straightened them out on that.

15 Q. Okay. When you started work for Exxon --  
16 I'm going to go back to this -- you mentioned the  
17 dewaxing unit as being a source of benzene. Is  
18 this the process that you're talking about that  
19 Texaco initiated or gave to Exxon?

20 A. That's right. That's correct.

21 Q. All right, sir.

22 A. But if you go through the world today  
23 and look at those units, none of them use benzene,  
24 because we demonstrated that you could substitute  
25 a safe material for that.

1 Q. Okay, sir. How many employees are  
2 employed say at the Baytown refinery when you  
3 were working for Exxon, sir?

4 A. At one time there were in the range of  
5 fifteen to sixteen thousand employees.

6 Q. All right, sir. Now, other than office  
7 personnel, sir, I'm not asking you about office  
8 personnel, of the fifteen to sixteen thousand of  
9 them, how many of those people actually worked  
10 what I would call inside the area of the refinery  
11 at any part of the refinery?

12 A. It would be strictly a guess on my part.

13 Q. Approximately how many, sir?

14 A. I'd estimate at three-fourths of those  
15 would have been in the plant from day to day, 24  
16 hours a day, seven days a week.

17 Q. About 10,000 people roughly?

18 A. 12,000, I would say.

19 Q. All right, sir. In your opinion, sir,  
20 while you were working for Exxon, were all 12,000  
21 of those individuals who worked inside your  
22 refinery exposed to unsafe levels of benzene?

23 A. I would say there would be -- the group  
24 that was working in the dewaxing program would  
25 have been -- the maximum would have been 25

1 people.

2 Q. Okay, sir.

3 A. That's the only ones that had any  
4 hazardous exposure.

5 Q. Okay, sir.

6 MR. FREEMAN: Excuse me, you said 25  
7 people?

8 THE WITNESS: 25 people.

9 MR. SPEARS:

10 Q. And that's -- thank you, Professor  
11 Hammond. That's the point I was making, of the  
12 ten or twelve thousand people working in the  
13 Baytown refinery, the people that you would be  
14 concerned with as far as for exposure to benzene  
15 were the 25 some-odd people working in the  
16 dewaxing unit; is that correct?

17 A. At that time, yes, but we expanded the  
18 operations so that it became several hundred.

19 Q. Okay, sir. At no time did you feel that  
20 all ten or twelve thousand people working in your  
21 refinery were exposed to unsafe levels of benzene,  
22 did you?

23 A. I'll go back to my original statement,  
24 that these were the only ones I detected by  
25 walk-through.

1 Q. Okay, sir. When you walked through your  
2 refinery, who were the people that you determined  
3 might be exposed to benzene vapors? Now, you  
4 mentioned the people in the dewaxing unit. Who  
5 were the people or what work craft would you  
6 consider as being a craft that would be  
7 potentially exposed to benzene vapors as you  
8 walked through a refinery? And I'm talking about  
9 your refinery, the Exxon refinery.

10 A. Only that one unit.

11 Q. All right, sir. And which unit was that?

12 A. A dewaxing unit.

13 Q. You were not concerned, were you not,  
14 with, say, pipefitters or boilermakers who were  
15 working in other units other than the dewaxing  
16 unit about their levels of exposure to benzene,  
17 were you?

18 A. To answer you to say that to be able to  
19 walk through and make an evaluation of an exposure  
20 you have to be professionally trained in this  
21 field.

22 Q. Yes, sir. Yes, sir. My question --

23 A. So I was trained in the field, and I knew  
24 what to -- what to look for and what to expect,  
25 and I knew the operations of the plant, what the

1 intermediate compounds were, what the finished  
2 products were and where the original exposure or  
3 the feed products came from, and I was able to  
4 evaluate them.

5 Q. All right, sir. In layman's terms,  
6 Professor Hammond, and tell me if I'm not being  
7 clear, what I'm trying to get at, and tell me if  
8 that's not correct, is that everyone who worked  
9 in your refinery -- not everyone was exposed to  
10 benzene; is that correct?

11 A. I think that's -- doesn't even deserve  
12 answering.

13 Q. Well, I want an answer.

14 A. Well, no, they didn't.

15 Q. Okay.

16 A. They didn't have any exposure to benzene.

17 Q. All right. Fine.

18 A. How would a boilermaker or a shop worker  
19 and so forth who never even had any solvent --

20 Q. All right, sir.

21 A. -- in the place -- let me explain it to  
22 you, and you can put this down as my answer. I  
23 walked through the plant, I looked at the  
24 operations and materials they were handling, how  
25 they were being exposed. If I was not satisfied

1 that I would be willing to work for a career of  
2 35, 40 years in that particular location where  
3 they were working, I then took measurements, and  
4 I took measures to improve it to the point where  
5 I would.

6 Q. Yes, sir.

7 A. Okay?

8 Q. I understand that. When you walked  
9 through the refinery at Exxon, did you feel safe  
10 walking through that refinery?

11 A. Perfectly safe, and if I didn't, then  
12 just like I did in this room and there was some  
13 operations that I wasn't pleased with and I  
14 wouldn't be willing to work in for the rest of  
15 my life, and I got busy and we tended to them.

16 Q. All right, sir.

17 A. And I used that policy all the way  
18 through until my son came about 15 or 16 years old  
19 and I began to worry about his occupation, I began  
20 to apply that same judgment to whether or not I'd  
21 want my son to go to work in that job for the rest  
22 of his life. And that was the criteria I used.  
23 That's the reason zero was a natural thing for me  
24 for benzene.

25 Q. Does your son work in a refinery?

1 A. He never did work in a refinery, no.

2 Q. Did you ever take him in the refinery  
3 with you?

4 A. As a visitor.

5 Q. All right, sir. Were you concerned when  
6 you took him in as a visitor that he might be  
7 exposed to benzene by just being in the refinery?

8 A. I was -- I had already been in there, and  
9 I was not exposed to -- I was not -- I was not  
10 concerned about my own exposure, and I said that  
11 was my first criteria, but when he came along he  
12 was so precious to me --

13 Q. Sure.

14 A. -- I wouldn't want to expose him to say  
15 now you go to work in this plant or that plant or  
16 this operation or that operation, you see?

17 Q. Sure.

18 A. The TLV's didn't mean a thing to me.

19 Q. I've been in many refineries, Professor  
20 Hammond. Not nearly as many as you, sir. But  
21 when I walk through a refinery I get a smell.  
22 It's just a -- I can't tell you what it is. I  
23 just call it a hydrocarbon smell of a refinery  
24 operation. Do you know what I'm talking about?

25 A. Yes, I do, surely do.

1 Q. Is there any danger in breathing that  
2 when you're walking around in a refinery?

3 A. I don't see how you would be exposed to  
4 any more than just passing through, no.

5 Q. In other words, just walking through a  
6 refinery, whether it's Exxon's refinery or anybody  
7 else, and getting a smell of -- a hydrocarbon  
8 smell doesn't necessarily mean you're being  
9 exposed to benzene, correct?

10 A. Well, today, because of the control group  
11 about air pollution and so forth, you wouldn't  
12 have that smell anymore. You don't get that.

13 Q. Are you telling me you could walk through  
14 Exxon's Baytown refinery today and not smell any  
15 hydrocarbons, Professor Hammond?

16 A. Yes, I do.

17 Q. You could do that today?

18 A. Yes, you can.

19 Q. And you could do that when you retired?

20 A. Oh, not -- not that long ago, but within  
21 the last ten years they've had to tighten it up.  
22 I'll just give you some idea about how important  
23 this is. When I retired professionally there were  
24 15 of us looking after all the refineries and some  
25 60,000 or more employees throughout the 50

1 states. Today they have like 80 to 90 industrial  
2 hygienists doing the same job with less employees  
3 than we had --

4 Q. Okay.

5 A. -- when I was working for them.

6 Q. Okay, sir. Professor Hammond, what I'm  
7 saying is that when you retired, which was in what  
8 year, sir?

9 A. '78.

10 Q. Okay. So when you retired, at least up  
11 in that point in time if you walked through the  
12 Exxon refinery you would smell a hydrocarbon  
13 smell, would you not?

14 A. I could detect it, yes, at certain  
15 locations.

16 Q. But it was not something to be concerned  
17 about, was it?

18 A. Not at all.

19 Q. All right, sir. Likewise, a boilermaker  
20 or a pipefitter or any other craft who is not  
21 working in the units, the dewaxing unit or the  
22 benzene unit, has nothing to fear about the fact  
23 that he is working in the refinery about being  
24 exposed to benzene, does he?

25 MR. BAGGETT: You're talking about at his

1 refinery?

2 MR. SPEARS: Yes, sir.

3 A. Well, I think I can answer that by saying  
4 after 1948, by that time we had controlled  
5 exposures to lead among the painters, we've never  
6 had any symptoms or any complaints of an  
7 occupational disease among our many employees over  
8 that 30-year period.

9 MR. SPEARS:

10 Q. Were you answering my question, Professor  
11 Hammond, or just talking?

12 A. I was just giving you an answer to your  
13 question about not being -- not -- people not  
14 getting any danger or not being necessarily afraid  
15 to be in the refinery.

16 Q. Okay. So it's nothing -- there's nothing  
17 unusual about a boilermaker just doing his job in  
18 a refinery. As long as he's not around the  
19 dewaxing unit or the benzene unit he's not going  
20 to be exposed to benzene, is he?

21 MR. BAGGETT: Excuse me, you're still  
22 confining your questions not to Cities Service --

23 MR. SPEARS: I'm talking about his  
24 refinery.

25 MR. BAGGETT: -- but to his refinery.

1 MR. SPEARS: Yes, sir.

2 A. I would limit it to the fact that he  
3 could work in any of our facilities, including  
4 the benzene plant, without any danger of exposure.

5 MR. SPEARS:

6 Q. All right, sir. All right. Likewise,  
7 did Exxon have vessels, ships?

8 A. They had -- they had tankers.

9 Q. All right, sir. Did they have tug boats?

10 A. In what particular facility and which  
11 operation?

12 Q. Did Exxon have any tug boats that you  
13 were aware of that plied the inland waters of the  
14 Gulf Coast?

15 A. I don't know that we had any tug boat  
16 operators. We had tanker operators, and they came  
17 in for special examinations and so forth, but tug  
18 boats, I think we contracted most of them.

19 Q. Okay, sir. All right. Did -- have you  
20 been told by Mr. Baggett or anybody else what this  
21 particular case is about that we're here today  
22 for, that being the Joseph Hebert lawsuit, sir?

23 A. No, I'm not familiar with it.

24 Q. All right, sir. No one told you that  
25 Joseph Hebert was a boat captain, a tug boat

1 captain for most of his life who plied the waters  
2 of the Gulf Coast?

3 A. I didn't know any more than he was a  
4 captain on what I would call marine operations  
5 and so forth.

6 Q. Were you aware, sir, that he picked up  
7 and loaded and off-loaded crude oil products,  
8 condensate and sometimes gasoline from various  
9 ports of call all along the Gulf Coast?

10 A. No.

11 Q. Were you aware that he also visited the  
12 Exxon facility in Houston, sir?

13 A. No.

14 Q. No one told you that?

15 A. No.

16 Q. Were you aware that Higman did business  
17 with Exxon's refinery in Baton Rouge and picked up  
18 crude oil products?

19 A. No, I didn't know where they operated. I  
20 haven't -- haven't looked into any of that field  
21 operations.

22 Q. All right, sir. The whole time that you  
23 were an industrial hygienist up until the time  
24 that you retired, sir, did you know of any need to  
25 warn people like Mr. Hebert who might be tug boat

1 captains picking up Exxon crude oil products from  
2 the dangers of benzene?

3 A. Well, let me ask that and say our  
4 practice was to have our tug boat employees that  
5 were loading or unloading -- we'll say loading  
6 products of ours into the barges were under our  
7 supervision and they wore the respirators when  
8 they needed them. If it was topping off or doing  
9 some job of that type or closing a hatch, things  
10 of that type, well, they did wear -- and they were  
11 under the medical surveillance program, too, as  
12 far as benzene was concerned.

13 Q. All right, sir. I understand that. And  
14 maybe I got off track again. Were you aware, sir,  
15 that Mr. Joseph Hebert, in his entire career,  
16 never hauled benzene?

17 A. No, I -- I didn't know anything about his  
18 operation and products.

19 Q. All right, sir. Well, take this as a  
20 given. Based on the information that we know,  
21 Professor Hammond, Mr. Hebert was a tug boat  
22 captain for most of his life plying the waters  
23 of the Gulf Coast. Okay, sir? You understand  
24 me so far?

25 A. I hear you.

1 Q. All right. And the products that he  
2 pushed or pulled in the barges consisted of crude  
3 oil, condensate and sometimes gasoline or like  
4 products but no benzene. Okay? Do you follow me  
5 so far?

6 A. So far.

7 Q. All right, sir. And he was not an  
8 employee of Exxon, sir. Do you understand that?

9 A. Yes.

10 Q. If Mr. Hebert had arrived at an Exxon  
11 dock, and he said he did, to pick up crude oil --

12 MR. BAGGETT: Wait a minute, who said he  
13 did?

14 MR. SPEARS: Mr. Hebert did, he said he  
15 visited the Exxon dock.

16 MR. BAGGETT: Whereabouts.

17 MR. SPEARS: In Houston.

18 Q. If he arrived at the Houston dock to pick  
19 up crude oil products, just crude oil, would he  
20 have received any sort of warning from you or any  
21 Exxon official about the products that he was  
22 about to load into his barge, if it was crude oil?

23 A. I do not know about his operations enough  
24 to be able to help you on that.

25 Q. All right. Professor Hammond, you were

1 the chief industrial hygienist for Exxon; is that  
2 right?

3 A. I was.

4 Q. You were responsible to determine if  
5 there was any exposure to harmful chemicals or  
6 substances to any employee or visitor at the Exxon  
7 refinery; is that correct?

8 A. Not -- not in -- not in that type of  
9 detail, individual. I'm just speaking for the  
10 maintenance and the safety measures from an  
11 industrial hygienist's standpoint that we took  
12 and I -- all of our employees that worked at the  
13 docks were all trained and trained by classes in  
14 a lecture room type as to the dangers of having  
15 all of the products that we had, when to wear  
16 respirators or approved types of masks.

17 Q. All right, sir. Were you --

18 A. And so they would have been a good  
19 example for any contract barge operator and so  
20 forth to have seen them if they had been handling  
21 any materials that were hazardous.

22 Q. Well, I'm asking you now based upon your  
23 work experience at Exxon, sir, did you initiate  
24 any type of program to warn tug boat operators or  
25 crew members about the dangers, if any, of Exxon

1 crude products that they may be loading or  
2 unloading?

3 A. I do not know of any for the crude oil.  
4 If he just stuck to crude oil, that would have  
5 been less likely that we would have taken him  
6 apart for -- taken him aside for that particular  
7 training.

8 Q. And the bottom line, Professor Hammond,  
9 do you know of any danger of contracting acute  
10 myelogenous leukemia from anyone who handles crude  
11 oil products only?

12 MR. BAGGETT: That, of course,  
13 hypothetically is not consistent with the evidence  
14 in this case and is therefore objectionable.

15 A. I do not know enough about his work and  
16 the materials that you mentioned earlier, what  
17 concentration of benzene that might have contained  
18 and so forth.

19 MR. SPEARS:

20 Q. Well, what -- what concentration of  
21 benzene were in your Exxon crude oils, sir?

22 A. We didn't have any concentrations to  
23 speak of. The crude oil had other types of gases  
24 that would have been diluted with the benzene so  
25 as to reduce it. It's very unlikely that there

1 would have been very much benzene coming out per  
2 se from the -- you see, the more volatile  
3 materials in crude than those found in benzene  
4 would have been predominantly in the vapors that  
5 come out, and that kind of a fractionation-type  
6 evaporation and very little of the thing is high  
7 boiling as that. Your propane, butane, pentane  
8 and so forth would have been the gases that you'd  
9 have been concerned about, and you'd have been  
10 concerned unless you control it that you might  
11 have a fire problem, fire hazard, or explosion.

12 Q. Well, it was a very long answer,  
13 Professor Hammond.

14 A. Well, it was necessary.

15 Q. Yes, sir. And I'm asking you. Now you  
16 said there was -- in your answer you said your  
17 crude oil did not have much benzene in it --

18 A. Not coming out, that would have been  
19 exposed to the air. Just pure benzene -- just  
20 pure petroleum crude, I don't know of any  
21 situation where you would have had hazardous  
22 concentration of benzene per se.

23 Q. That's what I'm asking you, sir.

24 A. I just don't -- I just don't know what  
25 materials he handled.

1 Q. Right.

2 A. But I'm sure that the investigations of  
3 these materials, because we know that when we were  
4 handling products containing benzene we had to put  
5 in very strict control measures, including medical  
6 surveillance, including urinary phenols and other  
7 control measures, but just the uncertainty of what  
8 type of product you're talking about, but crude  
9 oil only is not -- I'm not able to help up with  
10 that.

11 Q. Well, I'm going to ask you, sir,  
12 Professor Hammond. As an industrial hygienist,  
13 based on your work experience, do you know of any  
14 incidents where acute myelogenous leukemia has  
15 been associated with handling crude oil products  
16 only?

17 MR. BAGGETT: That, of course, is  
18 irrelevant in this case.

19 A. Well, not only --

20 MR. SPEARS:

21 Q. Do you know that, sir?

22 A. I know that we had none --

23 Q. All right, sir.

24 A. -- in all of our people.

25 Q. Have you ever heard of any?

1           A.    I have not heard of any, and I have not  
2    had one case, because we had a good control  
3    program --

4           Q.    All right, sir.

5           A.    -- all this time. Unless you had that,  
6    I'd say you were negligent in knowing what  
7    exposure he might have been having.

8           Q.    Who's negligent?

9           A.    Anyone who had the supervision over the  
10   potential exposure that he had.

11          Q.    What exposure did he have, Professor  
12   Hammond?

13          A.    I don't know.

14          Q.    Well, why did you make a statement like  
15   negligent, Professor Hammond?

16          A.    Well --

17          Q.    You don't even know his exposure.

18          A.    Because I don't know how you'd know  
19   that he didn't have exposure unless you had him  
20   under --

21          Q.    Why --

22          A.    -- surveillance.

23          Q.    -- in the world --

24               MR. BAGGETT: Wait a minute.

25               MR. SPEARS: -- would you make a statement

1     like that?

2             MR. BAGGETT: Wait. Wait a minute. I  
3     object to you interrupting the professor.

4             MR. SPEARS: All right.

5             Q.     Professor Hammond, why would you make a  
6     statement about he was negligent or somebody was  
7     negligent when you don't even know what the man's  
8     exposure was? Tell me.

9             A.     That's right, I don't know what his  
10    exposure was.

11            Q.     Well, why do you make a statement  
12    about --

13            A.     Had he been working for us, I'd have  
14    known about it.

15            Q.     If he had been working for you, you'd  
16    have known what?

17            A.     I'd have known if he had any exposure or  
18    not to benzene.

19            Q.     And how's that, sir?

20            A.     Because of the medical surveillance and  
21    testing -- testing urine and other means of  
22    determining it.

23            Q.     Exxon did not test every employee in that  
24    refinery, did they, sir?

25            A.     I don't see how that had any relation

1 to a --

2 Q. Yes or no? Did Exxon --

3 A. -- barge operation.

4 Q. Did Exxon test every employee of their  
5 refinery, urinary or phenol or anything?

6 A. No, because we had a good, intelligent  
7 program going --

8 Q. Okay.

9 A. -- to protect them.

10 Q. All right, sir. So not every employee  
11 was exposed to benzene; is that correct?

12 A. Unfortunately not every industrial  
13 operation by -- has been evaluated by other  
14 people, professionals.

15 Q. Professor Hammond, not every employee at  
16 Exxon was exposed to benzene; is that correct?

17 A. I don't -- I don't think so. I don't see  
18 what that has to do with this particular case.

19 Q. Well, I'm asking you, was every employee  
20 at Exxon exposed to benzene, yes or no?

21 A. Well, no.

22 Q. All right, sir. So if Mr. Hebert was  
23 handling crude oil products and he was a boat  
24 captain, do you have any knowledge about whether  
25 he would be exposed or not?

1 A. I do not know.

2 Q. Would you expect him to be exposed if he  
3 was a captain of a vessel?

4 A. I wouldn't know what products he's  
5 handling.

6 Q. Crude oil products, Exxon crude oil  
7 products.

8 A. Show me an analysis of the crude oils  
9 that he handled, and then I'll be able to give  
10 it to you --

11 Q. Well, I'm going to give it back to you,  
12 Professor Hammond. Is there -- was there, on your  
13 watch at any time while you were working for  
14 Exxon, was there any crude oil products -- I'm  
15 talking about crude oil now, that was considered  
16 hazardous in the sense that individuals who  
17 handled, loaded or unloaded your crude off and  
18 on a barge had to be medically monitored?

19 A. Depending on what other products that  
20 might have been handled --

21 Q. I'm limiting it to crude oil.

22 MR. BAGGETT: I'm going to object to you  
23 interrupting the doctor --

24 MR. SPEARS: Well, go ahead and object.  
25 I'm trying to get the guy to answer a question.

1 [Court reporter stopped proceedings]

2 MR. BAGGETT: Extend to this man, please,  
3 the courtesy of letting him answer before you  
4 interrupt.

5 MR. SPEARS: I'll extend him the courtesy  
6 if he extends the same courtesy of answering my  
7 question. We won't be here very long,  
8 Professor Hammond, if you'd just answer my  
9 question, quit trying to be an advocate and simply  
10 answer the question.

11 MR. BAGGETT: I object to your side bar  
12 comments on this record.

13 A. I guess you've been to the docks and you  
14 know that there are many products being handled  
15 sometimes at the same time.

16 MR. SPEARS:

17 Q. You're not answering the question now.  
18 I've not been to the docks.

19 A. I'm --

20 Q. Don't assume I've been to the docks.

21 Okay?

22 A. All right. Well --

23 Q. My question --

24 A. All I'm saying is that --

25 Q. Let me ask -- let me ask you a question

1 and you give me an answer. Did you monitor --  
2 while you were at Exxon did you medically monitor  
3 all of your employees at the Exxon docks in  
4 Houston, yes or no?

5 A. Has no relation to any matter of whether  
6 they were in danger or not whether I monitored all  
7 of them or not. The main thing was --

8 MR. SPEARS: Professor Hammond, it was a  
9 simple question.

10 No, Bill, I'm not. He's going to go off  
11 on something else.

12 Q. At your dock at Houston, at your dock on  
13 your watch did you medically monitor all of your  
14 Exxon employees working at your docks, yes or no?

15 A. No.

16 Q. All right.

17 A. But it depends on --

18 MR. BAGGETT: You can explain it.

19 A. What else they were handling at the same  
20 time, even though crude oil was on one barge, but  
21 were they putting some product that contained  
22 benzene on other barges.

23 MR. SPEARS: I object to that question --  
24 that answer as not being responsive to my  
25 question.

1 MR. BAGGETT: Well --

2 A. It's the only way to explain your --

3 MR. SPEARS:

4 Q. No, sir, it's not.

5 A. -- situation.

6 Q. It's not.

7 A. It depended on what else that were  
8 happening at that dock at the same time. I don't  
9 know. I wasn't ever with Mr. Hebert and  
10 procedure --

11 Q. I'm not talking about Mr. Hebert,  
12 Professor Hammond. I'm talking about your job --

13 A. Well, I thought you said you wanted to  
14 talk about him only handling crude, but he could  
15 have handled only crude and been exposed to  
16 benzene.

17 MR. SPEARS: I object to this line of  
18 just talking, Professor Hammond. I'm not  
19 interested in you reciting what Mr. Baggett's may  
20 have told you yesterday about this case.

21 MR. BAGGETT: Well, I'm not interested in  
22 hearing you testify either. And if you -- you  
23 asked him a question about monitoring people at  
24 the docks of his refinery, and he is telling you  
25 situations where he would do that.

1 MR. SPEARS: That's not the question.  
2 I'm not asking about situations. The question  
3 was, did you monitor all of your employees at the  
4 docks, yes or no?

5 MR. BAGGETT: And he's entitled to  
6 explain.

7 MR. SPEARS: Right.

8 A. Yes.

9 MR. SPEARS:

10 Q. Yes, you did?

11 A. Yes. Yes, I did.

12 Q. You monitored -- you monitored all the  
13 Exxon employees at the docks?

14 A. Yes, I did.

15 Q. When did that start, sir?

16 A. All the time, because I could look at the  
17 operations and know what was going on around about  
18 them, whether it was a particular material or  
19 whether it was other materials and know whether  
20 they needed to be monitored.

21 Q. When did you start the monitoring  
22 program?

23 A. 1947.

24 Q. All right. From 1947 until the time you  
25 retired all of the Exxon employees who worked at

1 the docks were medically monitored, sir?

2 A. If they needed to be.

3 Q. And how did you determine if they needed  
4 to be?

5 A. By being professionally trained to know  
6 how to recognize the materials that may lead to  
7 exposure.

8 Q. All right, sir. And if they were -- and  
9 which materials were that, sir?

10 A. Any type of material that you were --  
11 depending on what particular hazard you were  
12 looking at. Benzene would be a good example.

13 Q. That's the one I'm looking for, benzene.

14 A. All right.

15 Q. How did you determine whether an employee  
16 should be monitored at the docks in relation to  
17 benzene?

18 A. Well, any products on the docks are being  
19 handled or loaded or unloaded at the same time  
20 that you were handling crude oil might contain  
21 benzene.

22 Q. All right, sir. That would be the only  
23 time, sir?

24 A. Sure.

25 Q. How about if you were just handling crude

1 oil that did contain benzene?

2 A. I do not know the situation where you'd  
3 just be handling crude oil without other  
4 operations going on.

5 Q. You've never heard of a situations where  
6 a barge pulled up at your dock and off-loaded  
7 crude oil?

8 A. I cannot answer you on a particular  
9 problem. I never was there every moment.

10 Q. I understand that.

11 A. Okay.

12 Q. But you were responsible for the  
13 industrial hygiene at that plant, weren't you?

14 A. Well, we have never had any occupational  
15 health hazard and diseases after I went to work  
16 and had the situation under control.

17 Q. Say that again.

18 A. Never did have any occupational diseases  
19 develop in our employees after I went to work in  
20 1930 -- 47 and got the few conditions we had under  
21 control.

22 Q. Are you telling me that Exxon has never  
23 been sued for occupational disease occurring while  
24 you were working for Exxon?

25 MR. BAGGETT: I object to -- that isn't

1 his -- that's an improper and an unfair  
2 summarization of his prior testimony and is,  
3 therefore, objectionable as to form. Whether  
4 they've been sued since then has no relevancy to  
5 the answer that he gave you, which was an answer  
6 to your question.

7 MR. SPEARS:

8 Q. Has Exxon been sued, sir, that you  
9 know of -- has Exxon been sued for occupational  
10 illnesses occurring while you, sir, were chief  
11 industrial hygienist?

12 A. I never heard of it.

13 Q. You never heard of any?

14 A. No, not while I was industrial --  
15 director of industrial hygiene.

16 Q. Is there any asbestos suits pending  
17 against Exxon, sir?

18 A. Well, that's not the question you asked  
19 me.

20 Q. You don't consider asbestosis an  
21 occupational disease?

22 A. Oh, I'm -- I'm -- if you want to get into  
23 that field, I'll tell you I was trained by  
24 Dr. Kenneth Lynch, and he was the first American  
25 to write about cancer from asbestos.

1 Q. Do you consider asbestosis as an  
2 occupational disease, yes or no?

3 A. Yes, never had -- we never had a case  
4 of symptoms -- we took x-rays of all of our  
5 potentially-exposed people, but never one of  
6 them had any evidence of asbestosis.

7 Q. Professor Hammond, we're going to be  
8 here a long time if you don't answer my  
9 questions.

10 A. Yeah, I'm not going to answer them like  
11 you want them. I'm going to tell you the truth.  
12 That's all I'm --

13 Q. That's what I'm asking, sir.

14 A. You want to get me --

15 Q. No.

16 A. -- to break down --

17 Q. No.

18 A. -- and tell you --

19 Q. No, I'm not.

20 A. -- anything that is not true.

21 Q. No, I'm not. Do you consider --

22 MR. BAGGETT: Excuse me. For the record,  
23 I want to object to the basic principal that  
24 you're proceeding on. He has testified that  
25 during his employment there there was no

1 occupational disease, and you're trying to refer  
2 to occupational disease that may have been  
3 discovered since he worked there, and, therefore,  
4 you're being unfair to him unless -- unless you  
5 delineate what period of time you're talking  
6 about.

7 MR. SPEARS:

8 Q. Professor Hammond, do you consider  
9 asbestosis as being an occupational disease, yes  
10 or no?

11 A. Well, that's been known for 45, 50 years.

12 Q. All right, sir. It is an occupational  
13 disease?

14 A. Why, sure. Silicosis is an occupational  
15 disease.

16 Q. All right, sir. Has --

17 A. And lead poisoning is an occupational  
18 disease.

19 Q. Has Exxon been sued, that you're aware  
20 of, for -- by people saying they contracted an  
21 occupational illness called asbestosis as a result  
22 of working at the refinery and their work was on  
23 your watch?

24 A. Not to my knowledge, no.

25 Q. So you are not aware of any such suits?

1 A. No, no, I don't believe there have been  
2 any asbestosis cases filed against us.

3 Q. Against Exxon?

4 A. Yeah.

5 Q. You're not aware of any asbestos cases  
6 filed against Exxon?

7 A. I didn't say asbestos. I said  
8 asbestosis.

9 Q. All right, sir. You're not aware of any  
10 asbestosis lawsuits filed against Exxon as we sit  
11 here today?

12 A. Not at all.

13 Q. Is that correct?

14 A. Not at all.

15 Q. And you never have been; is that correct?

16 A. That's right.

17 Q. All right, sir. You're not aware of any  
18 lawsuits filed by any former employees of Exxon  
19 alleging mesothelioma, are you?

20 A. I know that there have been some, but I  
21 don't -- they're all since I left the company.

22 Q. All right, sir.

23 A. I heard about that.

24 Q. Okay.

25 A. But asbestosis and mesothelioma are

1 entirely two different diseases.

2 Q. Yes, sir. Yes, sir. Professor Hammond,  
3 we got off track here, sir, but you testified, did  
4 you not, in the Skeen case, did you?

5 A. Yeah, I did.

6 Q. You testified by deposition and at trial,  
7 did you not?

8 A. I did.

9 Q. All right, sir. That was a benzene  
10 exposure case, was is it not, sir?

11 A. Yes, it was.

12 Q. All right, sir. And in that case, sir,  
13 isn't it true that you testified that at the time  
14 of your testimony 10 parts per million, ppm, is a  
15 satisfactory and safe level of exposure to  
16 benzene?

17 A. Under some conditions.

18 Q. All right.

19 A. For some people.

20 Q. All right. So under some conditions and  
21 for some people you believe that 10 ppm would be a  
22 satisfactory and safe level; is that correct?

23 A. That's right.

24 Q. All right, sir.

25 A. But to some people that are

1 hypersensitive, it's not.

2 Q. All right. And what was the T -- the  
3 time-weighted average for exposure to benzene  
4 vapors established by the ACGIH in 1960, sir?

5 A. Right here we have that. In -- the last  
6 one we had was '58, and that was less than 25  
7 parts per million M.A.C. Now, as I said, the  
8 M.A.C. would indicate a TLV of somewhere like 60  
9 percent of that.

10 Q. All right, sir. Well, what was the TLV  
11 accepted by the ACGIH, sir, in 1960 for ppm levels  
12 of --

13 A. 25 parts per million.

14 Q. 25 parts per million --

15 A. That's right.

16 Q. -- benzene? That was accepted by the  
17 ACGIH, sir; is that correct?

18 A. That was -- that was the number they  
19 published, yes.

20 Q. All right, sir. And, again, you feel  
21 that the ACGIH is a very well-respected  
22 world-renowned organization; is that correct?

23 A. They're not the ultimate authority on the  
24 matter, as they will tell you that you shouldn't  
25 try to interpret these matters except by a

1 professional industrial hygienist. Now, if you  
2 tried to interpret --

3 Q. My question is they are a well-respected  
4 organization, correct?

5 A. They certainly have recognized status,  
6 yeah.

7 Q. Do you feel that you know more about  
8 the safe level of exposure to benzene, you as an  
9 individual, than the entire compilation of the  
10 ACGIH, sir?

11 A. I certainly do. In fact, I was on the  
12 committee that voted against it, 25 parts per  
13 million. Because it's a democratic group and  
14 the majority wins, I couldn't get my level to --

15 Q. So you feel that you know more about it  
16 than --

17 MR. BAGGETT: Wait a minute. You just  
18 let him finish, please. I object on the record  
19 to you continuing to interrupt Professor Hammond.

20 MR. SPEARS:

21 Q. Professor Hammond, do you feel like you  
22 know more about the safe level of exposure to  
23 benzene as an individual than the ACGIH itself?

24 A. Very definitely.

25 Q. All right, sir.

1           A.    And not only that, but, see, we have in  
2   our records a letter that I wrote Mr. Wrightman  
3   saying in 1948 we discussed this matter, and I  
4   said that zero level was the only one that was  
5   acceptable unless you put the men -- people under  
6   medical surveillance.

7           Q.    All right, sir.

8           A.    In 1947 I was -- '48 I was discussing and  
9   disagreeing with the TLV.

10          Q.    All right, sir. Now, you had -- you  
11   wrote a paper on how to design a benzene unit,  
12   did you not?

13          A.    I did.

14          Q.    And you're very proud of that paper,  
15   aren't you? You're very proud of that paper,  
16   aren't you?

17          A.    Well, no one had ever written one before.

18          Q.    No, are you very proud of that paper?

19          A.    Well, I'm not apologizing for it.

20          Q.    Okay, sir. All right. And in that paper  
21   that you wrote, did you design that system so that  
22   there would be absolutely zero level of exposure  
23   to benzene for everybody who worked in that --  
24   that unit?

25          A.    So far as practical, we did, but we also

1 said that that's not enough, you've got to have  
2 all of these other comporting programs to go with  
3 it, medical surveillance, urinary phenols and  
4 blood counts and all of those matters had to be  
5 part of the program and had to do that  
6 periodically to find out whether or not you had  
7 everything under control.

8 Q. Right, sir.

9 A. And we published the results after four  
10 or five years of operation and showed you where in  
11 the beginning we had some operations that had more  
12 than we wanted, more than zero.

13 Q. Right.

14 A. And then we got it all worked out, and we  
15 feel very satisfactory that we have no significant  
16 exposures to anyone in that -- in that plant.

17 Q. Well, you know, Professor Hammond, you  
18 used two different terms. And correct me if I'm  
19 wrong, we're talking about -- when I asked you  
20 earlier if you could design and operate a benzene  
21 unit or benzene plant so that there was absolute  
22 zero exposure to individuals, we got off on a  
23 tirade, and I apologize if I started on the  
24 tirade, but my question was, and tell me, it's not  
25 possible, is it, not possible to design and to

1 operate a benzene unit so that there will be zero  
2 level of exposure at all times to all of your  
3 employees, is there?

4 MR. BAGGETT: For the record, before  
5 you answer that, I want to object to the  
6 testifying of counsel, to his sidebar comments  
7 and to his summary of prior testimony which is  
8 objectionable as to form.

9 MR. SPEARS:

10 Q. Okay, sir.

11 A. What was your question?

12 Q. All right, sir. Is it possible, sir, to  
13 design and operate a benzene unit so that there is  
14 zero exposure to the individuals working in that  
15 unit?

16 A. Well, my answer to you is why do we go to  
17 try to -- get to that type of expensive control  
18 when outside the air you have to breathe in this  
19 room and elsewhere contains one or two parts per  
20 million of benzene.

21 Q. We're on the same unit now, sir. Now  
22 we're working together. In other words, everybody  
23 in the world --

24 MR. BAGGETT: I'm going to object to your  
25 comments about where we were, because I don't

1 think you are on the same units, and I can make  
2 that statement, too.

3 MR. SPEARS:

4 Q. Professor Hammond, what I'm saying is  
5 that you cannot design a unit, nor can you operate  
6 a benzene unit which would prevent exposure and  
7 bring it down to zero of benzene from the unit  
8 itself?

9 A. Well, just from a professional  
10 standpoint, how ridiculous would I have looked in  
11 trying to design something where the air that you  
12 have in this room and everywhere else contains  
13 some benzene.

14 Q. All right, sir.

15 A. And I look at the people smoking  
16 cigarettes --

17 Q. Right, sir.

18 A. -- and I know that every puff they take  
19 will have up to a hundred parts per million of  
20 benzene in it.

21 Q. Professor Hammond, you're getting way  
22 ahead of me, but you're absolutely right. As you  
23 face this camera today, every lawyer sitting in  
24 this room and every one of us as we leave here is  
25 going to breathe in a certain amount of benzene

1     because they're in Houston; is that correct?

2             MR. BAGGETT:  Objection to your testimony  
3     instead of a question that was preceded by a  
4     question.

5             A.     I don't know why you'd have to go to  
6     Houston, because if you went up in the hill  
7     country around Kerrville and that area where the  
8     cedar trees are, you'd have more than you would  
9     have in Houston.

10            Q.     All right, sir.  In other words, every  
11     American, every living, breathing American on  
12     this planet who takes a breath is going to have  
13     some exposure to benzene; is that correct?

14            A.     And we have resistance to those types of  
15     concentrations, because over the centuries and all  
16     the people have developed a tolerance to that type  
17     of an exposure.  And so it's not significant, what  
18     you're talking about.

19            Q.     I'm going to ask you again.  Does every  
20     American who lives and breathes on this planet  
21     breathe in benzene as he takes -- he or she takes  
22     a breath, yes or no?

23            A.     Well, they -- I've already answered it.

24            Q.     No, sir, you haven't.

25            A.     That you can't live in an atmosphere

1 that's not some benzene, period.

2 Q. All right.

3 A. I've never heard of it.

4 Q. So when you breathe in, when you take a  
5 breath, you take in benzene; is that correct?

6 A. That requires no professional --

7 Q. I'm asking you; is that correct?

8 A. Well, I'm not going to answer that  
9 question.

10 Q. Well, I'm asking you the answer. When  
11 you breathe in today, are you breathing in benzene  
12 vapors?

13 A. You're not breathing in vapors. You may  
14 be breathing in benzene in some small amount, but  
15 it's not of significance.

16 Q. All right.

17 A. Now, you don't want to add -- what I'm  
18 saying is you do not want to add any amount to  
19 that what you naturally have and you've developed  
20 it.

21 Q. All right, sir, but when you took -- when  
22 you drink water from Houston, the water that we're  
23 drinking here today contains some amount of  
24 benzene, does it not?

25 A. Possibly.

1 Q. You're not aware of that, sir?

2 A. I haven't ever tested the water for  
3 benzene.

4 Q. Do you believe there's any benzene in  
5 the water that you drink in Houston?

6 A. I have no proof of it being there.

7 Q. All right, sir. Now, what's -- what is  
8 the major source of benzene exposure in our  
9 environment today, Professor Hammond, other than  
10 a petrochemical or occupational exposure? What is  
11 it, sir?

12 A. I don't know what -- I never have looked  
13 into that part, that extensive part.

14 Q. It's smoking, isn't it, Professor  
15 Hammond?

16 A. Could be smoking, but also it should be  
17 combustible products from stacks.

18 Q. From stacks or automobiles?

19 A. Well, I imagine that there's some benzene  
20 in that, too.

21 Q. Tell me what you know, sir, about benzene  
22 exposure to someone who smokes.

23 A. Very little.

24 Q. What kind of -- benzene is part of the  
25 chemical that comes off of the smoke in cigarette

1 smoke?

2 A. Yeah, there was experiments that were  
3 carried out at Harvard where -- and discovered  
4 that it would run up to a hundred parts per  
5 million, but I didn't do the tests. I depended  
6 on my teachers to tell me about it.

7 Q. You're aware then of some experiments  
8 dealing with cigarette smoke that indicated there  
9 were a hundred parts per million exposure to the  
10 person smoking the cigarette; is that correct?

11 A. That's right.

12 Q. All right, sir. And, of course,  
13 secondhand smoke, in other words, if someone is  
14 not smoking but in a room with someone who is  
15 smoking, would also be exposed to benzene, would  
16 he not?

17 A. I assume he would.

18 Q. All right, sir. And every day as you and  
19 I drive along the interstate or the highways and  
20 byways of this country, we're exposed to some  
21 benzene coming from the exhaust of the automobile,  
22 are we not?

23 A. I assume we are.

24 Q. Okay, sir. That's true, is it not?

25 A. I'm not saying it's true, because I

1 haven't made the tests.

2 Q. All right, sir. When you or I or  
3 any member of -- John Q. Public goes up to a  
4 self-service station and pumps gasoline, that  
5 person is going to be exposed to some levels of  
6 benzene from the vapors of the gasoline; isn't  
7 that true?

8 A. I assume they would.

9 Q. And you would expect that?

10 A. In a short-term exposure of five minutes  
11 or so OSHA has never seen necessary to put up any  
12 restrictions on self-service stations and never  
13 has set a standard on that --

14 Q. And short --

15 A. -- for combustible engines.

16 Q. I'm sorry.

17 A. Fuel for combustible engines are not  
18 controlled.

19 Q. Right. But short-term exposure to  
20 benzene has never been considered a serious health  
21 hazard, has it?

22 A. How often are these short term occur.  
23 Depends on how often.

24 Q. All right. I'll give you an example.  
25 That's a fair comeback. Someone who would, say,

1 be exposed to benzene in a paint solvent or a  
2 paint thinner as he washed out his brush or  
3 something and his tools and then went back to  
4 work, maybe did that once a week or something  
5 like that or once a month, would you consider  
6 that to be a serious exposure?

7 A. It could be, yeah. I had a secretary  
8 who's father was a barber, and he had decided to  
9 refinish the furniture in his house, and so he  
10 got some solvent that contained, say, 15 percent  
11 benzene, and he died from leukemia and problems  
12 associated with the benzene. That is all he did,  
13 he was just a barber, but he -- his hobby was  
14 refinishing furniture, and he used some benzene  
15 on his -- it's a very hazardous, dangerous  
16 material, and the doctors couldn't tell him what  
17 was wrong until I went and evaluated all the  
18 materials he had used and discovered this  
19 substance.

20 MR. SPEARS: I'll object to the  
21 nonresponsiveness of that.

22 Q. Are you finished? Professor Hammond, are  
23 you finished?

24 A. Yeah.

25 MR. SPEARS: I'll just object to the

1 nonresponsiveness of the question.

2 Q. But does Exxon gasoline products contain  
3 benzene, sir?

4 A. I'm not familiar with the concentrations.  
5 If so, what they are and where they come from,  
6 which ones do and which ones not. I don't know.

7 Q. Well, I know you may not know now,  
8 because you've left Exxon, but surely as a chief  
9 industrial hygienist for Exxon part of your duties  
10 would be to know whether or not Exxon gasoline  
11 contained benzene; is that correct?

12 A. I would recommend that you read on the  
13 pumps of every gasoline station, Exxon, what the  
14 warning is about your health hazards.

15 Q. Well, you didn't put those pumps until  
16 1958, those warnings, did you?

17 A. Was it 1958?

18 Q. Yes, sir.

19 A. You mean 1968 or 1978 or what?

20 Q. When did you first put -- Exxon first put  
21 a warning on the gasoline pumps about the content  
22 of benzene in its gasoline?

23 A. It was after I left there. I don't know  
24 when it was.

25 Q. And you left when?

1 A. '78.

2 Q. Okay, sir. But you were aware while you  
3 were at Exxon that the gasoline products contained  
4 benzene, were you not?

5 A. I was aware that you didn't have any  
6 hazardous operations if you just filled the  
7 gasoline tank occasionally like we do once a  
8 week or once a month or whatever time you have  
9 to buy gasoline.

10 MR. SPEARS: I object again, Professor  
11 Hammond, to the nonresponsiveness of my question.

12 Q. I'm going to ask you again. Were you  
13 aware as chief industrial hygienist of Exxon,  
14 while you were working, that Exxon gasolines  
15 contained some amount of benzene?

16 A. I knew -- I knew they had some amount.

17 Q. All right, sir. Now, why, sir -- while  
18 you were chief industrial hygienist, why did you  
19 not initiate a program to put warnings on the  
20 pumps so that the public would be aware that when  
21 they pumped Exxon gasoline that they might be  
22 exposed to this benzene?

23 A. Well, I didn't have overall authority  
24 throughout the company to do that type of thing.  
25 I just had to protect the employees, and I did,

1 and that was my main job. And so the public also  
2 was under the supervision of the United States  
3 Public Health Service the state health departments  
4 and many other agencies, and they never saw fit to  
5 warn the public about that.

6 Q. Are you saying basically you were worried  
7 about Exxon employees but the public be damned  
8 about the products?

9 A. I didn't say that at all.

10 MR. BAGGETT: I object to your  
11 summarization of what he just said. It speaks  
12 for itself.

13 MR. SPEARS:

14 Q. Well, Professor Hammond, were you --  
15 did you feel that the public who was pumping Exxon  
16 products into their pump would or would not be  
17 exposed to some amount of benzene?

18 A. That's not a clear question.

19 Q. All right. While you were chief  
20 industrial hygienist at Exxon, we've already  
21 established that you were aware that the Exxon  
22 gasolines contained some amounts of benzenes.  
23 You knew that?

24 A. Right.

25 Q. And you knew that that gasoline --

1 A. Trace.

2 Q. -- was going out to the public and was  
3 being pumped into cars as self-service gasolines,  
4 true?

5 A. I brought it myself.

6 Q. All right, sir. All right.

7 A. I was not under any concern about my  
8 health from buying it to go in my car and using  
9 it at the -- at self service in my car.

10 Q. Did you feel that any person in the  
11 public should have a right to know and determine  
12 whether he or she wants to pump that gas, should  
13 know that there's benzene in that gasoline?

14 A. Well, that wasn't my duty to make that  
15 type of decision about the public.

16 Q. Well, whose duty was it?

17 A. The health department and the states and  
18 the EPA and others.

19 Q. But it was Exxon products, Professor  
20 Hammond.

21 A. Yeah, I know.

22 Q. Are you saying that if Exxon products  
23 were hazardous and they went out into --

24 A. I didn't say they were hazardous. I  
25 would say that if you went to the Exxon pump

1 you've got less likely to have benzene in it  
2 than the other pump across the street.

3 Q. Why is that, sir?

4 A. Because we extracted all of our benzene  
5 we possibly could get and sold it as benzene in  
6 concentrated form rather than letting it get in  
7 gasoline which sold for much cheaper. For  
8 example, one time we could get \$2 a gallon for  
9 benzene, and we could only get 20 cents for the  
10 gasoline. Why should we let that go out if  
11 there's any amount of benzene in it?

12 Q. Isn't it true that the benzene content of  
13 Exxon gasoline increased precipitously when the  
14 lead was taken out of gasoline?

15 A. That was all after I left. I do not know  
16 that.

17 Q. Okay. I don't want to talk about what  
18 Exxon did or didn't do after you left, Professor  
19 Hammond.

20 A. That's right.

21 Q. I just want to talk to you about what you  
22 did and what your duties and responsibilities were  
23 at Exxon.

24 A. Well, let's talk about Exxon employees  
25 and what I did to protect them.

1 Q. Professor Hammond, we're not going to --  
2 we're never going to get out of here if you start  
3 asking questions and directing this. You let me  
4 ask the questions, please. If you want to take a  
5 break, I'll be happy to give you a break, but  
6 we're not going to get anywhere if you start  
7 trying to tell me what I should ask. Okay, sir?

8 MR. BAGGETT: I'm going to object to your  
9 comments.

10 A. I didn't say you didn't have that right,  
11 but I just said my duties were to protect the  
12 employees of Humble and Exxon, and I did a good  
13 job, and I dare anyone to show me where I failed.

14 Q. Did your duties also include protecting  
15 people who went into your refinery who were not  
16 your employees?

17 A. I don't know what you mean. You mean a  
18 salesman go to the office?

19 Q. Well, we're going to start off with your  
20 duty was to protect Exxon employees. I understand  
21 that. My question is, was it also your duty to  
22 protect the safety and health of anybody who went  
23 into your refinery?

24 A. No, it wasn't.

25 Q. It was not part of your duties, sir?

1           A.     Not -- not my duties. I know we've  
2     been -- you're talking about people bringing  
3     suits, I'll tell you, a salesman came into our --

4           MR. SPEARS: Professor Hammond, I'm going  
5     to object again. This is nonresponsive.

6           A.     Well, I have to explain to you --

7           MR. SPEARS:

8           Q.     I'm not talking about --

9           A.     -- so we can confine ourselves to the  
10    problems I was responsible for.

11          MR. SPEARS: I'm going to object to the  
12    responsiveness of the question. Go ahead, sir.

13          A.     And this salesman came in maybe once a  
14    month, maybe once every few months and went to  
15    the purchasing department, and he came back and  
16    brought a suit against us for having exposed him  
17    to some condition in the refinery.

18          Q.     Okay. Professor Hammond, what do you  
19    envision or what did you envision your duty as  
20    chief industrial hygienist for Exxon was to, say,  
21    contract workers who worked in your refinery?  
22    They were not Exxon employees, but they were  
23    contract workers. What duty did you have to  
24    protect them from toxic substances?

25          MR. BAGGETT: You're asking him what he

1 considered. Of course, the duty is a question of  
2 the law --

3 MR. SPEARS: Yeah, I'm asking his duty.

4 MR. BAGGETT: -- in all of this.

5 MR. SPEARS: Right.

6 Q. What duty did you have, Professor  
7 Hammond, to protect contract workers from exposure  
8 to toxic substances if they worked in the Exxon  
9 refinery?

10 A. That -- that's not a pertinent question  
11 in my profession.

12 MR. BAGGETT: It may -- it may be more  
13 relevant, and I object to you asking him what  
14 was his duty. You may think it would be more  
15 appropriate to ask him what he did in the  
16 performance of his work.

17 MR. SPEARS: Well, Bill, you certainly  
18 can ask him the question if you want to.

19 Q. But you were chief industrial hygienist  
20 for Exxon; is that correct?

21 A. You said that a dozen times.

22 Q. Right. And as chief --

23 A. I don't disagree with you.

24 Q. And you had a duty and that job to  
25 protect the employees of Exxon to make sure

1 that they didn't come into contact with toxic  
2 substances or certain levels of toxic substances;  
3 is that correct?

4 A. That's my duty.

5 Q. All right, sir. Now --

6 A. Let's leave it at that.

7 Q. No, I'm not, sir. What was your duty in  
8 regard to a contract worker who was working side  
9 by side with the Exxon employee?

10 A. They had to comply with all of our rules.  
11 The -- I'm just telling you what we did, I'm not  
12 saying my duty, but I'm saying that they had to  
13 comply with all the regulations in regard to  
14 control as far as exposure that any of our  
15 employees had.

16 Q. All right, sir.

17 A. And our safety inspectors were there on  
18 the job, and if a contractor was going into an  
19 area where our people needed protection, extra  
20 protection, we took them into the classroom and  
21 explained to them what they had to do and what  
22 they had to wear and how they had to perform.  
23 And also our employees made sure that they didn't  
24 do anything differently that would expose them  
25 without warning.

1 Q. Did you -- as chief industrial hygienist  
2 for Exxon, did you or were you aware of any  
3 program that Exxon had in place while you were  
4 there to monitor -- medically monitor contract  
5 workers?

6 A. Not regularly, no.

7 Q. I'm sorry?

8 A. No, because we had employees -- the  
9 contract worker come in and maybe work for us for  
10 a few months, but we had the employees doing the  
11 same job we let them do that worked there 40 years  
12 without any problem. Why should we worry about a  
13 person who wasn't overexposed more than our own  
14 employees, should be worried about him working a  
15 week or day or ten days or so.

16 Q. Okay. All right. So -- and maybe I got  
17 this in a roundabout way -- what you're saying  
18 is that any of your employees who worked in the  
19 refinery on a regular basis and were not  
20 monitored, medically monitored, because of  
21 their job, then you didn't do any more when the  
22 contractor came in to do that same type of job?

23 A. We just saw that this contract worker  
24 didn't violate our regulations and rules over  
25 doing it. If he did, he didn't stay in there very

1 long. He was dismissed.

2 Q. Did you, as chief industrial hygienist  
3 for Exxon, or at any time while you were there,  
4 did Exxon implement any type of program, random  
5 checking -- for lack of a better description, I'm  
6 going to call random checking of contract workers  
7 to see if maybe they had been exposed to some  
8 products and, you know, phenol testing of some  
9 sort like that? Did you do anything like that?

10 A. We didn't have to do that.

11 Q. Why is that?

12 A. Because we had workers that we were  
13 checking regularly, and we found they had no  
14 exposure, and if the contractor helper would  
15 help working with our people and doing the same  
16 job, they had no chance of being exposed doing  
17 that.

18 Q. Okay, sir. All right. And so if an  
19 individual -- if an individual like Mr. Hebert,  
20 Joseph Hebert, pulled up to your dock at Exxon  
21 and just so happened that it was his shift change,  
22 and he walked through the refinery with his wife  
23 or drove through the refinery to go back home,  
24 would you monitor those types of people?

25 A. Why would I do?

1 Q. All right. Would you expect them to be  
2 exposed to any levels of chemicals that need  
3 monitoring?

4 A. How could they be when our own people  
5 were there 24 hours a day and never had any  
6 exposure?

7 Q. Okay, sir. At the docks?

8 A. Wherever you're talking about Exxon  
9 people work.

10 Q. Okay.

11 A. You pick out your place.

12 Q. Okay, sir. The literature --

13 A. My time's about up for you now, I'm  
14 telling you. I don't usually stay on deposition  
15 longer than four hours at each -- at a time.

16 Q. Well, Professor Hammond --

17 A. Do you want to come back tomorrow?

18 Q. -- I want you to know -- no, sir, I don't  
19 want to come back tomorrow, and I want you to know  
20 in all honesty and candor to you, sir, there was  
21 never represented to me that there was going to be  
22 a time limit on this deposition. If it was  
23 represented to you, it wasn't represented to me.

24 MR. BAGGETT: Then I've let -- I've let  
25 the professor down, because he asked me to do that

1 before we started, and I thought that there was no  
2 way that we'd be here over four hours and I should  
3 have let you know at the half --

4 THE WITNESS: If you want to come back  
5 tomorrow, I'll be glad to --

6 MR. SPEARS: No, sir.

7 THE WITNESS: -- come back and discuss  
8 these matters with you.

9 MR. BAGGETT: Well, we'll see. How far  
10 are we along?

11 MR. SPEARS: I just want to go over some  
12 of his testimony in the Skeen case and a couple of  
13 others, and then I'll be finished with him.

14 THE WITNESS: What about the other  
15 people?

16 MR. MYERS: I don't expect to be more  
17 than about 20 minutes.

18 MR. FREEMAN: I've got probably 20  
19 minutes, 30 minutes maybe.

20 THE WITNESS: Well, let's have a little  
21 lunch. Can we?

22 MR. SPEARS: Sure.

23 THE WITNESS: Because it's 2 o'clock.

24 VIDEOGRAPHER: End of tape No. 2, we're  
25 off the record. It's about 2 o'clock.

1 [Recess]

2 MR. SPEARS: The parties have agreed  
3 that --

4 MR. BAGGETT: Wait a minute. While we're  
5 all here, I want us to agree when to continue it.

6 MR. SPEARS: I don't have any calendar  
7 here now, Bill. I can't give you that. I mean,  
8 if I give you a date, I swear I don't have any  
9 calendar with me, so --

10 MR. FREEMAN: I wouldn't be adverse to  
11 doing it on a Saturday.

12 MR. SPEARS: No, no more Saturdays.

13 MR. BAGGETT: All I want is an agreement  
14 that we will do it within the next 30 days.

15 MR. SPEARS: No problem.

16 MR. MYERS: That's an agreement. I will  
17 agree to that.

18 MR. SPEARS: We will do this again within  
19 30 days. Mr. Baggett will contact Professor  
20 Hammond and will arrange a convenient time and  
21 place to do it. Meanwhile, the deposition is  
22 recessed.

23 -----

24

25

SIGNATURE OF WITNESS

I, Professor James Hammond, solemnly swear or affirm, under the pains and penalties of perjury, that the foregoing contains a true and correct transcript of the testimony given by me at the time and place stated, with changes, if any, and the reasons therefor noted on a separate sheet of paper and attached hereto, and that I am signing this before a Notary Public.

-----  
Professor James Hammond

THE STATE OF TEXAS]

Subscribed and sworn or affirmed to before me, the undersigned authority, by Professor James Hammond on this the \_\_\_\_ day of

\_\_\_\_\_, \_\_\_\_.

-----  
Notary Public in and for  
the State of Texas

1 STATE OF TEXAS]

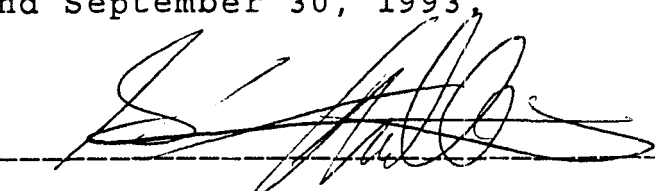
2  
3 COURT REPORTER'S CERTIFICATE

4  
5 I, Shawn Kelley, a Certified Shorthand  
6 Reporter within and for the State of Texas, hereby  
7 certify that the foregoing proceedings occurred  
8 before me.

9 I further certify that the foregoing is  
10 a true and correct copy of the transcript of the  
11 proceedings to the best of my ability.

12 I further certify that I am neither  
13 attorney for, related to nor employed by any of  
14 the parties or any attorney of record in this  
15 cause, nor do I have a financial interest in the  
16 matter.

17 Witness my hand September 30, 1993,

18  
19   
20 Shawn Kelley, Texas CSR 3448\*

21 Nell McCallum & Associates

22 2900 Smith, Suite 104

23 Houston, Texas 77006

24 (713) 523-3767

25 \*My Certificate Expires January 1, 1995

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Hammond Deposition

Volume 2

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| JOSEPH L. HEBERT AND | ] | 14TH JUDICIAL DISTRICT COU |
| MARIE HEBERT         | ] |                            |
| V.                   | ] | PARISH OF CALCASIEU        |
| HIGMAN BARGE LINES,  | ] |                            |
| ET AL.               | ] | STATE OF LOUISIANA         |

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VIDEOTAPE DEPOSITION OF  
**PROFESSOR JAMES HAMMOND**  
VOLUME 2

November 18, 1993

Between the hours of 10:00 AM and 2:00 PM

Houston Airport Marriott Hotel

Houston, Texas

Wanda G. Kelley, Court Reporter

Nell McCallum & Associates Inc.

2900 Smith, Suite 104

Houston, Texas 77006

(713) 523-3767

JAN 13 1994

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WANDA G. KELLEY, CSR  
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Marathon Oil Company, Mobil Oil Corporation,  
Monsanto Company, Phillips Petroleum Company,  
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Phil Shedd - Videographer

1 MR. BAGGETT: Gentlemen, by agreement --  
2 this is a different date, and by agreement, is it  
3 understood that this is a continuation of the  
4 previous deposition taken -- started on September  
5 27th, '93, and that the same stipulation pertains to  
6 this continuation?

7 MR. MYERS: Agreed.

8 MR. SPEARS: It's agreed.

9 MR. FREEMAN: Yes.

10 MR. BAGGETT: And all parties are  
11 represented that were here at the previous  
12 deposition.

13 MR. SPEARS: That's correct.

14 MR. BAGGETT: Only thing that I would say,  
15 representing the plaintiff Joseph Hebert and  
16 presenting Professor Hammond to you or having taken  
17 his deposition, is that I reiterate our position of  
18 the previous tender that we made, acknowledge that  
19 he is not a medical doctor, that he's not an  
20 epidemiologist, that he's not a toxicologist, he's  
21 not a hematologist, that the purpose of his  
22 testimony was to present state-of-the-art evidence  
23 concerning what was known and knowable about benzene  
24 and when it was known and knowable.

25 VIDEOGRAPHER: On the record, 10:12.

1 THE WITNESS: I'll have a chance to review  
2 all of this, will I?

3 MR. BAGGETT: Yes. The original he has not  
4 had a chance to review, but he did catch one error  
5 that I want to call to your attention. And it's an  
6 error apparently in the typing where they typed  
7 millions instead of billions. And it was on page --  
8 I think it was on page 156 of the -- and you may  
9 want to look at that, where he was talking about  
10 ambient air, they made a mistake of putting per  
11 million when it was per billion, b i l l i o n.

12 MR. FREEMAN: I don't see it on 156.

13 MR. BAGGETT: It's on page 156. On line  
14 19, page 156 of his original transcript. Otherwise,  
15 I will submit the entire deposition to him for  
16 reading and signing. It hasn't been done as yet.

17

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19

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25

1                   PROFESSOR JAMES HAMMOND,  
2                   being previously duly sworn, continued to  
3                   testify as follows:  
4  
5

6                   EXAMINATION BY MR. SPEARS  
7

8                   Q       Professor Hammond, just continuing in my  
9                   line of questioning, I've got a few questions I want  
10                  to ask you to follow up, please, and then I'll  
11                  tender you to these other lawyers here.

12                  Can you tell me, what is an MSDS sheet? If  
13                  you're familiar with that terminology.

14                  A       Material -- material data safety -- it is a  
15                  material safety data sheet pertaining to the health  
16                  and safety hazards of product.

17                  Q       All right, sir. On the MSDS sheet, what  
18                  kind of information is usually contained therein?

19                  A       Information, data, is what the chemical and  
20                  physical properties and characteristics of a  
21                  substance, and then it deals with the problems  
22                  associated with safety, handling and use of the  
23                  material from the standpoint of fire and combustible  
24                  qualities. And then it has the health aspects as  
25                  far as chronic and acute exposure, concentrations

1 that would be important.

2 Q All right, sir. And an MSDS sheet is  
3 usually sent out when?

4 A It's generally sent out in the time of when  
5 a customer expresses an interest in the product, and  
6 it goes along with other pertinent sales information  
7 dealing with the cost and so forth. But it goes out  
8 early to the customer.

9 Q All right, sir. In your work experience  
10 working for Exxon, did Exxon utilize MSDS sheets?

11 A We had our own, yes, we did, and we started  
12 this before it became a legal requirement.

13 Q All right, sir. And you've previously  
14 testified, and I won't go back over that, but you  
15 previously testified when you started work for  
16 Exxon. But my question to you, sir, is when you  
17 started work for Exxon, at that point in time was  
18 Exxon utilizing an MSDS sheet or anything similar to  
19 that?

20 A I'm trying to remember. Yes, there were  
21 sheets that were already prepared and available when  
22 I arrived in 1947.

23 Q All right, sir. Did you -- in your  
24 capacity as an industrial hygienist for Exxon, did  
25 you take part in creating additional MSDS sheets or

1 updating the MSDS sheets that presently existed at  
2 the time that you came to work for Exxon?

3 A Yes, I did. I was chairman of that  
4 committee that was responsible for those sheets.

5 Q All right, sir. Did you -- when I said  
6 "you," I meant Exxon. Did Exxon send out an MSDS  
7 sheet for all of the products that it sold in the  
8 stream of commerce while you were employed at  
9 Exxon?

10 A That's too broad for me to tell you that we  
11 did but we tried to get them all and I'm not aware  
12 of any omissions that we had.

13 Q All right, sir. For example, take benzene,  
14 for example. At some point in time Exxon sold  
15 benzene -- and benzene we're talking about is pure  
16 benzene -- to various customers. Is that correct?

17 A Not in small containers that would be of  
18 consumer product, no.

19 Q All right, sir. And I didn't mean to limit  
20 it to small containers, Professor Hammond. At some  
21 point in time, did Exxon sell benzene to other oil  
22 companies or industrial customers in large volumes?

23 A We did.

24 Q All right, sir. And at what point in time,  
25 to the best of your recollection, did Exxon begin

1 selling these large volumes of benzene to industrial  
2 customers?

3 A At the completion of our benzene extraction  
4 plant, and that was in the early parts of 1950, we  
5 began to sell the products.

6 Q All right, sir. Immediately upon selling  
7 this large volume of benzene to industrial  
8 customers, did Exxon also accompany those shipments  
9 with what we talked about earlier, MSDS sheets?

10 A The MSDS sheets were not appropriate  
11 because these went out in volumes, such as pipeline  
12 operations, and there were letters in all of the  
13 pertinent materials that we knew about from a health  
14 standpoint sent along with that, early letters  
15 before we sold any of these products to the  
16 customer.

17 Q And I'm confused, Professor Hammond, and  
18 perhaps it's the awkward way I've asked the  
19 question. And clarify for me, will you. When Exxon  
20 sold -- and I'm just using an example. If Exxon  
21 sold benzene through a pipeline to, say, Shell, for  
22 lack of a better word, would Exxon send an MSDS  
23 sheet to Shell or any of its customers at some point  
24 in time after the sale of the benzene even if it was  
25 transported in pipeline?

1           A       We did that beforehand. Whenever they  
2       inquired as to availability of benzene or interest  
3       in purchasing benzene, we generally had a very close  
4       conference with them and shipped it to them with  
5       their full understanding of all the hazards and how  
6       to use it.

7           Q       Okay, sir. Are you telling me -- and I  
8       don't want to put words in your mouth, but you tell  
9       me if I'm wrong here. Are you saying that when  
10      Exxon sold benzene to industrial customers that they  
11      did not always send what is known as an MSDS sheet  
12      to those industrial customers? Is that correct?

13          A       No, that's not right.

14          Q       All right, sir.

15          A       We included the material safety data sheets  
16      along with it, but that was not sufficient selling  
17      benzene. We generally had to have a one-to-one  
18      customer contact with us as the seller, by oral and  
19      telephone and letters, and we were very careful not  
20      to sell it to anyone who didn't understand all the  
21      hazards and being capable to adopt the measures that  
22      needed to be made.

23          Q       Okay, sir. Well, then the opposite would  
24      be true, then, so that when you did sell benzene,  
25      pure benzene to industrial customers, is it your

1 testimony that Exxon always sent out an MSDS sheet  
2 along with other letters to those industrial  
3 customers?

4 A The material safety data sheets was just  
5 part of the whole package that we sent to them and  
6 did not reflect the conferences we had with them,  
7 and we were very careful not to sell to anyone that  
8 didn't have the knowledge, the technical and medical  
9 knowledge, industrial hygiene knowledge to be able  
10 to handle it safely.

11 Q All right, sir. But if we can limit it  
12 just to the MSDS sheet, an MSDS sheet from Exxon  
13 always went to the customers of Exxon who were  
14 buying benzene in large volumes? Is that correct?

15 A There were also -- in addition to the  
16 MSDS sheets, there were also the precautionary  
17 labeling that went along to them, and it covered the  
18 same area but not as much in detail as we felt was  
19 necessary, so we always had to have either telephone  
20 or personal conferences with them or send them  
21 additional letters and materials.

22 VIDEOGRAPHER: We need to go off the record  
23 for a second. Off the record 10:24.

24 [Recess]

25 VIDEOGRAPHER: On the record, 10:40.

1 MR. SPEARS:

2 Q Professor Hammond, I was asking you about  
3 an MSDS sheet. And I don't want to belabor the  
4 point here, but what I would like -- and I certainly  
5 don't want to be argumentative with you. But if  
6 it's possible, if you can give me a yes or no answer  
7 to my question, if it's possible I would ask that  
8 you please do that. You have a right to explain it,  
9 but if you can give me a yes or no answer to this  
10 question, I would appreciate it. And what I'm  
11 asking you is: Yes or no, did Exxon send out an  
12 MSDS sheet to all of the customers who purchased  
13 benzene during your time at Exxon?

14 A Yes, they did. If someone missed it, it  
15 was purely by accident and some problem that I  
16 wouldn't know about.

17 Q All right, sir. And your knowledge of  
18 benzene, Professor Hammond, and the dangers of  
19 benzene, have you learned anything in the last few  
20 years that you didn't already know?

21 A I'm not aware of anything that was  
22 pertinent to the control and use of benzene.

23 Q All right, sir. Did -- who made the  
24 decision at Exxon -- and if it was one person or a  
25 committee, I would like for you to tell me. Who

1 made the decision to either send out an MSDS sheet  
2 or not send out an MSDS sheet, depending upon the  
3 product that was being sold? In other words, who  
4 made the decision whether an MSDS sheet was  
5 appropriate for a particular product that Exxon was  
6 marketing?

7 A That would be too wide because we were  
8 involved with several hundreds of people,  
9 salespeople, and if someone should violate the rules  
10 of the standard, I wouldn't know about it for that  
11 particular person and that product.

12 Q All right, sir. Is it safe to say that at  
13 least while you were working for Exxon, the company  
14 always sent out an MSDS sheet accompanying a product  
15 that you thought the customer needed to be aware of  
16 about the dangers and health hazards and stuff?

17 A That was a company-wide policy and we did  
18 that and if there was any violation it was a  
19 violation and not known to the company itself.

20 Q All right, sir. Let me ask you, among some  
21 of the products that Exxon sold to various  
22 industrial customers, was crude oil a product that  
23 Exxon sold?

24 A I'm not in a position to answer you about  
25 that. That was already established before I came,

1 and it was handled by the marketing department early  
2 on and I wouldn't know.

3 Q How long did you work for Exxon, Professor  
4 Hammond?

5 A From April of 1947 until February 1978.

6 Q And it's your sworn testimony today that  
7 during that time frame that you worked for Exxon you  
8 were not aware of the fact that Exxon was selling  
9 crude oil?

10 A No, you misstated me. I didn't say they  
11 didn't sell it. They had their customers long  
12 before I came; and what they told them in the  
13 beginning, I couldn't answer it for you.

14 Q Yes, sir. Professor Hammond, what I want  
15 to know, sir, is while you were working for Exxon,  
16 between the time you went to work and the time that  
17 you retired, were you, Professor James Hammond,  
18 aware of the fact that Exxon was selling crude oil  
19 to various customers?

20 A Yes, I was.

21 Q All right, sir. Did Exxon send out an MSDS  
22 sheet to the various customers who purchased Exxon  
23 crude oil?

24 A Not that I'm responsible for. I did not  
25 prepare one.

1 Q All right, sir. If an MSDS sheet would  
2 have accompanied a sale of a product, an Exxon  
3 product, would you have had any input on how that  
4 MSDS sheet was phrased, during your time frame with  
5 Exxon?

6 A Yes, but I don't know of any situation  
7 where that might have occurred.

8 Q While you were working for Exxon, sir,  
9 between the time that you went to work there and the  
10 time that you retired, were you aware of any need to  
11 send out an MSDS sheet with a crude oil shipment?

12 A No, not any particular shipment  
13 specifically, I would not have been aware of that.

14 Q All right, sir. It's true, is it not,  
15 Professor Hammond, that crude oil contains some  
16 trace of benzene? Is that correct?

17 A That, I'm not able to answer, no, because  
18 there is such a wide variation in the fields in  
19 which crude oils are produced, it's not practical  
20 for me to tell you as a firsthand knowledge of just  
21 how much and where it was. I didn't look into that  
22 part for any particular customer.

23 Q Professor Hammond, maybe I misphrased my  
24 question. I wasn't asking you to be specific about  
25 the percent, the trace percent of benzene in various

1 crude oil products coming from various fields. I  
2 was just asking you, based on your knowledge and  
3 your experience while working for Exxon, were you  
4 aware that crude oil contained a trace amount of  
5 benzene in general?

6 A Yes, I know most crude oils have trace  
7 amounts of benzene as well as many other.

8 Q All right, sir. How did Exxon ship its  
9 crude oil to various customers, Professor Hammond?  
10 Was it by pipeline, barge, or both?

11 A Yes, by all means. Much of the crude oil  
12 was brought from overseas in tankers.

13 Q All right, sir. Would it also mean that  
14 there were times when Exxon employees in various job  
15 classifications would be called upon to handle the  
16 transportation of Exxon crude oil?

17 A Yes, there would have been those occasions.

18 Q All right, sir. While you were working for  
19 Exxon, did you ever feel that your employees who  
20 were engaged in the transportation of crude oil,  
21 Exxon crude oil, were being exposed to levels of  
22 benzene that could be considered as a health  
23 hazard?

24 A No, because we measured the operations, and  
25 we knew what they were handling, our employees, and

1 we protected them.

2 Q All right, sir. The employee for Exxon who  
3 was driving a tanker truck during your watch while  
4 you were working for Exxon, the employee who was  
5 driving a tanker truck just loaded with crude oil  
6 and nothing else, what safety measures did Exxon  
7 take to protect that employee, if any, from exposure  
8 to the crude oil?

9 A I cannot answer you, no, I do not know.

10 Q Would that be something that was part of  
11 your job, Professor Hammond, to know what rules and  
12 regulations were being implemented by Exxon to  
13 protect the health and safety of its employees?

14 A No. That individual tank driver and his  
15 knowledge of the crude oil would not have come to my  
16 attention.

17 Q All right, sir. My question, sir, was:  
18 How would the driver of the tank truck who was  
19 hauling Exxon crude oil, how would he be informed by  
20 Exxon, if at all, that the crude oil which he was  
21 transporting carried some percent of benzene?

22 A No, I wouldn't have had that type of  
23 intimate knowledge of the driver and his load.

24 Q Well, did Exxon make it a policy -- while  
25 you were working for Exxon, did they make it a

1 policy to notify all of their drivers who were  
2 transporting crude oil products of the fact that  
3 there was some trace amount of benzene in the  
4 crude?

5 A No, not to my knowledge, I do not know.

6 Q All right, sir. The individuals who were  
7 handling the transportation of crude on barges for  
8 Exxon, what information, if any, would be conveyed  
9 to those Exxon employees who were handling crude oil  
10 for Exxon on barges about the fact that the crude  
11 may have some trace amounts of benzene?

12 A It was covered by our policy that all of  
13 the employees associated with dock operations,  
14 including barges and tankers and so forth, were  
15 under the medical surveillance program all the time.

16 Q All right, sir. And I gather that the  
17 drivers of the tank trucks who were carrying crude  
18 oil were not under a medical surveillance program  
19 similar to the one that you had for the dock  
20 workers. Is that correct?

21 A No, not to my knowledge. However, their  
22 truck drivers all were subject to periodic physical  
23 examinations to determine if they had any changes.  
24 It would have been indicated that they were being  
25 exposed.

1           Q       Are you saying that all of the Exxon truck  
2 drivers who transported crude oil were periodically  
3 tested for exposure to benzene?

4           A       They had medical examinations that did  
5 cover the blood picture, and any changes in the  
6 blood picture would have been detected for them.

7           Q       Professor Hammond, throughout your  
8 career -- and it's been a very distinguished career,  
9 and I agree -- throughout your career with Exxon,  
10 were you aware of any literature indicating that a  
11 person could contract a leukemia because of exposure  
12 to trace amounts of benzene?

13          A       I cannot answer, no, I cannot answer you  
14 positively.

15                 MR. BAGGETT: Unless you define trace  
16 amounts. And I think you do need to define that,  
17 for that question to have any relevancy. If it's  
18 synonymous with low dosage exposure, then it becomes  
19 relevant in '48 or earlier. So I'm saying that  
20 you've got to define that, for it to be relevant.

21                 MR. SPEARS:

22          Q       Professor Hammond, did you understand my  
23 question?

24          A       No, I did not. I don't know what you mean  
25 by trace amounts, nor the condition in which the

1 worker was working. I do know that they were all  
2 under medical surveillance for any changes that  
3 would have been significant for that product,  
4 benzene, or for any other chemical that they might  
5 be handling.

6 Q Professor Hammond, have you yourself ever  
7 used the word trace amount of benzene in any  
8 testimony, in any deposition?

9 A I may have, and that would be referring to  
10 materials that were less than one part per million  
11 or less than detectable amounts.

12 Q Do you consider the amount of benzene in  
13 crude oil that Exxon marketed to be trace amounts of  
14 benzene?

15 A I cannot answer that, no.

16 Q Would that be something that was within  
17 your job classification to know whether there was --  
18 what percent of benzene was in Exxon crude?

19 A No, it surely would not have been because  
20 of the thousands of sources of the crude oil and  
21 including overseas operations.

22 Q Well, Professor Hammond, you stated earlier  
23 in your deposition that you never considered any  
24 level of benzene exposure as being safe. Is that  
25 correct?

1           A       That's true, zero for everybody because of  
2 susceptibility. But you can collect those people,  
3 identify those people easily by a good program,  
4 medical surveillance, every annual examinations.

5           Q       My question was: If you felt, while you  
6 were working for Exxon, that there was no safe  
7 amount of exposure to benzene except zero, are you  
8 telling the court today that you were not aware of  
9 the percent of benzene in the various Exxon crudes  
10 that was being marketed by Exxon?

11          A       Yes, I would want the court, the jury, to  
12 understand that we didn't take any chances on  
13 letting crude or any other product be handled by our  
14 employees without knowing its effect upon them, and  
15 we could detect that because we had a good medical  
16 surveillance program that was ongoing with all of  
17 these employees.

18          Q       Well, what percent -- don't you need to  
19 know the percent of benzene in crude in order to  
20 make a reasonable determination of whether that  
21 percent of benzene constitutes a health hazard,  
22 Professor?

23          A       No, you do not. You have to be backed up  
24 by the medical surveillance examinations that would  
25 detect any sign of benzene exposure and to warn you

1 because of the thousands of different locations of  
2 fields and different composition of the crude oil  
3 you might run into.

4 Q So it's your testimony as a chief  
5 industrial hygienist for Exxon, you were not  
6 concerned with the various percents of benzene in  
7 crude oil? It didn't concern you to even know  
8 whether it contained a certain percent or not?

9 A I would restate, my position was to protect  
10 all employees from exposures that would be  
11 significant. And the way that I had, the method of  
12 detecting that was by the physical examinations that  
13 were being performed on these individuals every year  
14 as to whether or not there was any blood changes  
15 that could be associated with benzene. That would  
16 be the practical and only way you could really set  
17 up a program as I set up to handle the protection of  
18 the employees.

19 Q Professor Hammond, tell me if I'm stating  
20 this awkwardly. And if I am, I'll try to rephrase  
21 it. My question to you is: In order to determine  
22 if a product constitutes a health hazard -- and I'm  
23 talking about an Exxon product -- isn't the first  
24 thing you have to know is what percent of benzene is  
25 in that product before you can determine if it is or

1 is not a health hazard?

2 A Yes, you are talking about products that we  
3 would be selling to the public or to the market. We  
4 analyzed every potential material, that would go  
5 out, for benzene concentration. And there must be  
6 25 or 30 of those, and we tabulated that in terms of  
7 the quantity of benzene in them, and that was mailed  
8 out with our material safety data sheet. And I  
9 thought possibly you already have a copy in your  
10 files. I would hope you might have.

11 Q Okay. Professor Hammond, while you were  
12 working for Exxon, did you ever consider the percent  
13 of benzene in Exxon crude to be of any concern from  
14 a health and safety standpoint?

15 A No, because there is no safe concentration  
16 of benzene that you can handle in the field without  
17 control; and you have to be able to detect the  
18 employees, whether or not they are being exposed, by  
19 some other means than going out and sampling every  
20 batch of crude oil that you might be shipping. And  
21 if you don't have that types of means of medical  
22 surveillance, you really are not meeting your  
23 requirements of protection of the employees. We did  
24 have that program established and we worked at it  
25 very earnestly and very hard and as a result we

1 never had any problems with benzene.

2 Q Did Exxon do blood tests on all of the  
3 employees of Exxon, every single one of them, every  
4 year?

5 A Not every single one. If they were young  
6 and had no potential exposure to chemical products  
7 of any nature of that type, we didn't do that, but  
8 about once every three years we would give the  
9 physical. But all the people who were handling  
10 products that you have enumerated here would be  
11 under that program at least once a year.

12 Q It's your testimony today that all of the  
13 Exxon employees who handled the transportation of  
14 Exxon crude oil products regularly took blood tests  
15 as part of their physical?

16 A They did.

17 Q All right, sir. At what percent -- and I'm  
18 going to use Exxon crude for an example. At what  
19 percent do you consider the benzene content to be  
20 trace amounts, if we're talking about Exxon crude?

21 A Anything above zero.

22 Q All right, sir. So you're saying that any  
23 benzene content at all in crude oil products  
24 constitutes a trace amount?

25 A I did not say that. Anything above zero in

1 the crude, and there may be products of crude oil  
2 that do not have any benzene in them.

3 Q Are you saying that Exxon had crude oil  
4 products -- we're talking about crude oil. I  
5 misspoke. Did Exxon have crude oil in its process  
6 that contained no benzene at all?

7 A I do not know.

8 Q The term Toxigram has come up a few times,  
9 Professor. What is a Toxigram?

10 A That was a name we gave to our  
11 precautionary labeling sheet and where we explained  
12 the reasons for the cautions that need to be taken  
13 in handling a product or need to be made aware to  
14 the customer or to the employee to protect them.

15 Q What's the difference -- and tell me if  
16 there is a difference -- between an MSDS sheet Exxon  
17 and a Toxigram Exxon?

18 A The sheet is really described legally by  
19 the federal, state people, and that just briefly  
20 outlines the particular characteristics of a product  
21 that would cause you to be safety conscious or  
22 healthwise concerned about their product, but it  
23 doesn't tell you anything more than the very  
24 basics. Whereas, the material safety -- our  
25 Toxigram went into full details to disclose all that

1 were known, in a very brief summary, of the  
2 hazardous nature of the material and how to protect  
3 it and how to prevent it and much else.

4 Q Can you tell me what point in time the  
5 Exxon Toxigram appeared in correlation with the  
6 Exxon MSDS sheet? Which one came first?

7 A The precautionary labeling came first.

8 Q That would be the Toxigram?

9 A And that would -- and the Toxigram became  
10 available about 1951 or '2 --

11 Q All right, sir. So the MSDS --

12 A -- to my knowledge.

13 Q The MSDS sheet came first, and then the  
14 Toxigram came about in the Fifties?

15 A Early Fifties, yes.

16 Q All right, sir. Professor, as part of your  
17 job description as an industrial hygienist, is it  
18 fair to say that you try to keep up with the  
19 literature dealing with health hazards in the  
20 industry?

21 A Yes. And I don't know what particular  
22 health hazards you're looking for.

23 Q I didn't try to make it too broad, and I  
24 apologize if I did, Professor. I was saying that in  
25 your job capacity as chief industrial hygienist for

1 Exxon, did you feel it part of your job duties to  
2 keep up with the medical literature in general  
3 dealing with health and safety hazards in the  
4 petroleum industry?

5 A I did.

6 Q All right, sir. Are you aware of any study  
7 written by any individual indicating that a person  
8 who handles crude oil, in the transportation of  
9 crude oil, is susceptible to leukemia or any disease  
10 at all?

11 MR. BAGGETT: I'm going to object to that  
12 unless you make the hypothet complete and say crude  
13 oil containing percentages of benzene because the  
14 benzene is where the warning has been made. I  
15 object. And certainly it will be proven, if it  
16 hasn't been proven already, that it's common  
17 knowledge in the industry that crude oil contains  
18 benzene. So I object to your hypothetical question  
19 as being incomplete.

20 MR. SPEARS: Fine. Your witness indicated  
21 earlier that not all Exxon crude oil contained  
22 benzene, Bill.

23 A No, I did not. I'm not aware of any that  
24 did not contain benzene.

25 Q I'm sorry. Are you saying that all of

1 Exxon crude oil contained benzene? Is that your  
2 statement today?

3 A There may be -- not to my knowledge, but it  
4 may be that there was some field or some area where  
5 benzene didn't occur.

6 Q Is it a safe assumption to assume that  
7 most, if not all, crude oil that comes from the  
8 ground contains some percent of benzene?

9 A Contains some amount of benzene?

10 Q Some percent.

11 A Any percent? I'm not sure where your  
12 percent starts and stops.

13 Q I wasn't trying to quantify it, sir. I  
14 just asked you: Is it a fair statement to say that  
15 most, if not all, crude oil contains some percent of  
16 benzene?

17 A The reason it's so difficult, I might  
18 explain to you that one percent benzene is 10,000  
19 parts per million, and certainly that would be  
20 considered a very hazardous material, if not handled  
21 properly.

22 Q I'm going to ask you again, Professor, and  
23 tell me if you can answer this. Is it fair to state  
24 that most, if not all, crude oil contains some  
25 percent of benzene?

1           A       To my knowledge, I would not know which  
2 particular product, and I can't be specific to you  
3 to tell you with all authority of the world that I  
4 would like to, yes, there is some materials in the  
5 form of crude oil that does not contain benzene, but  
6 I don't know of those.

7           Q       All right, sir. Is it fair to state that  
8 while you were working for Exxon and your knowledge  
9 of the crude oil that Exxon marketed, that all of  
10 the Exxon crude contained some percent of benzene?

11          A       No, no, I cannot tell you that.

12          Q       You cannot say that?

13          A       No, I cannot tell you.

14          Q       So are you saying, then, there is some  
15 crude oil products that does not contain benzene?

16          A       I do not know of them, and I would want --  
17 wouldn't want to exaggerate. I'm not aware of any  
18 benzene-free products.

19          Q       All right, sir. Going back to my original  
20 question, then, and Mr. Baggett has made his  
21 objection. Are you aware of any articles written in  
22 the literature indicating that a person who handles  
23 crude oil, in the transportation of crude oil, is at  
24 a higher risk of contracting leukemia?

25               MR. BAGGETT: I still come back and say

1 it's not a complete question unless you enumerate  
2 whether or not it contains benzene and the  
3 percentages that it contains.

4 MR. SPEARS: The objection is made.

5 Q Professor, can you answer my question?

6 A Repeat your question.

7 Q Yes, sir. Are you aware of any literature  
8 while you were working for Exxon or any literature  
9 that you have read up until today indicating that a  
10 person or persons who handles the transportation of  
11 crude oil is at a higher risk of contracting  
12 leukemia?

13 A Yes, I would just relate to you what we  
14 considered was a minimum safe program to have all of  
15 our dock workers and other handling, loading and  
16 unloading cars, trucks, and so forth, with any  
17 regularity or with any routine practice to be under  
18 the benzene control program.

19 Q I'm going to respectfully object to your  
20 answer, Professor Hammond, as not being responsive  
21 to my question. My question to you, sir -- and tell  
22 me if I'm not being clear. I'll try to be clear.  
23 Are you aware of any literature, medical articles,  
24 while you were working for Exxon or any articles  
25 that you have read since leaving Exxon, indicating

1 that a person or persons who handles crude oil, in  
2 the transportation of crude oil, is at a higher risk  
3 of contracting leukemia?

4 MR. BAGGETT: Same objection I made  
5 earlier.

6 MR. SPEARS: All right, sir.

7 Q Are you aware of any such literature,  
8 Professor?

9 A To my knowledge, it was necessary to  
10 consider these people handling any crude oil or any  
11 other petroleum products that there were benzene  
12 present and we needed to take the precautions to  
13 have them on the program.

14 Q Professor, we're going to be here a long  
15 time, sir, if you don't answer my question. And I  
16 don't want to be argumentative with you. I'm asking  
17 you about literature. Do you understand what a  
18 medical article is?

19 A Yes, I do, and we prepared our materials  
20 out in advance of any other. So I already knew what  
21 you were asking as being necessary to be done.

22 Q I'm going to try to take it step by step.

23 MR. BAGGETT: Ken, I'm going to object to  
24 you pursuing this line unless you tell him whether  
25 or not the crudes involved contains benzene or not.

1 You are trying to delineate it to crude, quote, and  
2 you can't do it without knowing what the components  
3 of crude are for it to have any relevance to this  
4 litigation.

5 MR. SPEARS: Bill, I appreciate your  
6 objection. I really don't believe the professor is  
7 answering my question, so I'm going to try to pursue  
8 that.

9 Q While you were working for Exxon, Professor  
10 Hammond, did you read medical articles or literature  
11 from various medical publications? Yes or no.

12 A No. In regard to what you're getting at, I  
13 do not understand the question. But, no, I didn't  
14 read any such articles.

15 Q Now, tell me how you can operate as a chief  
16 industrial hygienist for Exxon without reading  
17 medical articles and literature.

18 MR. BAGGETT: I think his answer, you  
19 missed -- your question is objectionable to form  
20 because you misstate what he has responded, and you  
21 missed -- you are not articulating it correctly. He  
22 said which you are referring to, which is crude,  
23 whether or not it contains benzene. It's the same  
24 argument we're facing.

25 MR. SPEARS:

1       Q     My question didn't say anything about  
2 crude, Professor. I want to take it step by step  
3 with you. While you were working for Exxon as chief  
4 industrial hygienist, did you or did you not read  
5 medical articles and medical literature dealing with  
6 the safety and health hazards of products in the  
7 petroleum industry? Yes or no.

8       A     Yes. And I think that I should explain  
9 that. It would average between 30 and 40 journals a  
10 month and covered all hazardous materials in the  
11 nature of occupational diseases.

12       Q     All right, sir.

13       A     There were none, neither English, nor  
14 French, nor Italian, or German that came to my  
15 attention that I didn't get a translation and read,  
16 if it was something new.

17       Q     All right, sir. Now -- excuse me. Are you  
18 finished?

19       A     As well as English.

20       Q     All right, sir. Now, referring to all of  
21 those articles that you just articulated, all of the  
22 articles that you have read during your career with  
23 Exxon, do you recall reading any article indicating  
24 that a person or persons who are in the business of  
25 transporting crude oil are at a higher risk of

1 contracting leukemia?

2 A No, I don't remember that detail.

3 Q All right, sir. In the articles that you  
4 have written -- I mean read and just articulated,  
5 are you aware of any articles from that literature  
6 indicating that a person or person who transports  
7 gasoline is at a higher risk of contracting  
8 leukemia?

9 A No, at this time I don't remember any  
10 specific article.

11 Q All right, sir. When you were working for  
12 Exxon, did Exxon send out an MSDS sheet to the  
13 customers who purchased gasoline, sir?

14 A Yes, we did, regularly, and it was a well  
15 established program.

16 Q Was that something that was established  
17 after you came to Exxon, or was that something that  
18 was already implemented when you came to Exxon?

19 A It was already an ongoing program.

20 Q So each customer who purchased Exxon  
21 gasoline would have received an Exxon MSDS sheet.  
22 Is that correct?

23 A I cannot answer that, no, because there  
24 were millions and millions of people buying gasoline  
25 that I wouldn't know about. And I haven't taken an

1 interview with all of them.

2 Q I understand, sir, and it wasn't -- maybe I  
3 didn't articulate my question. It was Exxon's  
4 policy, then, to send out an MSDS sheet accompanying  
5 all gasoline shipments to customers. Is that  
6 correct?

7 A Again, that's too broad for me to be able  
8 to answer it, because all shipments, and it might  
9 have been some that were shipped that they did not  
10 follow the policy of the company.

11 Q Did each product that Exxon used an MSDS  
12 sheet with, did each such product also have a  
13 Toxigram accompanying it when the Toxigram policy  
14 came into effect?

15 A No.

16 Q How would you make a determination about  
17 whether a particular product had an MSDS sheet that  
18 went with it but not a Toxigram?

19 A By knowledge of the particular hazardous  
20 nature of the material. If it was just strictly  
21 limited to explosion and fires, we would not put out  
22 a Toxigram on it.

23 Q Did Exxon send out a Toxigram on crude oil  
24 that it marketed to its various customers, to your  
25 knowledge?

1           A       I can't remember that we did.

2           Q       All right, sir. Would that be something  
3 that would have been within your department to know  
4 if such Toxigrams were or were not being sent while  
5 you were working for Exxon?

6           A       No, it was never brought to my attention.  
7 But had it been a material of a hazardous nature  
8 other than the ones I mentioned, I'm pretty sure  
9 that my committee would have been the one to devise  
10 such a Toxigram if we needed it.

11          Q       As part of your work with Exxon, did you  
12 from time to time actually go out into the various  
13 physical plants belonging to Exxon or Humble to do  
14 surveys?

15          A       I did.

16          Q       All right, sir. Did you go to the Baytown  
17 facility on occasion?

18          A       I did.

19          Q       All right, sir. When you went to the  
20 Baytown facility, did you take readings of, for  
21 example, benzene in the atmosphere?

22          A       In some time, where it was indicated.

23          Q       All right, sir. When you visited the Exxon  
24 facility in Baytown and specifically took readings  
25 for the benzene content in the atmosphere, do you

1 recall if you ever found any benzene present at 20  
2 to 30 ppm?

3 A I don't think I was ever there when that  
4 type of concentration was created, no.

5 Q Would you consider that to be a high  
6 concentration of benzene in the atmosphere, sir, or  
7 a low concentration?

8 A Anything above zero levels of benzene  
9 persisting in the air where employees might be  
10 exposed is entirely too high.

11 Q All right, sir. If there were readings at  
12 the Exxon facility in Baytown of 20 to 30 ppm of  
13 benzene at various times, would you consider that to  
14 be a violation of Exxon policy?

15 A It would be very strictly a violation, and  
16 the individuals that had a potential exposure would  
17 always be under our medical surveillance program and  
18 the biotesting program of urinary phenols and other  
19 measures that we take.

20 Q All right, sir. You consider, Professor  
21 Hammond -- and correct me if I'm wrong. You  
22 consider the benzene facility that was constructed  
23 at Baytown, when it was constructed, to be, quote,  
24 state of the art as far as safety?

25 A It was an advanced pioneering plant that

1 was constructed with the best procedures we could  
2 devise and think of. And all of this was published  
3 and you have copies, I'm sure.

4 Q Yes, sir.

5 A But no secrets about any of our exposures  
6 nor how to control them that we knew about. That  
7 was clearly brought out to me the first two or three  
8 months I was with the company, that we had no secret  
9 on health and safety matters, from our competitors  
10 or anyone else.

11 Q All right, sir. I want to show you a  
12 document, Professor, that I'm going to mark as  
13 D-1. It's dated February 13, 1958, addressed to  
14 Mr. T. S. Howell at Baytown. Who was Mr. T. S.  
15 Howell?

16 A Dr. Howell, he was a physician in the  
17 medical department.

18 Q All right, sir. Take a second to read  
19 that, Professor.

20 A All right.

21 Q All right, sir.

22 MR. BAGGETT: Excuse me. May I see that?

23 MR. SPEARS:

24 Q Professor Hammond, specifically with  
25 Exhibit D-1, dated February 13, 1958, this indicates

1 to me that this was a written -- you memorialized  
2 one of your visits to the Baytown facility at which  
3 time you participated in some air sampling. Is that  
4 correct?

5 A I don't recall the details of that safety  
6 trip, no.

7 MR. BAGGETT: Of course, I object to what  
8 it appears to you. The document speaks for itself,  
9 once it's authenticated.

10 MR. SPEARS:

11 Q Professor Hammond, this document which is  
12 D-1, and I'll quote from it, indicates that -- it  
13 said: We found that the concentration at the eye  
14 wash fountain near the oil separator at breathing  
15 level was 20 to 30 ppm. Is that what the document  
16 says?

17 A Yes.

18 MR. BAGGETT: Excuse me. Just so my  
19 objection is reserved until that document has been  
20 authenticated to be what it purports to be, and then  
21 it would speak for itself. I just want to reserve  
22 my objection.

23 MR. SPEARS: Do you have any reason to  
24 believe that this is a false document?

25 MR. BAGGETT: I have no reason to believe

1 anything about it because the proper foundation  
2 hasn't been laid for reference to it. And you can  
3 question him about it; but until it's authenticated,  
4 then I've got to object, Ken. I'm sure you will do  
5 what you've got to do to get it into evidence, if  
6 it's relevant.

7 MR. SPEARS:

8 Q All right, sir. This document that is  
9 Exhibit D-1 indicates that the ppm concentration of  
10 benzene at the breathing level near the eye wash  
11 fountain was 20 to 30 ppm. Is that correct?

12 A No, it doesn't tell me how long it had been  
13 20 to 30. A leak had just developed, apparently, at  
14 that area and they had to do some plumbing to  
15 correct it, to close the leak.

16 Q Let me read it to you, Professor, and tell  
17 me if I'm reading this wrong. It says: We found  
18 that the concentration range at the eye wash  
19 fountain near the oil separator at breathing level  
20 was 20 to 30 ppm. Is that what it says?

21 A It says more than that, to me. It says  
22 that we were on the job, and as soon as the leak had  
23 developed that we were on top of it to take care of  
24 it. And it was an ongoing program, and we didn't --  
25 as you see, we didn't tolerate it to be there. And

1 the people that were exposed to that, potentially  
2 exposed to that, was under medical surveillance, and  
3 it tells me that we run urinary phenol on the people  
4 and make sure, medically supervision of it, that  
5 they would be examined to make sure they hadn't been  
6 exposed to any benzene. It just further expands  
7 what I've been trying to tell you. We had an  
8 airtight, gastight ongoing program for our company.  
9 We were very proud of that letter. Glad you brought  
10 it up. The jury would understand that we were on  
11 the job and we had a program to take care of any  
12 situation that might develop.

13 Q Then you recognize this letter as a letter  
14 that you would have generated as part of your  
15 surveillance of the Baytown refinery?

16 A I generated that letter and am very proud  
17 of it.

18 MR. BAGGETT: Then I withdraw the  
19 objection.

20 MR. SPEARS:

21 Q Okay. Professor Hammond, then, this -- and  
22 correct me if I'm wrong, but -- and I would like for  
23 you to tell me, if you can, in a yes or no answer,  
24 does this letter state, yes or no, that a  
25 concentration of 20 to 30 ppm of benzene was found

1 at the eye wash fountain near the oil separator at  
2 breathing level? Yes or no.

3 MR. BAGGETT: Ken, that letter speaks for  
4 itself. I've already said that. If you're trying  
5 to attach some significance to it because of taking  
6 something out of context, not listening to the  
7 doctor's -- professor's testimony, then that's not  
8 fair to him. And he's explained that letter, what  
9 it means to him, and you're taking something out of  
10 context which speaks for itself.

11 MR. SPEARS:

12 Q Can you answer my question, Professor?

13 A Repeat your question.

14 Q Does the letter, that you said you are very  
15 proud of, indicate that you participated in air  
16 monitoring and found a 20 to 30 ppm level of benzene  
17 at the breathing level at the Baytown refinery near  
18 the oil separator?

19 A Yes, and it illustrates how alert we were  
20 to be on the job to make sure that no one was  
21 exposed to that. And we have no proof until we run  
22 our medical surveillance and urinary phenol whether  
23 anyone might have been exposed to any  
24 concentration. And the matter of them drinking  
25 water at that fountain would be maybe not long

1 enough for them to show up in any picture, but we  
2 corrected it without any assurance that anybody had  
3 ever been exposed.

4 Q Does this letter that I have marked as  
5 Exhibit D-1 indicate also that there were two or  
6 three other locations where you found leaks, such as  
7 dripping sampling cocks?

8 A It does. And that, again, it tells you how  
9 strong and strict our program was, how thorough it  
10 was, how we were on the -- daily we were on the job,  
11 and we just didn't let people be exposed to  
12 benzene. We felt that zero level was the only one  
13 that was safe for them.

14 Q How many times did you go to the Baytown  
15 facility to take such tests as exhibited in D-1, on  
16 a weekly basis, Professor?

17 A Entirely depends upon the need for my  
18 presence.

19 Q Did you have to be there for this sampling,  
20 air sampling to take place, or somebody else could  
21 do it?

22 A I had a Ph.D., Dr. Herman was there on the  
23 job 24 hours a day, as far as the need, and he was  
24 thoroughly capable of -- as well as several other  
25 people in the refinery -- to make samples and take

1 samples.

2 Q Well, thank you, Professor.

3 Who is J. A. Allen, Mr. Hammond?

4 A Where did you find out Mr. J. A. Allen, and  
5 what occasion?

6 Q I'm asking you, do you know a J. A. Allen?

7 A Well, I know Allens. I don't know if it's  
8 J. A. specifically, but there are a lot of Allens in  
9 this world.

10 Q You do not recall the name J. A. Allen?

11 A I do not recall that individual.

12 Q Do you recall a Mr. E. F. LeBrocq?

13 A Yes.

14 Q Who is he, sir?

15 A He was an assistant industrial hygienist  
16 that worked at the Baytown refinery some, as well as  
17 other locations, yes.

18 Q And who was Mr. B. G. Simpson, sir?

19 A He also was an associate for Mr. LeBrocq,  
20 and they worked together. And I have it in mind  
21 they were stationed for a while at the Baytown  
22 refinery.

23 Q All right, sir. I'm going to show you a  
24 document, Professor Hammond, that I've marked D-2,  
25 which on the cover sheet indicates it's an Exxon

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from BC's original

1 Q But on page 1 of the document, Professor  
2 Hammond, does it not indicate that there was  
3 significant potential for exposure to benzene to  
4 some of Exxon employees?

5 A It does not say anything about whether  
6 were really exposed, it just said potentially  
7 exposed. And also, they probably had to be wearing  
8 respiratory protection while they were doing that,  
9 as a general practice.

10 MR. SPEARS: I'm not finished. I want to  
11 ask him some more questions.

12 MR. BAGGETT: Has that been marked for  
13 identification?

14 MR. SPEARS: D-2.

15 Q These type of surveys were done routinely  
16 within the Exxon plant, were they not?

17 A That's right. It illustrates -- what year  
18 was that?

19 Q 1975, sir.

20 A Well established program had been running  
21 for more than 20 years, and those individuals were  
22 tested regularly.

23 Q Professor Hammond, again on page 1 of  
24 Exhibit D-2, which is the industrial hygiene study  
25 of the aromatics extraction unit at the Baytown

1 chemical plant, dated October 1975, does it not  
2 indicate that high concentrations of benzene were  
3 found coming from open sewer grates in the facility  
4 and that this study recommended that introduction of  
5 aromatics to the sewer should be eliminated? Is  
6 that not what it says?

7 A It does that. And, again, it illustrates  
8 how carefully we were monitoring at the refinery and  
9 all the operations ongoing because the people who  
10 worked at that unit had been on our medical  
11 surveillance program for at least 20 years and it  
12 was probably due to -- and that had been surveyed  
13 many times without finding a condition. Indicates  
14 that there had been somewhere a cross connection or  
15 a leak that developed and needed to be corrected,  
16 getting into storm sewers.

17 Q All right, sir. And does the report  
18 indicate how long this particular problem was  
19 allowed to go on?

20 A You have the report. That was a violation  
21 of our rules if it was knowingly allowed to go even  
22 for one day, that would have been in serious  
23 violation of our standards. And that was the reason  
24 it was so interesting to me that they had found  
25 probably a brand new leak, a development shortly

1 after it had developed and never did show up in any  
2 of the medical finding and medical surveillance that  
3 was ongoing for our people. Those persons working  
4 in that unit had been on -- about 1975, they had  
5 been on 30-odd years at least, maybe 40, of the  
6 medical surveillance for indications of benzene  
7 exposure.

8 Q Professor Hammond, in 1975, what did you  
9 consider to be the threshold limit value of exposure  
10 to benzene?

11 A Zero.

12 Q All right, sir. And was that a company  
13 policy, sir?

14 A That was a company policy since 1947.

15 Q All right, sir.

16 A That I know about.

17 Q All right, sir. Let me show you page 6 of  
18 Exhibit D-2 where there is a specific date of  
19 October 7, 1975, indicating a sample location and  
20 benzene being found, and there is a threshold limit  
21 value put next to it in another column. What is the  
22 threshold limit value of benzene in that document,  
23 sir?

24 MR. MYERS: What is it?

25 MR. SPEARS:

1 Q Yes, what number is it, sir?

2 A 10.

3 MR. BAGGETT: And he can explain that if he  
4 wants to.

5 A And they talked about the air contamination  
6 level, parts per million. We measured one part per  
7 million, see, it shows here, but 10 would have been  
8 legally acceptable if the NIOSH people or the OSHA  
9 people, they come in, or the State Department of  
10 Health, anyone in enforcement. That's the only  
11 reason that's put there. Just shows how much better  
12 we ran our company. I'm very proud of that.

13 MR. SPEARS:

14 Q All right, sir. And this document, if one  
15 would look at it, it's an Exxon document and it does  
16 say on its face the threshold limit value of 10 ppm  
17 for benzene. Is that correct?

18 MR. BAGGETT: Ken, that's misstating and  
19 that's really misleading. The man has said that was  
20 the legal TLV, but he said Exxon's TLV was zero by  
21 their policy. And that's been spelled out. And  
22 what you are trying to do is put something contrary  
23 in the record. The document speaks for itself, and  
24 it's been explained. So I object as to the form of  
25 the question because it's an improper summation of

1 what's previously been said.

2 MR. SPEARS:

3 Q All right, sir. Professor Hammond, subject  
4 to that objection, this Exxon document D-2, does it  
5 not state, where my finger is, Threshold Limit Value  
6 (ppm)? Is that correct?

7 A The purpose of that is not that we were  
8 using that value as a health measure, but to let the  
9 supervisors and management know that if someone came  
10 in, an officer came in from either NIOSH or from the  
11 State Health Department or the County Health  
12 Department, that we would not be charged with a  
13 legal violation of the OSHA or the State Department  
14 of Health. That's all, just for management and  
15 supervisors' knowledge. They maybe didn't know what  
16 it might be, whether that one part per million was  
17 in violation or not.

18 Q All right, sir. I'm going to ask you the  
19 question again, Professor Hammond. The document at  
20 page 6, Exhibit D-2, does it not state Threshold  
21 Limit Value? Is that correct?

22 A No, it only states what the legal  
23 enforcement level of the product would have been.

24 Q I'll ask it this way, Professor Hammond.  
25 Would you read to me what I've highlighted in yellow

1 on page 6 of the document?

2 A No, I see no purpose in my reading that.

3 MR. BAGGETT: It speaks for itself. He's  
4 explained it a thousand times.

5 MR. SPEARS: Well, he's done a lot of  
6 things, but explaining it he's not.

7 MR. BAGGETT: He has explained it. He's  
8 explained that the paper has a threshold limit value  
9 of 10, why it's there, for management, and what it  
10 is, is the legal limit. And it's not inconsistent  
11 for him to say that Exxon's adopted standard was  
12 zero.

13 MR. SPEARS: We're going to get to that in  
14 a minute, but right now I want to talk to him about  
15 what the document says.

16 Q Does the document say threshold limit value  
17 10 ppm, Professor Hammond?

18 A I agree he read that into the record.

19 Q And I read it from the document? You can't  
20 read that, Professor Hammond?

21 A I see no purpose in my reading it.

22 Q Can you read it?

23 A What part?

24 Q The part that I have highlighted in  
25 yellow.

1 MR. BAGGETT: Sir, we'll stipulate that  
2 subject to his explanation which has been given  
3 umpteen times that the document says threshold limit  
4 value 10. We'll stipulate to that.

5 MR. SPEARS: All right, sir.

6 THE WITNESS: Very proud of that.

7 MR. SPEARS:

8 Q I'm going to show you -- refer you to page  
9 12 of this document, Professor Hammond, which is the  
10 1975 industrial hygiene study of the aromatics  
11 extraction unit at the Baytown chemical plant. I'm  
12 going to ask you if it does not state that the  
13 allowable standard for short-term exposure to  
14 benzene is 25 ppm?

15 A The allowable standard for law enforcement,  
16 yes, is 25 parts per million.

17 Q Is that what the document states?

18 A Not necessarily, but that's there because  
19 we have basically the zero control for our standard,  
20 and everyone knew it, even a new employee like  
21 Simpson and LeBrocq.

22 Q On page 6, where you and I got into an  
23 argument, and I apologize for you, you wanted to  
24 tell me that 10 --

25 A You don't need to apologize to me.

1 Q Well, when I asked you what the threshold  
2 limit value was of 10, you said the significance of  
3 that was 10 was the legal limit. And on page 12 of  
4 the same document, it says the allowable standard is  
5 25 ppm, does it not?

6 A Let me explain to you. For short-term  
7 exposure is five, from five to 15 minutes. And that  
8 is part of the problem with you not being  
9 professionally trained trying to interpret the ACGIH  
10 standard. And that has definite meaning of the  
11 purpose of having it 25 parts per million.

12 Q Well, are you telling me that there was a  
13 10 ppm legal limit that you understood and then  
14 there was a 25 ppm allowable standard? Is that what  
15 you are saying?

16 A Do you know what the 10 parts per million  
17 covers, what period it covers, and how you go about  
18 determining that?

19 Q Let me ask the questions, Professor  
20 Hammond, please.

21 A Well, I'm trying to get you to understand  
22 what I'm saying. We had a zero level, and we were  
23 putting down here the OSHA and the State levels that  
24 would be enforceable by law if you violated them.

25 Q Well, the level that you were concerned

1 about enforcement, was it 10 ppm or 25 ppm, in  
2 1975?

3 A Neither one for our purposes. This is an  
4 internal report that was going to people who were  
5 knowledgeable and knew what the program was.

6 Q Does this document at page 12, which is the  
7 industrial hygiene study of the aromatics extraction  
8 unit, Baytown chemical plant, dated October 1975,  
9 indicated that one of the practices that you  
10 discovered or was discovered in this survey was  
11 exposure to benzene caused by flushing sample lines  
12 to the pad in the unit?

13 A That says that should be corrected, that be  
14 stopped. Who set up the method of flushing sample  
15 lines, I do not know. But anyway, my industrial  
16 hygienists detected it, and they put a practice, a  
17 stop to it.

18 Q Okay, sir.

19 A Again, we had an alert team, and we didn't  
20 let any of those type of conditions exist. So it's  
21 another proof of our good program.

22 Q Well --

23 A And all of those -- point out again, all of  
24 the operators that worked around that unit were on  
25 our benzene exposure medical surveillance list.

1 Q Professor Hammond, while you were working  
2 for Exxon, certainly in the early years, say, in the  
3 Forties, Fifties and Sixties, Exxon had or the  
4 company had company-owned service stations, did they  
5 not, throughout the country?

6 A They did.

7 Q All right, sir. And most of those what we  
8 used to call full-service service stations have just  
9 about disappeared by now, have they not?

10 A I am not able to make any intelligent  
11 evaluation of that.

12 Q What I meant was that there seems to be a  
13 proliferation of self-service service stations now;  
14 but back in the Forties and Fifties and Sixties,  
15 there were very few self-serve service stations,  
16 weren't there?

17 A I'm not aware of the numbers. Today most  
18 would have several pumps that might be full service;  
19 you can get all of the red carpet treatment you want  
20 if you stop in there, sir.

21 Q While you were working for Exxon during the  
22 time frame when they had full-service Exxon service  
23 stations, did you consider the person or persons who  
24 were pumping gas in the cars on a regular basis to  
25 be at a risk of contracting a leukemia or a cancer?

1           A       I did not because that had been studied by  
2 the United States Public Health Service and various  
3 state organizations, and they did not ever classify  
4 it as being hazardous.

5           Q       Okay, sir. Were you aware, when these  
6 self-service service stations were using Exxon gas  
7 in the Forties and Fifties and Sixties, that those  
8 Exxon gasoline products contained some amount of  
9 benzene?

10          A       No, I could not give you any amount or help  
11 you in that question.

12          Q       I didn't ask you an amount, Professor, and  
13 maybe I awkwardly phrased my question again. While  
14 you were chief industrial hygienist for Exxon,  
15 during your watch, were you ever aware that Exxon  
16 gasoline contained any amount of benzene?

17          A       No, I was not.

18          Q       You were not aware of that?

19          A       No, because we had extracted every drop of  
20 benzene we could possibly get from these potential  
21 gasoline products before they got to the gasoline  
22 stage, and selling them as fuel was a money losing  
23 proposition if we could extract it out.

24          Q       So it's your testimony here today that to  
25 the best of your knowledge, the Exxon gasoline that

1 was sold during your tenure contained zero percent  
2 of gasoline -- of benzene?

3 A No, I could not say that. I never did see  
4 an analysis of all the gasolines that we sold.

5 Q Well, were you aware of the fact that Exxon  
6 gasoline, in the Forties, Fifties and Sixties,  
7 contained any amount of benzene whatsoever,  
8 Professor Hammond?

9 A No, I was not aware of it.

10 Q Is that something that you should have been  
11 aware of?

12 A No, it would not have been my  
13 responsibility. That was a public health problem.

14 Q Why would you consider it a Public Health  
15 problem?

16 A Because they were all over the outside and  
17 many owned their own stations and we had no either  
18 privilege nor authority to investigate them;  
19 whereas, the Public Health people were responsible  
20 for that.

21 Q It's true, is it not, that many of the  
22 service stations that Exxon owned in the Forties and  
23 Fifties and Sixties were owned by Exxon?

24 A They were.

25 Q All right, sir. And the employees at those

1 service stations were Exxon employees?

2 A Some of them were.

3 Q All right, sir. You did not consider the  
4 fact that those Exxon employees were pumping  
5 gasoline that contained some amount of benzene as  
6 being a possible safety hazard?

7 A No, and I doubt if they ever had any  
8 exposures.

9 Q Why do you say that, Professor?

10 A Because the nature of the material we sold.

11 Q I thought you weren't aware of the benzene  
12 content at all of the gasoline that you sold.

13 A I'm not aware of all of them, and I'm only  
14 speaking for the Public Health aspects of it that  
15 they were never brought to anyone's attention that  
16 it was a hazardous operation.

17 MR. SPEARS: Take a break for a second.

18 VIDEOGRAPHER: Off the record, 11:48.

19 [Recess]

20 VIDEOGRAPHER: On the record, 11:54.

21 MR. SPEARS:

22 Q Professor Hammond, I was asking you, just  
23 before the break, about the Exxon service stations  
24 in the Forties and Fifties and Sixties that were  
25 owned by Exxon and run by Exxon employees, and if we

1 can limit my question just to those service  
2 stations. Did you consider the fact that those  
3 Exxon employees were pumping gas on a daily basis  
4 into cars as being a source of potential health  
5 hazard for those employees?

6 A That was not my responsibility.

7 Q All right, sir. And why was it not your  
8 responsibility? And I'm limiting it just to the  
9 Exxon service stations owned by Exxon, run by Exxon  
10 employees.

11 A Those particular individuals came under our  
12 contract -- I mean usual program and were examined  
13 every year or more often.

14 Q The individuals whom I'm speaking of would  
15 be Exxon employees. You understand that?

16 A Yes, I do.

17 Q And they would be pumping gas into cars.  
18 Do you understand that?

19 A I do.

20 Q All right, sir. Based on your knowledge  
21 and experience, do you consider the fact that these  
22 individuals pumped gas in cars on a daily basis as  
23 being a source of a potential health hazard?

24 A No.

25 Q All right, sir. And the literature,

1 Professor Hammond, that we spoke about earlier in  
2 your deposition, I'm talking about the literature in  
3 the Forties and Fifties and the Thirties and  
4 Forties, back then, that dealt -- that spoke in  
5 terms of low concentrations of benzene. It's true,  
6 is it not, that 40 years ago a low concentration of  
7 benzene was close to 100 parts per million?

8 MR. BAGGETT: I'm going to object to that  
9 unless you can point me to something that says that,  
10 that's in the API, which is completely contrary. I  
11 don't know how you can define low concentration  
12 without defining it for him.

13 MR. SPEARS: I appreciate your objection,  
14 Bill, but I believe the Professor understands what  
15 I'm asking. And if you don't, you can tell me,  
16 Professor.

17 Q But it's true, is it not, that the  
18 literature that spoke in low concentrations, 40 or  
19 50 years ago, the low concentrations that they were  
20 talking about were in the neighborhood of 100 ppm?  
21 Is that correct?

22 A No.

23 Q Sir?

24 A No.

25 Q That's not correct?

1 A No.

2 Q All right, sir.

3 A I do not know what the definition for low  
4 concentration was.

5 Q Let me show you an exhibit, Professor, that  
6 I'll mark as Exhibit D-3 which is an excerpt from  
7 your testimony under oath in the case of Skeen  
8 versus Monsanto. Do you recall testifying in that  
9 case, Professor?

10 A I do.

11 Q You did testify?

12 A I did.

13 Q All right, sir. At page 13 of the  
14 transcript, the question was asked of you:

15 "What is a small amount, 40 or 50 years  
16 ago, what was a small amount of the low  
17 concentration of benzene?"

18 And your answer was: "Forty or fifty years  
19 ago, the criteria was that we would get it down to  
20 below a hundred parts per million."

21 A That was the legal value.

22 Q Was that your answer in the Skeen case,  
23 sir?

24 A It was, and it applied to a legal  
25 responsibility.

1 MR. BAGGETT: Taking something out of  
2 context, I'm going to object to it until I review  
3 the entire deposition, but the Professor has  
4 explained it.

5 MR. SPEARS:

6 Q All right, sir. Let me ask you again, sir,  
7 and this is at page 14 of the transcript of the  
8 Skeen testimony. And I'll read you the question  
9 verbatim, Professor, from the Skeen transcript.

10 "So in the literature 40 or 50 years ago,  
11 if they discussed low concentrations or small  
12 amounts, you could safely assume that they are  
13 talking about something in the range of a hundred  
14 parts per million; isn't that right?"

15 And your answer, under oath, was, "Yes."  
16 Correct, sir?

17 A The legal application did not apply until  
18 you had gotten above a hundred parts per million.  
19 That's what my answer to that is. It doesn't ask  
20 what my personal threshold limit value.

21 Q No, sir. The question that was asked of  
22 you is the same question I'm asking of you --

23 A It was a legal question.

24 Q 40 or 50 years ago, when you read the  
25 documents that are 40 years ago and they talk about

1 low concentration, 40 or 50 years ago, low  
2 concentration back then was a hundred parts per  
3 million?

4 A Less than a hundred parts per million.

5 Q Around that area, right?

6 A No, not necessarily.

7 Q Between 75 and a hundred?

8 A I cannot answer you any better than it was  
9 less than a hundred parts per million, legally.  
10 Some of the states had adopted 75, and some had  
11 adopted 50 --

12 Q Well, Professor Hammond --

13 A -- at that time. But legally, Texas, I  
14 don't know what it was at that time, I wasn't here.

15 Q I'm going to refer you again, in the Skeen  
16 testimony, under oath at trial --

17 A That's right.

18 Q -- you were asked: You could safely  
19 assume, 40 or 50 years ago when they were talking  
20 about low concentrations, they were talking about  
21 something in the range of a hundred parts per  
22 million; isn't that right? And your answer was  
23 yes. Is that correct?

24 A Yes, legally, yes, that was right. And --

25 Q Are you aware, based on your experience,

1 knowledge, Professor Hammond, of any article  
2 indicating that benzene is a human leukemogen at a  
3 level of 10 parts per million or below?

4 A Yes, there is a great deal in the  
5 literature about that.

6 Q And how long have you known that,  
7 Professor?

8 A Since 1942.

9 Q All right, sir. Again, Professor, I'm  
10 going to refer you to page 20 of the transcript of  
11 the Skeen testimony where this question was asked of  
12 you:

13 "Is benzene a human leukemogen; that is,  
14 does it cause leukemia in humans at the level of 10  
15 parts per million?"

16 And your answer, under oath, was: "I'm not  
17 aware of any experiences or cases where it was  
18 proven that 10 parts per million caused that."

19 MR. BAGGETT: I'm going to object to the  
20 manner in which you have approached that because  
21 your prior question does not allow or serve as a  
22 foundation for approaching him with a document that  
23 way. What you've asked him a question on and what  
24 you just read to him are entirely two different  
25 things. So I object to the manner and foundation.

1 MR. SPEARS: All right, sir.

2 Q When you testified in the Skeen case, you  
3 testified under oath that you were not aware of any  
4 cases or anything in the literature proving that  
5 benzene was a leukemogen at 10 parts per million.  
6 Is that correct?

7 A I did not have information personally, and  
8 that was a medical question I would rather somebody  
9 else answer.

10 Q You have already testified that everything  
11 you have known about benzene you have known in the  
12 last 40 years, 50 years?

13 A 50.

14 Q You haven't learned anything new in the  
15 last few years. Is that correct?

16 A Not that changed my zero concentration  
17 necessary to keep --

18 Q So when you testified under oath in the  
19 Skeen case that you were not aware of any  
20 experiences or cases where it was proven that 10  
21 parts per million caused leukemia, you were  
22 testifying truthfully, were you not?

23 A I did not know of any tests where they had  
24 air samples or any other proof of the exposure  
25 level, and I still don't have that information.

1 Q My question was: When you testified that  
2 you were not aware of any experiences or cases where  
3 it was proven that 10 parts per million caused  
4 leukemia, were you testifying truthfully?

5 A Yes. You would have to have the case  
6 leukemia and you would have to have his work period  
7 and concentrations as to how much he was exposed for  
8 40 hours a week throughout his lifetime, maybe 40  
9 years, and I didn't know of any case like that.

10 Q What is the ACGIH, Professor?

11 A American Conference of Governmental  
12 Industrial Hygienists.

13 Q Are you a member, sir?

14 A No, not today.

15 Q Were you a member?

16 A I was.

17 Q Is it a very well respected organization?

18 A It has its good membership. And in what  
19 way or where, who respects it and so forth, would  
20 you ask me the question?

21 Q Just generally in the industry, is the  
22 ACGIH respected as being consisting of people like  
23 yourself, when you were a member, of knowledgeable  
24 people in the industry?

25 A Generally that was a value that was adopted

1     legally and enforced by some states, counties,  
2     cities and nation, is what I know about it.

3           Q     Well, when you were a member of the ACGIH,  
4     sir, is it true that the ACGIH classified benzene as  
5     a suspected human carcinogen?

6           A     I remember that term and I objected to it  
7     but I was just one member of the team. Like all  
8     committees, everybody had a vote, and I was  
9     outvoted.

10          Q     But my question to you, sir, was, the  
11     ACGIH, while you were a member, classified benzene  
12     as a suspected human carcinogen. Is that correct?

13          A     I explained it, yes, that's correct. And I  
14     explained what it was, where it got there, not that  
15     I approved of it. And we didn't have it in Exxon  
16     Company. Another good illustration of how we just  
17     stepped out ahead and began, in 1947, to enforce a  
18     one -- zero concentration as far as our work period.

19          Q     Are you saying, Professor, that the  
20     ACGIH -- and I don't want to put words in your  
21     mouth, you tell me -- but the ACGIH classified  
22     benzene as a suspected human carcinogen, but that  
23     was not your opinion? Is that what you're saying?

24          A     I thought it was very definitely a  
25     carcinogen.

1 Q So when in the Eighties, in '86, when the  
2 ACGIH classified benzene and kept the classification  
3 of benzene as being a suspected human carcinogen,  
4 your opinion was it was a known human carcinogen.  
5 Is that what you are saying?

6 MR. BAGGETT: I object to the form of that  
7 question until the statement counsel has made is  
8 proven.

9 MR. SPEARS:

10 Q What was the classification of the ACGIH  
11 for benzene, sir, in 1980? Wasn't it suspected  
12 human carcinogen?

13 A As I recall that criteria was behind the 10  
14 parts per million, and a question mark was raised.

15 Q And it was still called a suspected human  
16 carcinogen by the ACGIH, is that correct, in the  
17 Eighties?

18 A Not the entire membership.

19 Q No, sir.

20 A But a majority of the members.

21 Q The membership -- I understand there were  
22 votes taken, and the ACGIH had to have a policy.  
23 And the statement made by the ACGIH in the Eighties  
24 was that benzene was a suspected human carcinogen.  
25 Is that correct?

1           A       That was in the TLV handbook, yes.

2           Q       All right, sir. But it's your opinion that  
3 despite the fact that the ACGIH said suspected, you  
4 knew all long that it was a human carcinogen. Is  
5 that what you are saying?

6           A       I had enough information in 1942, by the  
7 diagnosticians, to indicate that some people were  
8 susceptible at any concentration above zero and  
9 would be subject to leukemia and other diseases.

10          Q       Is it your testimony, Professor Hammond,  
11 that by the mid 1970s, certainly, or I think --  
12 correct me if I'm wrong -- scratch that.

13                   Is it a correct statement to say that by  
14 the time you went to work for Exxon, the very first  
15 time, that you were of the opinion that benzene was  
16 a known human carcinogen?

17          A       I was.

18          Q       All right, sir. And that has always been  
19 your policy?

20          A       No exception.

21          Q       All right, sir. In 1977, Exxon had a  
22 material safety data sheet for benzene, did it not,  
23 sir?

24          A       It did.

25          Q       All right, sir. And it's true, sir, is it

1 not, that in that material safety data sheet, which  
2 you signed, it states that benzene is a suspected  
3 human carcinogen?

4 A That is the term that was used with the  
5 threshold limit value.

6 Q All right, sir. Now, you're telling me  
7 under oath that you knew most definitely that  
8 benzene was a known human carcinogen since 1940, and  
9 yet you allowed a 1977 Exxon material safety data  
10 sheet, which you authored, to go out with the term  
11 suspected human carcinogen? Is that what you're  
12 saying?

13 A I did.

14 Q So you just followed what the ACGIH had  
15 been doing, suspected human carcinogen. Is that  
16 correct?

17 A That was going out to be utilized by people  
18 in the legal manner, that they did not violate the  
19 TLVs that had been approved by the ACGIH. I had no  
20 authority to override them on these material safety  
21 data sheets.

22 Q Who sent out the material safety data sheet  
23 for Exxon? Was it the ACGIH or Exxon?

24 A Exxon.

25 Q And who was in charge of the policy

1 implementing MSDS sheets? Was it Jim Hammond or the  
2 ACGIH?

3 A Our Toxigrams speak for themselves on that  
4 matter. Do you have a copy of that?

5 Q Professor Hammond, who was in charge of the  
6 MSDS sheets and the language contained therein for  
7 Exxon in '77? It was Jim Hammond, wasn't it?

8 A Not Jim Hammond alone. We had a  
9 committee. And I had to, again, have the problem of  
10 being a minority member that believed it should be  
11 definitely spelled out, but I didn't have the vote  
12 on the committee to see that it was.

13 Q Well, once you got away from the committee,  
14 when you were allowed to send out an MSDS sheet to  
15 the people who were buying benzene, in 1977, you put  
16 suspected human carcinogen. Is that correct?

17 MR. BAGGETT: Wait a minute. You have said  
18 an awful lot there that I object to the form of the  
19 question, until that is proven that until he got  
20 away from the committee, et cetera. I don't know  
21 that that's a fact, so I object to the form of the  
22 question.

23 MR. SPEARS:

24 Q Answer the question, Professor.

25 A My answer is that the sheet went out that

1 way, and it went out because it had legal  
2 obligations to meet and that was in compliance with  
3 the legal. But the people who interpreted that  
4 should be qualified professional people who knew the  
5 background and the knowledge. And it was quite  
6 plainly in literature that susceptible people were  
7 not to be exposed to anything above zero. And that  
8 was our internal company policy.

9 Q But if someone were to read your 1977 MSDS  
10 sheet authored by Jim Hammond and it said on there  
11 suspected human carcinogen, would they be allowed to  
12 assume that Jim Hammond was telling them the truth?

13 A You surely would because that should alert  
14 them to go and make the investigation to find out  
15 how, why and what risk they would be taking by  
16 adopting that susceptible --

17 Q But --

18 A That's a weasel word.

19 Q But truth and fact, Jim Hammond was not  
20 saying the truth in that 1977 --

21 A I was not -- I was saying -- I was saying  
22 susceptible is acceptable in that particular case,  
23 but it wasn't my opinion.

24 Q You were saying, in the 1977 MSDS sheets  
25 sent out by Exxon, which you signed, that benzene is

1 a suspected human carcinogen, while at the same time  
2 you knew, in your own mind, you were convinced it  
3 was a known human carcinogen. Is that correct?

4 A I applied the known wherever I had the  
5 authority to do it. But only -- as I said, the only  
6 thing that ACGIH 10 parts per million told you was  
7 susceptible but not that I approved of it.

8 Q Professor Hammond, it's true that while you  
9 were working for Exxon, you never recommended or  
10 worked towards a goal of zero exposure to benzene.  
11 Is that correct?

12 A Wrong. Do you have a copy of my letter of  
13 1953 to Mr. Wrightman? It should be part of all of  
14 our exhibits here. Wrightman and I told them in  
15 1948, and if you didn't have zero concentration you  
16 must put in all the medical surveillances and  
17 monitoring and so forth to make sure the people  
18 wasn't susceptible to it.

19 Q Professor Hammond, my question to you, in  
20 the real world it was not practical to work towards  
21 a zero exposure level of benzene, was it?

22 A Yes, it was. We did.

23 Q And that's always been your position?

24 A That's been my position ever since I have  
25 been -- 1942.

1       Q     Professor Hammond, I'm going to refer you  
2 to page 74 of your sworn testimony under oath in the  
3 Skeen case. You recall testifying in that case,  
4 sir?

5       A     I do.

6       Q     All right, sir. And the question was asked  
7 of you at page 74:

8               "The statement has been made informally  
9 that the maximum allowable concentration for benzene  
10 should be zero.' Do you remember that?"

11              And your answer was, "I heard that."

12              And the question was, "You don't agree with  
13 that," do you?

14              And your answer was, "I don't think that's  
15 practical that you can live that way."

16              "No. I don't recommend zero as a limit."

17              MR. BAGGETT: Wait just a second. You  
18 asked him a question and then propose to present him  
19 a document. You asked him one question which is not  
20 contrary at all, and you're suggesting that now he  
21 said something different. He hasn't. The proper  
22 foundation hasn't been laid for the way that you  
23 have proceeded here. You asked him one question and  
24 then present an answer to the other.

25              MR. SPEARS: Thank you, Bill.

1 MR. BAGGETT: And so I object to the form  
2 of your question.

3 MR. SPEARS:

4 Q Under oath, when you testified in the Skeen  
5 case in 1986, you testified under oath that you did  
6 not recommend zero ppm as a limit. Is that correct,  
7 sir?

8 A No, not that way you have stated it, no.

9 Q Read it, sir.

10 MR. BAGGETT: That's great, read it  
11 because, Ken, you are saying that you recognize  
12 maximum as a limit, and that isn't what he says.

13 MR. SPEARS: No, no.

14 MR. BAGGETT: It speaks for itself. Go  
15 ahead, and I'll straighten it out when I get him.  
16 It doesn't matter.

17 MR. SPEARS:

18 Q Professor Hammond, I want to refer you to  
19 your testimony that you gave in the Skeen case. Did  
20 you say that, "I do not recommend zero as a limit"?  
21 Yes or no.

22 A Under what conditions? Why didn't I  
23 recommend it?

24 Q I'm just reading the question and answer to  
25 you.

1           A     No, you didn't read all of it. You just  
2 read part of it.

3           Q     I'll start again, Professor.

4           A     Read the whole thing.

5           Q     The statement -- this is a question to  
6 you.

7                     "The statement has been made informally  
8 that the maximum allowable concentration for benzene  
9 should be zero.' Do you remember that?"

10                    And your answer was, "I heard that."

11                    Are you following me so far, sir?

12           A     Go ahead.

13           Q     And the next question was, "You don't agree  
14 with that?"

15                    And your answer was, "I don't think that's  
16 practical that you can live that way."

17                    Next question, "And you weren't trying to  
18 tell the jury that Monsanto should have known that  
19 zero was the exposure level in '50 or even today?"

20                    "No. I don't recommend zero as a limit."

21                    "I think 10 parts per million and less is  
22 sufficient."

23                    Is that what you testified to --

24           A     I did.

25           Q     -- in 1986?

1           A       And with that, I had already testified that  
2 they had to have medical surveillance programs and  
3 control, and you just read part of it. But the jury  
4 already knew that I recommended if you didn't have  
5 zero, then you had to put all these medical  
6 surveillance programs into the program to be sure  
7 you took care of the susceptible people. And you  
8 never know who is susceptible. And all of that had  
9 been explained to the jury.

10           Q       What we do know --

11                   MR. BAGGETT: Excuse me just a second. I  
12 want to articulate my objection on the record right  
13 now.

14                   MR. SPEARS: Objection to what?

15                   MR. BAGGETT: My objection to the -- to  
16 what you are improperly inferring in the record by  
17 the method in which you have proceeded. You refer  
18 to legal limits and adoption of legal limits and  
19 suggest to the jury that the doctor -- Professor has  
20 testified to something different than that, which is  
21 completely erroneous. What he has testified to is  
22 there is a difference between legal limits,  
23 enforceable limits in the work place and the policy  
24 which he had of attempting to be zero, which is the  
25 same policy that I'll show that Conoco had in 1953

1 that they announced, it's the same policy that he  
2 has -- that the API suggested in 1948, is that you,  
3 because of individual susceptibility, that you shoot  
4 for zero. You may have different maximum allowables  
5 or TLVs for legal enforcement. And there is a  
6 difference and you have not -- you have tried to  
7 avoid that distinction in the way that you have  
8 proceeded with your interrogation. And the whole  
9 form of your interrogation has been misleading and  
10 confusing to the jury. And I will ask that it be  
11 stricken.

12 MR. SPEARS: Bill, for the record --

13 MR. BAGGETT: I just want to -- while I'm  
14 thinking about it.

15 MR. SPEARS: For the record, of course, I  
16 object to your pontificating and stating -- it's not  
17 an objection, you were testifying. So for that --  
18 the court will figure out whether the objection is  
19 valid or not, but I object to your statements in the  
20 record.

21 Q It's true, Professor Hammond, that in 1986  
22 you thought 10 parts per million of benzene was  
23 sufficient?

24 MR. BAGGETT: Sufficient for what? I  
25 object. Sufficient for what? I object. It's not a

1 complete question.

2 MR. SPEARS:

3 Q The question was, in the light of this  
4 ridiculous statement about zero, absolute zero,  
5 Professor, truth in fact, you never worked for an  
6 absolute zero because you knew that absolute zero is  
7 just not attainable. Is that correct?

8 A If you had used part of the exhibit  
9 there -- do you have Wrightman, the letter I wrote  
10 to Mr. Wrightman in 1953, discussing what we decided  
11 upon as policy in the company in 1948, that we would  
12 have said that if you do not have zero, you have to  
13 put all of these medical surveillance and monitoring  
14 programs such as urinary sulfates, urinary phenol,  
15 and you have to do medical examinations on all these  
16 employees periodically, starting out frequently, to  
17 see which one is susceptible so you can remove those  
18 susceptible individuals out of further exposure.  
19 And you just have part of your -- my testimony in  
20 that particular --

21 MR. SPEARS: Professor, thank you, but I  
22 object to your answer as not being responsive to my  
23 question, with all due respect to you, sir.

24 Attach Exhibit D-3 to the deposition.

25 That's all I have, Professor. Thank you

1 for your patience.

2 MR. BAGGETT: Do you want to break for  
3 lunch?

4 THE WITNESS: I guess we better. It's now  
5 12:20.

6 MR. FREEMAN: I've just got a few  
7 questions, probably 10 or 15 minutes worth.

8 MR. BAGGETT: Have you got many, Bob?

9 MR. MYERS: About 15.

10 MR. BAGGETT: You want to go ahead, and  
11 then we'll have lunch afterward?

12 THE WITNESS: Sure.

13 VIDEOGRAPHER: Off the record, 12:20, to  
14 change tape.

15 [Recess]

16 VIDEOGRAPHER: On the record, 12:22. Tape  
17 number two.

18

19

20 EXAMINATION BY MR. FREEMAN

21

22 Q Mr. Hammond, you have mentioned a couple of  
23 times, in response to Mr. Spears' questions, a 1953  
24 letter that you wrote to a Mr. Wrightman?

25 A Yes.

1 Q Do you have a copy of that letter with you  
2 here today? It was not attached as an exhibit.

3 MR. BAGGETT: I hope it's attached to one  
4 of the earlier depositions. And I may have it out  
5 in the car. I'll try to get it as soon as you  
6 finish here.

7 MR. FREEMAN: Good.

8 Q But as far as you're concerned,  
9 Professor Hammond, you don't have it personally with  
10 you here today?

11 A No.

12 Q You have indicated several times about a  
13 medical surveillance program that you were involved  
14 in some fashion with initiating at either Humble or  
15 Esso or Exxon at some point in time. As far as  
16 those Exxon employees that were working on the dock  
17 that were involved in the marine transportation  
18 aspects as well as those employees that were the  
19 truck drivers of the Humble tanker trucks, can you  
20 detail for me what exactly that medical surveillance  
21 program included for those type of workers?

22 A Yes, but I would refer you to one of my  
23 publications in which I spelled that out very  
24 clearly. And it's about seven, eight different  
25 items. And if you have any of my exhibits, in 1958,

1 '59, Dr. Herman and I published a report covering  
2 that. So I would rather refer you to that, if you  
3 will accept the reference.

4 Q This is a document other than your 1955  
5 benzene exposure control document?

6 A Yes.

7 Q So it's a separate piece of paper?

8 A It came out after we had five years of  
9 experience with controlling benzene and the way we  
10 did it.

11 Q Just so as I understand, Exhibit 22 to your  
12 deposition is what I understand to be a three-page  
13 or a four-page document that you put together in  
14 1955. Mr. Baggett is showing you a copy of Exhibit  
15 22. You authored Exhibit 22?

16 A On page 3 beginning with V, Medical and  
17 Industrial Hygiene --

18 COURT REPORTER: I'm sorry, beginning with  
19 V --

20 A V.

21 MR. FREEMAN:

22 Q Roman Numeral V?

23 A On page 3 and Roman Numeral, yeah, Medical  
24 and Industrial Hygiene.

25 Q So are these the details of the medical

1 surveillance programming?

2 A That's right.

3 Q If you would, Professor Hammond, just  
4 explain what those are or list those for the court  
5 so we don't have to refer back to this exhibit  
6 necessarily.

7 A I think most of them speak for themselves.  
8 And the medical examination would be a  
9 preplacement. And covering the preplacement on the  
10 potential employee to work at the plant would be a  
11 complete blood count, exclude the people with  
12 evidence or history of simple anemia or other blood  
13 cell diseases, C, consider any chronic condition  
14 involving liver or kidneys for exclusion.

15 Q Preplacement examination, that is before  
16 they're employed?

17 A Before they go to work on a benzene unit or  
18 a unit that has benzene concentrations.

19 Q And then at least once a year to do some  
20 sort of a urinary phenol examination of the urine?

21 A We then began down there measuring phenol.

22 COURT REPORTER: I'm sorry. I can't  
23 understand you.

24 A Measure phenol in urine by the G.C. That's  
25 a gas chromatograph, is really what it is, but G.C.,

1 according to the method of Haaften & Sie, and he  
2 gives a volume of second Industrial Hygiene Journal,  
3 Volume 26, No. 1, pp 52-58, January-February of  
4 1965.

5 Q So do I understand, then, that as far as  
6 the medical testing itself, the primary test is a  
7 urinary phenol examination?

8 A No. This is done in industrial hygiene  
9 laboratory where we have specialists that know how  
10 to handle the analysis of these samples.

11 Q Again, these questions are very basic, but  
12 is the urinary phenol a test that's performed on an  
13 employee's urine?

14 A That's right, and it reflects a way of  
15 monitoring the potential exposure that the employee  
16 might have had during the period of eight hours  
17 before the sample was collected.

18 Q Any other industrial hygiene or medical  
19 biological testing on the individual employee other  
20 than the urinary phenol, pursuant to this program in  
21 1955?

22 A Not from that standpoint of being able to  
23 evaluate their prior exposure to the last work  
24 shift, for example.

25 Q You indicated that the preplacement

1 physical examination would be before an individual  
2 is placed into some sort of a unit or some sort of a  
3 possible exposure location?

4 A Where he might have a potential exposure,  
5 yes.

6 Q If an individual is going to be hired to  
7 work on the docks loading and discharging barges or  
8 hooking up hoses, would that require such a  
9 preplacement physical examination?

10 A It did. We do.

11 Q How about for a truck driver that's  
12 carrying crude oil?

13 A Not unless we knew that he had had exposure  
14 to the area, but he would be picked up also by the  
15 medical surveillance program because when he came up  
16 for his physical examination, of course, the  
17 complete blood count is part of that examination,  
18 and that would detect any potential change in the  
19 blood.

20 Q Same question for a gasoline pumper at an  
21 Exxon retail gasoline station in the Fifties or  
22 Sixties. Would he be required to go through a  
23 preplacement physical examination?

24 A If he was an Exxon employee, he would.

25 Q If you would, Professor Hammond, flip over

1 to the Esso Toxigram which has been marked as  
2 Plaintiff's Exhibit 13 in that volume you have  
3 there.

4 A Yes.

5 Q You were employed or with the company known  
6 at this particular time known as Esso?

7 A No, not that particular time. It was 1958,  
8 I see, and at that time we had not united between  
9 Humble and Esso to form the Exxon Company.

10 Q Were you involved in any fashion with  
11 review or authoring this particular Toxigram at  
12 about the time it was being put together either by  
13 Exxon or Esso?

14 A I was.

15 Q At that time in the spring of '58 or  
16 preceding that period, at that time you knew in your  
17 mind, it was your opinion, was it not, that benzene  
18 was a known human carcinogen?

19 A Yes. I think that justified this  
20 statement. May I read it?

21 Q Yes.

22 A "Most authorities agree that in light of  
23 present knowledge, the only level which can be  
24 considered absolutely safe for prolonged exposure is  
25 zero."

1 Q It doesn't say anything in there about your  
2 opinion that it causes cancer?

3 A That reflects my opinion.

4 Q You had indicated earlier today that the  
5 legal standard for short-term exposure at some point  
6 in time to benzene was 25 parts per million?

7 A I remember that was the acceptable TLV  
8 listed by the ACGIH.

9 Q For short-term exposure, and I believe you  
10 defined short term to be five to 15 minutes?

11 A I did.

12 Q How many times per day would an individual  
13 be allowed to be exposed to that short-term  
14 concentration for that short amount of time and  
15 still be within the eight-hour TLV?

16 A Oh, that would only allow the person to be  
17 exposed -- they have spelled that out. I don't  
18 remember whether it was three times a day or so many  
19 minutes, but it was probably expressed in that term,  
20 either the number of minutes in an eight-hour time  
21 or the number of times at, we'll say, less than 15  
22 minutes for that period. But it's all spelled out  
23 in the ACGIH standard.

24 Q So it is likely, then, that an individual  
25 could be exposed to the short-term limit more than

1 one period a day and still be within the  
2 time-weighted average for an eight-hour day?

3 A Yes, for legally speaking that, again,  
4 permitted them to transfer some benzene from one  
5 container to another, for example, in the laboratory  
6 or something.

7 Q You had earlier indicated that you chaired  
8 Exxon's committee that had the oversight  
9 responsibilities for the MSDS sheets. Do you recall  
10 that testimony, sir?

11 A Yes, I do.

12 Q At what period of time did you chair that  
13 committee?

14 A I was secretary in 1948, and then that same  
15 year I became chairman in 1948, and I was still  
16 chairman when I retired in 1978.

17 Q 1970?

18 A '8.

19 Q 1978? So for 30 years, you chaired that  
20 committee?

21 A I did.

22 Q Again, in response to some of Mr. Spears'  
23 earlier questions concerning what Exxon may or may  
24 not have done when Exxon was selling large  
25 quantities of benzene to Exxon's industrial

1 customers, you had indicated that when that shipment  
2 occurred through a pipeline, that in addition to the  
3 MSDS there would be a -- and you used the words a  
4 very close conference with that benzene customer,  
5 and then paraphrasing it, to make sure that they  
6 understood the dangers. Do you recall that  
7 testimony?

8 A Yes, I do, and that means that we would  
9 confer with the physician, if they had a physician  
10 on board, or if they had an industrial hygienist we  
11 would bring him into it. And also, if not, we  
12 sometimes dealt with the head of the safety  
13 department, safety engineers.

14 Q I'm assuming that your reference to  
15 pipeline transportation was merely an example of the  
16 various types of transportation modes when Exxon  
17 utilized this sort of communication between Exxon's  
18 customers and Exxon.

19 A Yes, but actually at Baytown, for example,  
20 across the ship channel, we had, and probably still  
21 do, an arrangement with Du Pont to use our product.

22 Q Excuse me. Go ahead.

23 A Before they built the unit down at the  
24 Monsanto chemical plant in Texas City, we had a line  
25 that ran directly that was just dedicated to benzene

1 to them and others such as that. I don't remember  
2 whether Carbide, Union Carbide had that arrangement  
3 with us or all of them. I don't remember all of  
4 them, but the principle was the same.

5 Q So the same policies or the same Exxon  
6 procedures would be in effect if the delivery route  
7 did not involve a pipeline but involved a ship?

8 A Barge.

9 Q A barge? So the same arrangement would  
10 have occurred for maritime transportation?

11 A Would have occurred for marine operation.

12 Q Can you recall any instance where you were  
13 involved for Exxon with one of these large customers  
14 involving bulk sales of benzene where the shipper  
15 was involved within this Exxon notification  
16 procedure to the Exxon customer?

17 A I don't recall any particular shipper. We  
18 did tests on our own people that were loading the  
19 barges that were measuring, sampling the degree of  
20 filling and so forth. We had them, and they would  
21 very much come under the same control program we had  
22 for the employees in the plant, the medical  
23 surveillance, medical selection.

24 Q Mr. Hammond, are you aware today, sitting  
25 here, of any warnings that were issued by Exxon to

1 Higman Barge Lines or Higman Towing Company  
2 concerning the dangers of benzene?

3 A I don't recall that name, no, in any  
4 details. I am not -- I was not familiar with them  
5 coming and receiving our product, personally, I  
6 don't know.

7 Q That's all I'm asking is your personal  
8 knowledge, your personal opinions here today. Same  
9 question as far as Humble warnings to Higman Towing  
10 Company?

11 A No.

12 Q Same question as far as Esso's warnings  
13 concerning benzene to Higman Towing Company?

14 A I don't have any individual knowledge of  
15 that.

16 Q Those questions related specifically to  
17 benzene warnings. Do you have any knowledge  
18 concerning the same type of warnings given either by  
19 Exxon, Humble or Esso to Higman Towing Company  
20 concerning the dangers of crude oil exposure?

21 A No, I do not. The signs and warnings that  
22 were posted for our own people were available to  
23 them on the docks and in that area, and our  
24 requirements in regard to the use of gas masks and  
25 other type respiratory equipment would apply to them

1 as far as any information that they received from  
2 our people using the right devices and so forth.  
3 And again, our people working on those areas, the  
4 docks areas, were under our medical surveillance and  
5 testing program.

6 Q You mentioned some warnings, apparently a  
7 sign or some sort of a physical board on the dock?

8 A Yes.

9 Q Do you recall what those said?

10 A Most of them pertained to explosive and  
11 fire hazardous nature, but sometimes we had them  
12 there that referred to the particular compound that  
13 would be like in the classification of benzene.

14 Q Do you recall any of those warnings, those  
15 placards placed on the dock referring explicitly to  
16 the dangers of inhaling crude oil vapors?

17 A No, I do not have that detailed information  
18 in front of me. I don't have it in my mind.

19 Q Are you aware today of any warnings, any  
20 warnings that were issued either by Exxon, Humble or  
21 Esso to Higman Towing Company or Higman Barge Lines  
22 concerning the dangers or the possible exposure  
23 dangers of crude oil? I've already asked you the  
24 crude oil, but gasoline, aviation gas or diesel?

25 A No, I don't have any knowledge of field

1 operation.

2 Q Earlier in your testimony you had indicated  
3 that the Exxon employees that were working on the  
4 dock wore respirators or breathing protection when  
5 it was necessary. When, in your opinion,  
6 Mr. Hammond, was it necessary for those type of  
7 employees to wear a respirator?

8 A It was necessary whenever they had to open  
9 the hatch on a barge or on a tanker and also  
10 particularly when they were sampling the level of  
11 filling or measuring the quantity of benzene in the  
12 tank at the time or gasoline at the tank.

13 Q So anytime when an Exxon employee would  
14 open the hatch of a barge carrying benzene, they  
15 were required to wear respirators?

16 A They were. And also even gasoline and  
17 other volatile material such as benzene.

18 Q Did those other volatile materials, in your  
19 mind, include crude oil?

20 A It could, depending upon the oil, but I  
21 don't know of any specific field operation where I  
22 saw them wearing them.

23 Q When they were handling crude oil?

24 A Yeah, I don't remember. I just wasn't on  
25 the barges that much.

1       Q       So, as a general statement, the usual,  
2 customary practice of the Exxon employees on the  
3 dock would not be to wear a respirator when they  
4 were opening the hatches of a barge carrying crude  
5 oil?

6       A       Oh, you had very hazardous material there,  
7 in many cases sour crude, for example, hydrogen  
8 sulfide, and that certainly was deadly poison that  
9 had to be protected. And anytime the safety and  
10 fire department people thought that we needed  
11 respirators, they were always available and used by  
12 the people.

13       Q       If we remove the H<sub>2</sub>S danger, the hydrogen  
14 sulfide danger, the sour crude from that type of  
15 cargo -- my question is a general type question,  
16 Professor Hammond -- as a general statement, wasn't  
17 it true that when the Exxon employees popped open  
18 the hatch covers, dipped or gauged the tanks,  
19 checked the ullages on a barge carrying normal crude  
20 oil, that they were not required by your department  
21 to wear respirators or other respiratory protective  
22 equipment?

23               MR. BAGGETT: I want to object to that  
24 until you define what is normal crude oil and  
25 specify whether or not it contains benzene and the

1 percentages of benzene.

2 MR. FREEMAN:

3 Q Normal crude oil, anything other than sour  
4 crude containing excessive amounts of hydrogen  
5 sulfide?

6 MR. BAGGETT: Object to form. It's not a  
7 complete hypothet.

8 MR. FREEMAN:

9 Q You can go ahead and answer the question,  
10 Mr. Hammond.

11 A I cannot imagine them opening up any barge  
12 on sampling or else measuring without the person  
13 wearing a full respiratory protective equipment  
14 because of the volatile materials that normally  
15 would be there, the other materials that might be  
16 generated in the barge by content or what it had had  
17 before in it before it was an empty barge, a filled  
18 barge. They wore respiratory protection until they  
19 had monitored the tank or the barge and tanker, yes,  
20 it was general practice. And also had a combustible  
21 gas indicator to determine what the danger from fire  
22 and explosion was.

23 Q Assume with me, Professor Hammond, that  
24 there is not going to be entry into a tank by man.  
25 Assume with me further that there is not going to be

1 any hot work performed in a tank. Under any of  
2 those circumstances, is there any reason to sniff it  
3 with a combustible gas meter?

4 A Absolutely.

5 Q There is?

6 A Yes, and that's just a quick overall test  
7 for presence of gas of any nature that might be  
8 there that's combustible.

9 Q I need to make sure I understand your  
10 testimony, Mr. Hammond. So it's your testimony  
11 today that as a general matter, Exxon employees  
12 working on the dock when they checked the tank tops  
13 or opened up a barge containing crude oil, normal  
14 crude oil, excluding excess amounts of hydrogen  
15 sulfide, that they wore full protective gear  
16 including respirators?

17 MR. BAGGETT: I think the testimony was  
18 that they should have. I don't know whether --  
19 you're asking him to testify as to what they did for  
20 30 or 40 years. I think it's objectionable.

21 MR. FREEMAN: I'm asking about his  
22 understanding of the general practices of the Exxon  
23 employees.

24 MR. BAGGETT: That's different.

25 A It was our general practice they did wear

1 respirators.

2 MR. FREEMAN:

3 Q For crude oil barges?

4 A For crude oil barges.

5 Q Even if the Exxon personnel were satisfied  
6 the benzene content of that crude oil was less than  
7 2.5 percent?

8 A No, we had no such tests made on the  
9 product before in terms of benzene concentration.

10 Q Would it have made any difference to you as  
11 chairman or head of the industrial hygiene  
12 department if you knew for certain that each crude  
13 oil coming in on that barge, each load of crude oil  
14 contained less than 2.5 percent benzene by volume?

15 A No. The other materials, all the  
16 hydrocarbons that would be there, all of the  
17 volatile material would be respiratory -- dangerous  
18 to be inhaled or to be breathed, and so it put no  
19 criteria that we had to analyze every batch before  
20 we did anything. We just took precautions in the  
21 beginning.

22 Q My question was not what you did to  
23 actually determine it, but would it be important to  
24 you as the head of the IH department to know if it  
25 was below that certain level of 2.5 percent

1 benzene?

2 A No, it would have had no effect. I've  
3 assumed it was bad from the beginning.

4 Q Do you recall participating in some sort of  
5 a study at the request of either Union Carbide or an  
6 attorney representing Union Carbide in the mid to  
7 late Eighties?

8 A I do.

9 Q What was the subject of that particular  
10 study, the workers or the employees that were the  
11 subject of that study?

12 A Those particular barges was hauling  
13 products up to their companies' plants in West  
14 Virginia, and they had to go through some locks on  
15 the Ohio River. So I flew up there and rode the  
16 barges through and made measurements to see if there  
17 was any particular occasion where inside the locks  
18 that the vapor pressure -- the vapors themselves  
19 might have moved above the normal. And these  
20 particular barges were all sealed and there was no  
21 gas leak and there was no occasion or no way for  
22 them to have lost gases. Their question was just  
23 a safety measure to make sure that there wasn't  
24 some -- because it was in that lock and in a closed  
25 system that there wasn't some way gas could build up

1 in there. But in my particular case, I didn't find  
2 any leaks around the barges, and the seals were all  
3 good and tight and so on. There was no exposure.

4 Q Do you recall what year you did your field  
5 work for that study?

6 A I don't recall for sure, but it was in the  
7 1980s. I don't recall the year, '85 or '87,  
8 somewhere in that period.

9 Q Who retained you to do that work?

10 A The Union Carbide people did. That was for  
11 Union Carbide products, wasn't it? I thought you  
12 had the name of the company there that I worked  
13 for. It was Union Carbide, I believe.

14 Q Do you recall whether or not the contact  
15 came to you from West Virginia or --

16 A No, it came from locally here, from the  
17 medical department or the personnel department for  
18 the company.

19 Q Did you prepare a written report and then  
20 forward that report to the same person that hired  
21 you to do the study?

22 A I wrote him a letter. That was all the --  
23 no formal report other than just a letter telling  
24 them that the barges were all sealed and I didn't  
25 find, detect any gases.

1           Q       Do you recall that man's name you sent that  
2 letter to?

3           A       No, I don't recall.

4           Q       But he was with Union Carbide here in the  
5 Houston area?

6           A       Yes, he was.

7           Q       In the medical department?

8           A       I don't know. It might have been the  
9 personnel department that handled safety and medical  
10 for the company.

11          Q       Were you in the field only for that one  
12 occurrence to see what was going on on those barges  
13 through the particular Ohio locks?

14          A       That particular one, yes, was the only time  
15 I rode the barge.

16          Q       What was the cargo in the barges at that  
17 time?

18          A       I don't recall.

19          Q       You don't recall if it was crude oil?

20          A       No, I don't recall what it was.

21          Q       Could it have been benzene?

22          A       It was some of their products that they  
23 generate in Texas City and went for utilization in  
24 the plant in West Virginia. But I don't recall. It  
25 was a volatile material, but what it was, I don't

1 recall.

2 Q Do you have a copy of that letter or that  
3 report that you sent to whomever hired you?

4 A I don't think I have. I think it's been  
5 maybe used in some exhibits, some trial or  
6 something, but I don't have a copy.

7 Q Can you recall where that report was used,  
8 either at the courthouse or in a deposition?

9 A No, I don't. It's beyond me. I don't  
10 recall.

11 Q Do you recall any of the lawyers that may  
12 have been involved in that litigation involving that  
13 study?

14 A There wasn't any lawyers involved. This  
15 was a precautionary measurement, evaluation and  
16 monitoring before they had any problems. I  
17 understood there were no problems, no personnel  
18 problems.

19 Q Have you participated in any other studies,  
20 examinations, industrial hygiene surveys in any  
21 fashion at any time in your career, other than this  
22 one that you have just mentioned, involving marine  
23 transportation workers?

24 A No, I don't recall. I had several  
25 associates and assistants that rode the tankers and

1 rode the barges, but I didn't personally do that.

2 Q That was when you were still with Exxon?

3 A Yes. It was back at the beginning of  
4 1950s, and over a period of 20 years until I retired  
5 we did that several times.

6 Q If you would, Mr. Hammond, turn over to  
7 Exhibit No. 3 in that volume in front of you. I  
8 believe that's your letter to Mr. Baggett at some  
9 point in 1991.

10 A Oh, yes, all right.

11 Q You have already --

12 A I remember this.

13 Q You've already gone over that letter in  
14 some detail when Mr. Baggett was asking you the  
15 questions. Even though that letter was written  
16 several years ago, almost four years ago, three  
17 years ago now --

18 A What, this letter?

19 Q Is it dated in 1991?

20 A Oh, yes. Oh, yes. Excuse me, go ahead.

21 Q Is it still -- does it still fairly state  
22 your opinions as detailed in that letter, or has  
23 anything occurred since you wrote that letter that  
24 would cause you to modify any of the statements  
25 contained in Exhibit 3?

1       A       No, I think this letter is still pretty  
2 much sound, and I haven't made any --

3               MR. BAGGETT: Gentlemen, I see that  
4 attached to the -- to this Exhibit No. 3 was the  
5 February 23rd, 1953 letter that came from the safety  
6 department's file, and it described in summary  
7 recommendations for hazard to benzene exposures and  
8 their control in certain operations in the petroleum  
9 industry in '48. I see that I did not bring that  
10 as an exhibit. It may be in my car. I'm going to  
11 go try to get it when we take a break, if I've got  
12 it.

13              MR. FREEMAN:

14       Q       Mr. Hammond, if you would, turn over to  
15 Exhibit 9 in that same volume, which I understand to  
16 be the API Toxicological Review concerning benzene.  
17 Again, a great deal of time was spent going over  
18 this document with you earlier. But as far as a  
19 general statement, would you agree that at the time  
20 this document was written, at that time API was  
21 strongly recommending 50 parts per million as an  
22 allowable safe exposure limit?

23              MR. BAGGETT: Wait a minute. The document  
24 speaks for itself as to what the -- and what you  
25 refer to as allowable safe limit is misleading,

1 unless you describe what you're talking about.

2 MR. FREEMAN:

3 Q Professor Hammond, would you agree that the  
4 general majority view among the API members was that  
5 50 parts per million should be, at the time the  
6 document was written, 50 parts per million?

7 A Again, that goes back to the regulatory  
8 agencies that was trying to enforce some level of  
9 exposure.

10 Q I appreciate that response, Professor  
11 Hammond, but I need to object to the responsiveness  
12 of it. Again, the question was: Do you agree that  
13 it was the majority view of the API members in 1948  
14 that 50 parts per million was the strongly  
15 recommended safe allowable limit?

16 A No, I don't know what the persons, the  
17 group there, the people's opinion was. I didn't  
18 talk to any of them individually.

19 Q You were a member of a number of API  
20 committees, were you not?

21 A I was.

22 Q You were active in the API for many years?

23 A Yes.

24 Q You chaired certain committees or  
25 subcommittees at specific times in your

1 distinguished career, did you not?

2 A I did.

3 Q And you are unable to give us your opinion  
4 as to what the majority view of the API members were  
5 in 1948 concerning allowable limit of benzene  
6 exposure?

7 A No, I wouldn't be able to even estimate  
8 that for you.

9 Q There on the first page past the cover  
10 page, which is a Bates stamp of triple ought two,  
11 0002, there is a Section 3, Roman Numeral III, where  
12 this API documents talks about probable sources of  
13 contact. Do you see the section of the document I'm  
14 referring to, Mr. Hammond? Lower --

15 A I see under that, yes.

16 Q It talks about the extensive use of benzene  
17 in the petroleum industry, talks about how it's  
18 blended into gasolines. Do you have any explanation  
19 today, Professor Hammond, why that a probable source  
20 of contact such as inhalation of crude oil fumes is  
21 not discussed here in this document?

22 A Benzene was used in that period,  
23 apparently, but not in the United States as it was  
24 commonly used in Europe where they had a lot of  
25 distillation of coal. The source at that time was

1 primarily in the coking operations where they  
2 collected the vapors from coke and condensed it down  
3 into benzene, and it was blended with petroleum  
4 products into gasoline, particularly in Europe, but  
5 not much that we knew about in the United States. I  
6 think that applied to the European practice.

7 Q A couple of last questions, Professor  
8 Hammond. If you can turn over to Exhibit 22, which,  
9 again, is your 1955 benzene exposure control  
10 document. I believe you have already explained to  
11 us, when either Mr. Baggett or Mr. Spears was asking  
12 the questions, that this document applied to  
13 processes involving, number one, pure benzene?

14 A Yes.

15 Q Like 1-A, the benzene plant?

16 A Yes.

17 Q There on the first page. But did it apply  
18 to other process streams or other possible sources  
19 of exposure?

20 A Yes.

21 Q I believe those are detailed at Roman  
22 Numeral Section III on page 2 of this document?

23 A Yes.

24 Q Particular concern is detailed for those  
25 streams at the refinery containing 5 percent or more

1 of benzene. Do you agree?

2 A I see that is with five or more, recommend  
3 appropriate control --

4 COURT REPORTER: I'm sorry. Five or  
5 more --

6 A Five percent or more benzene, recommend  
7 appropriate control items under 1-A unit and VB,  
8 capital VB, medical.

9 MR. FREEMAN:

10 Q So for process streams involving 5 percent  
11 or more by volume of benzene in that product steam,  
12 you're recommending the same engineering practices,  
13 the same medical surveillance practices as the  
14 benzene unit?

15 A As pure benzene.

16 Q Then for those process streams, refinery  
17 streams involving 2-1/2 percent to 5 percent  
18 benzene, you were requiring some particular  
19 investigation to determine the type and the quantity  
20 of exposure. Is that true?

21 A As you see there, investigate and determine  
22 the potential exposure.

23 Q But in 1955, you were not recommending  
24 either a full medical surveillance program, such as  
25 was in place for the benzene unit workers, nor were

1 you recommending investigation for those people that  
2 were exposed to the process streams or the refinery  
3 streams less than 2-1/2 percent by volume of  
4 benzene? Agree?

5 A This applies to 2-1/2, investigate and  
6 determine exposure potential for all of those  
7 particular ones. Some of them was so locked in and  
8 gastight that there wasn't any particular -- you  
9 didn't find any potential exposure. You would  
10 maybe -- you would ignore those that are inside, and  
11 some of them would even be destroyed. The streams  
12 would be destroyed before they came out into a  
13 finished product that might be released.

14 Q You said a lot right there, and I didn't  
15 quite follow. But you indicated you would ignore  
16 those, and is it my understanding that you would  
17 ignore those employees exposed to less than 2-1/2  
18 percent benzene concentration?

19 A No. All of those streams were carefully  
20 investigated and a potential exposure were  
21 determined on them and the employees were being  
22 examined and checked periodically.

23 Q So for the employees that were exposed to  
24 refinery streams containing between 2-1/2 percent  
25 and 5 percent benzene by volume --

1           A       Well --

2           Q       It was your -- let me finish the question.  
3       It was your recommendation in 1955 that those  
4       employees would be investigated, the exposure  
5       routes, the concentrations were to be investigated  
6       to determine additional data? Is that a correct  
7       statement?

8           A       No. We had at least a dozen streams that  
9       are not recorded here, and many of them were below  
10      the 2-1/2 percent. And they were also treated,  
11      employees were treated if they were exposed to 100  
12      percent benzene, anything where there was benzene  
13      that could get in the air. But we required first  
14      and foremost that the higher streams be the ones  
15      that we would investigate and determine first.

16          Q       You've already testified, Mr. Hammond, that  
17      the benzene unit that was brought on-line by Exxon  
18      at the Baytown facility in the mid Fifties was a  
19      state-of-the-art production facility? Correct?

20          A       It was a production facility for benzene  
21      manufacturing.

22          Q       It was also state of the art as far as  
23      engineering controls which you had a direct hand in  
24      implementing as far as to reduce the possible  
25      benzene exposure to those employees that worked at

1 that state-of-the-art production unit. Agree?

2 A It did, and it's spelled out in this  
3 exposure control manual.

4 Q And your benzene exposure control which you  
5 had a direct hand in authoring, which is identified  
6 as Exhibit 22, Plaintiff's Exhibit 22, that also was  
7 a state-of-the-art exposure control policy procedure  
8 or protocol? You agree with that statement?

9 A It was for that purpose.

10 Q And there is nothing in Exhibit 22, this  
11 document, indicating any special treatment for those  
12 employees of Exxon that are exposed to refinery  
13 streams of less than 2-1/2 percent benzene  
14 component?

15 A That decision was made after we had  
16 investigated the operations, and sometimes even a  
17 tenth of a percent was not permitted without putting  
18 them under medical surveillance programs. We just  
19 worked it from the top down, that we worked from 5  
20 percent down and treated 5 percent as a pure benzene  
21 and worked it on down, depending on how they were  
22 handling it, how much exposure potential it had, and  
23 put the men under the medical surveillance and  
24 phenol biology examination, depend on what we saw  
25 out there in the field.

1       Q       The first page of my copy of Exhibit 22 has  
2       a handwritten note up in the upper right-hand  
3       corner. Does your copy also have that handwritten  
4       note? Is that your handwriting, sir?

5       A       Yes, it is.

6       Q       Could you read it for me? I can't quite  
7       read it.

8       A       This control program was in operation by  
9       1955, Baytown refinery and HO&R, Humble Oil &  
10      Refining Company.

11      Q       What's the word separating 1955 and  
12      Baytown?

13      A       "In," just the word in Baytown refinery.

14      Q       You testified earlier, Mr. Hammond, about  
15      some opinions concerning the Walsh-Healey Act. Do  
16      you have an opinion today, sir, whether or not the  
17      Walsh-Healey Act applied to either Higman Towing  
18      Company or Higman Barge Lines?

19      A       I wouldn't be qualified to answer that.

20              MR. FREEMAN: Thank you. I don't have any  
21      other questions.

22

23

24

25

EXAMINATION BY MR. MYERS

1

2

3

4

Q Professor Hammond, have you met Joseph Hebert, the plaintiff in this case?

5

A Oh, no.

6

Q No?

7

A No.

8

Q Have you read his deposition?

9

A No.

10

Q Do you know what type of work he did?

11

A No, I don't know what he did. I'm leaving that up to someone else.

12

Q You have no indication at this point as to the type of employment he was engaged in for the, oh, 37 or so years he worked for Higman Barge Lines?

16

17

A I understand he was an operator on the barge.

18

19

Q During your period of employment with Exxon, you were concerned about potential exposure of benzene to employees of Exxon?

21

22

A I was.

23

Q Did you ever write or author any article, paper, internal memorandum with Exxon, when you were the chief industrial hygienist for that company,

25

1 specifically addressing Exxon employees handling of  
2 crude oil?

3 A I don't remember any publication. I  
4 participated in seminars within the company on that  
5 subject, but I didn't write it up. No, I don't have  
6 anything written.

7 Q Did you ever address any memorandums, any  
8 directives to subordinates within the company  
9 concerning potential exposure to benzene products to  
10 Exxon employees that were handling crude oil  
11 products?

12 A The letter that I referred you to,  
13 Mr. Wrightman was addressed on that matter. It was  
14 a pipeline handling of crude oil in Wyoming in which  
15 they were making tests on that oil to determine how  
16 much BS&W it had in it, and I wrote -- that letter  
17 would explain my position on that.

18 Q What was your position?

19 A That any amount of benzene that was present  
20 would require that the employee be placed under a  
21 medical surveillance test and the program that we  
22 had for benzene handlers.

23 Q Did you implement any program while at  
24 Exxon so that the products, the crude oil products  
25 that the employees of Exxon were handling would be

1 tested to determine how much benzene was contained  
2 in those products?

3 A I never did that type of examination.

4 Q How would you know that an employee was  
5 exposed to benzene by handling Exxon crude oil if  
6 the crude oil was not tested?

7 A The crude oil was tested by other  
8 individuals and by the laboratories that -- service  
9 laboratories that did that type of work.

10 Q Did you get the results of those tests?

11 A I did, whenever they contained any --

12 Q Did you ever, after receiving the results  
13 of those tests, implement any program to have the  
14 employees that were handling the crude oil placed on  
15 medical surveillance?

16 A I did.

17 Q You are certain about that?

18 A I do.

19 Q All right. And when we talk about medical  
20 surveillance, sir, what are we talking about? How  
21 often?

22 A At the first, for example, the concentrate,  
23 we started out on a weekly basis, and then we  
24 expanded that for these employees as we had more  
25 confidence that they did not show any deterioration

1 or any hypersensitivity. And finally with that,  
2 three months range, and then later on it was a  
3 half -- six months, and then a year, once a year,  
4 but never longer than a year afterwards, so long as  
5 they worked in potential exposure to benzene.

6 Q Do you have any opinion, sir, as to how  
7 much exposure to benzene it takes to have a positive  
8 result in the urine test that you would give, for  
9 example?

10 A I don't have that value in mind, but it has  
11 been determined.

12 Q And what is it?

13 A I say I don't have it.

14 Q You don't know?

15 A Well, I knew at the time, but right today I  
16 don't remember.

17 Q You have gone over the history of the  
18 identification of problems associated with exposure  
19 to benzene and you have given your opinions based on  
20 your participation in the petroleum institute, as a  
21 member, and also a member of the ACGIH. Is it  
22 correct to say, sir, that as early as 1940, when the  
23 knowledge of potential problems with benzene first  
24 became discussed in the industrial hygienist  
25 community, that the acceptable level at that period

1 of time for exposure was 100 parts per million?

2 A Federally, I don't remember that there was  
3 any established. The State of Massachusetts and the  
4 State of New York about that period developed a  
5 recommended level for their department of labor to  
6 enforce, and I don't remember the exact  
7 concentration.

8 Q But suffice it to say, and I think you will  
9 testify to this, that from that point, whatever it  
10 was, it became lower and lower and lower from the  
11 various agencies over a period of 50 years. Is that  
12 correct?

13 A I think they had settled, by 1970, on a 10  
14 parts per million.

15 Q Ten parts per million?

16 A And then -- 50 years was a little too  
17 long. I think it was more like 25 years.

18 Q What is the acceptable regulatory exposure  
19 level right now?

20 A One tenth of a part per million.

21 Q All right. What was it five years ago?

22 A Which agency?

23 Q ACGIH.

24 A Ten parts per million, I believe. And  
25 OSHA, too. But OSHA had recommended one part per

1 million back in 1978, and the Supreme Court threw it  
2 out. So they went back to the 10 parts per million.

3 Q And you were of the belief that no parts  
4 per million is the acceptable level. Is that  
5 correct?

6 A Because there are certain -- yes, because  
7 there are certain sensitive people that even  
8 Dr. Hunter, in 1939, and his diagnostic finding was  
9 that he reached that conclusion and published it in  
10 the medical literature from Boston General  
11 Hospital. Fortunately, I was working there in 1941,  
12 '42, and got to know Dr. Hunter, and he convinced  
13 me from his -- his finding with patients that only  
14 zero, and he recommended it in his article of 1939  
15 that for some people only zero concentration was  
16 safe.

17 Q But you can't reach zero concentration  
18 levels, can you?

19 A Well, you can substitute -- in addition to  
20 getting them as low as practical, you can then  
21 substitute your medical surveillance and pick up  
22 those hypersensitive people before they go beyond a  
23 certain point in their blood changes and rescue  
24 them, so to speak.

25 Q What's the concentration of benzene in the

1 air outside, in your opinion?

2 A Here in Houston, Harris County?

3 Q Yes.

4 A Not greater than one -- average of one part  
5 per billion.

6 Q Billion or million?

7 A Billion.

8 Q Are there areas in South Texas that are one  
9 parts per million in air concentration?

10 A I don't know of any that I have seen the  
11 results. I have seen some alleged concentrations,  
12 but the EPA and the Texas Board of Air Pollution  
13 Control would have all that information available by  
14 district, county, cities and counties, but I don't  
15 have it.

16 Q And I believe you mentioned in your earlier  
17 testimony that there are extremely high  
18 concentrations of benzene in cigarette smoke. Is  
19 that correct?

20 MR. BAGGETT: I'm going to object to your  
21 references to, quote, extremely high, unless you --

22 MR. MYERS: I'll rephrase the question.

23 Q That per puff, for cigarette per puff the  
24 concentration is in the area of 100 parts per  
25 million?

1           A       That is the value that was available to me  
2       in 1941 while I was associated with Harvard School  
3       of Public Health. And Dr. Drinker's students made  
4       those tests. I did not make them, so it's hearsay  
5       to me. But I have no reason not to think that  
6       Dr. Drinker and his group, being the authorities  
7       that they were on method, were able to detect that  
8       much. And that was reported to me as a student.

9           Q       And you believe that report that you read  
10      as to the 100 parts per million per puff?

11          A       I did at that time. Now, of course, I  
12      recognize that the tobacco companies may have  
13      changed the composition of the tobacco, and that may  
14      not be the same value that was found in 1930s.

15          Q       And then, of course, with the concentration  
16      of benzene in cigarette smoke, you would, I take it,  
17      reasonably conclude that secondhand smoke, that is,  
18      people that are exposed to smoke that are in a  
19      general, an area of the smoker would be exposed to  
20      high concentrations of benzene, wouldn't you?

21          A       I do not have that information. I have  
22      curiosity to know just what it might be, but I don't  
23      know how to go about getting it.

24          Q       Exxon did not provide its subcontractor  
25      employee or subcontractor employees with respiratory

1 equipment when moving crude oil, did they?

2 A It depended entirely on whether they had  
3 their own or what they were doing. And our safety  
4 department served as safety officers, and if they  
5 were doing anything different than what we would  
6 have been doing under the circumstances, handling  
7 the materials they were handling, they would have  
8 had to have had respiratory protection. Even we  
9 would furnish it to them, if they needed it.

10 Q Of course, you implemented a program when  
11 you were at Exxon to make sure that these  
12 subcontractors employees that were hauling crude oil  
13 for Exxon would be provided with respiratory  
14 equipment, didn't you?

15 A Only when we figured -- only when we  
16 analyzed the exposure and thought that they would  
17 be -- our employees would be wearing respiratory  
18 protection, we also insisted on them doing that.

19 Q And do you have any documents or any  
20 memorandums that you wrote to set up this particular  
21 program that you just mentioned to give respiratory  
22 equipment to subcontractor employees?

23 A No. I didn't remember putting it in a  
24 formal report, no, I don't recall I did.

25 Q Did you provide respiratory equipment to

1 Exxon employees that worked at service stations in  
2 the Forties and Fifties and Sixties that were direct  
3 employees of Exxon to protect them while they were  
4 pumping gasoline and petroleum products into  
5 customers' tanks?

6 A No, I don't remember we ever found that  
7 necessary.

8 Q Would you admit with me, sir, here today in  
9 this deposition under oath that those employees  
10 would be exposed to benzene vapor?

11 A No, I couldn't have any -- I don't have any  
12 information that would help you on that.

13 Q You don't know one way the other, then?

14 A I do not have any information.

15 Q Do you have any opinion, sir, as to what  
16 the concentration of benzene is in crude oil, any  
17 crude oil you can dream up?

18 A No. I understand others have looked into  
19 this but I never did do any personal investigation  
20 and I don't have any ways to limit it, what range it  
21 was.

22 Q I take it, then, when you were at Exxon,  
23 your concern over the benzene exposure with various  
24 employees was due to the concentration of the  
25 substance benzene itself, once it was taken and

1 extracted from other products and put into one final  
2 product? Is that what your major concern was, the  
3 exposure to the benzene product itself after it was  
4 purified for sale?

5 A No. The light streams that we had in the  
6 refinery, many of those employees that had to do  
7 sampling and other things had to be included in our  
8 medical surveillance program. And they didn't have  
9 benzene in any particular concentration that I  
10 recall, but they were just included because they  
11 worked around the unit that potentially might have  
12 products that would be in the boiling range of the  
13 characteristics of benzene. And so we put them in  
14 the program, too.

15 Q Would you expect that an employee working  
16 on the inland waters or on the high seas  
17 transporting crude oil on tankers or barges would be  
18 required to walk around with a respirator on?

19 A I do not know about the conditions well  
20 enough to know. You're speaking of conditions that  
21 would be equally important, how well the barge seals  
22 were to prevent leaks and any escaping materials and  
23 so forth. All of those other factors of great  
24 concentration -- I mean great importance as well as  
25 the equal concentration of the benzene that they

1 would be handling.

2 Q Are you a direct employee of Exxon at this  
3 point? Are you a salaried employee?

4 A No. I've been retired since '78.

5 Q You receive a retirement --

6 A 65, when I retired.

7 Q You receive retirement benefits from Exxon?

8 A I'm annuitant. I accumulated pension. I  
9 was there 31 years.

10 Q Are you familiar with Koch Industries, Koch  
11 Oil Company?

12 A Koch Oil?

13 Q Oil Company, Koch Industries? Have you  
14 ever heard of it?

15 A Huh-uh, I don't guess I have. I know coke  
16 was the primary source of benzene in our country for  
17 many years in the steel manufacturing, where they're  
18 coking the coal and they capture the vapors and  
19 fumes and recover it, distill it to get benzene,  
20 toluene, xylene.

21 Q Out of coal?

22 A Out of coal, soft coal.

23 Q That's not the company, though, that's the  
24 product?

25 A That was the nature of the product that

1 they had to have for steel manufacturing, coke.

2 MR. MYERS: That's all I have. Thank you.

3

4

5

FURTHER EXAMINATION BY MR. BAGGETT

6

7 Q Professor, reference has been made to  
8 Exhibit No. -- Plaintiff's Exhibit No. 22, which has  
9 been referred to as the benzene exposure control  
10 program that was in place by '55. I direct your  
11 attention to part No. 2, page 2, dealing with truck  
12 transportation, railcars and barges. Now, I ask you  
13 if this part of your report relates to engineering  
14 controls and means by which loading of barges can  
15 be -- the benzene exposure can be limited?

16 A Yes. You see, we didn't make any exception  
17 of truck or barge or railcars and so forth. Down  
18 here now, when you get down to the potential  
19 exposure, number K, you make sure that you follow  
20 those. One place in here where it mentioned that  
21 sampling, gauging the barges and others to be  
22 accomplished with respiratory protection and  
23 neoprene gloves.

24 Q Yes, sir. When you were asked about this  
25 report, there was no reference to the barge

1 controls. This sets out, does it not, how product  
2 is to be drained, how waste is recovered, how you  
3 have dripless valves and how you have automatic  
4 cutoff valves to prevent overflow, you have  
5 mechanical seals on pumps, you have calibrated probe  
6 with nitrogen for gauging during the filling. All  
7 of these were recognized back in the early Fifties  
8 as means where barge employees could be protected,  
9 were they not?

10 A We did.

11 Q Also, you were not asked about this, but  
12 look over on paragraph 5 on page 3. Were not  
13 product shipping employees, such as gaugers, truck,  
14 railcar, barge and tanker loaders, were they not  
15 involved in your medical and industrial hygiene  
16 urinary phenol program?

17 A They were, and they received periodic  
18 examination to determine if there were blood changes  
19 and so forth.

20 Q Sir, did you make it clear, when you were  
21 asked that -- was your -- when you were questioned  
22 about the refinery streams and the investigating and  
23 determining exposure potential for streams with 2.5  
24 to 5 percent benzene, did I understand you to say  
25 that after that was done you moved on to the other

1 process streams in the refinery to determine benzene  
2 content?

3 A Yes, yes, we did.

4 Q You didn't just stop because of 2.5  
5 percent?

6 A Not at all.

7 Q Sir, going back when we began this  
8 deposition, you were questioned on state-of-the-art  
9 things that were known and knowable, and you  
10 referred to exhibits that are numbered in your  
11 deposition that show going back to the Thirties.

12 A Yes.

13 Q Was it not recognized back as late as the  
14 Thirties that if you had exposure, potential  
15 exposure to benzene and if -- you determined that,  
16 in the first instance, by monitoring. Is that  
17 correct?

18 A Yes.

19 Q And if you've got potential exposure to  
20 benzene, then it has been long recommended that you  
21 should be a part of a medical surveillance program?

22 A It has in these articles that were  
23 published back in the Thirties and even in the  
24 1920's by the American Safety Council.

25 Q All right, sir. And looking as early as

1 1948 at the API bulletin, doesn't it tell you that  
2 chemically benzene is the simplest of the aromatic  
3 hydrocarbons?

4 A Yes.

5 Q Chemically, that's what it is. What is  
6 petroleum? What is crude? Isn't it hydrocarbons?

7 A It's hydrocarbons, but different  
8 configuration as far as the molecules and so forth  
9 are concerned.

10 Q But the aromatic hydrocarbons has been  
11 known, has it not, to be a part of a crude product?

12 A It has been known, yes.

13 Q And in 1948, did they not point out that  
14 benzene was used extensively in the petroleum  
15 industry? Is that correct, sir?

16 A It was. It had certain characteristics  
17 that were good for solvents. And, for example, you  
18 would take a potential lube oil and you would  
19 extract all the wax out of that lube oil with using  
20 a mixture of methyl ethyl ketone and benzene. And  
21 they were doing that in a plant that had been  
22 designed for our refinery in Baytown when I came.  
23 But we were able to substitute toluene rather than  
24 benzene, and we never bought any more benzene --

25 Q Professor Hammond --

1           A       -- for that purpose.

2           Q       -- to illustrate what was available in the  
3     petroleum industry in the Forties in the way of an  
4     industrial hygiene survey, you have testified about  
5     Exhibit P23, did you not?

6           A       I did.

7           Q       Sir, you have testified as to what was  
8     known and knowable, and that was the primary purpose  
9     for your testimony by the plaintiffs. You also have  
10    testified as to what the program was in place at  
11    Exxon during your stay as an industrial hygienist?

12          A       I did.

13          Q       Efforts were made, obviously, to question  
14    the validity of the Exxon program by Defendants'  
15    Exhibits 1 and 2. Can you tell me what these  
16    exhibits reveal so far as your program, industrial  
17    hygiene program at Exxon?

18          A       The first one in 1958, and it's Dr. Howell  
19    who did all the examination for us of these  
20    employees with potential exposure. So we worked  
21    with him on the chemical plant, on the benzene plant  
22    as well as others, and he is well familiar with it.  
23    So when we went into the refinery and we had any  
24    type of information that would be new or original to  
25    add to his knowledge, we would inform him. If he

1 saw some question in an employee that was  
2 questionable in his mind and he came from a certain  
3 unit, well, then he would let us know so that we  
4 could go back and make a survey of that unit to see  
5 how he could have been exposed to benzene.

6 Q Are these two documents just part of  
7 documents that show an ongoing industrial hygiene  
8 program that you put into place, and that is once  
9 you determined something was happening to result in  
10 a potent -- or to create a potential exposure, that  
11 steps were taken immediately to eliminate that?

12 A That was our program, yes.

13 Q And D No. 2 is actually one of the  
14 industrial hygiene surveys that were made back in  
15 1975?

16 A It was.

17 Q Sir, the reference to a TLV or a maximum  
18 concentrate by reference to the industrial hygiene  
19 standards or by reference to the TLVs adopted by  
20 OSHA, those are for regulatory purposes, are they  
21 not, to set legal limits?

22 A They are what we know, and I used to work  
23 with the Department of Labor and others, that they  
24 were enforceable limits. In other words, if the  
25 employer did not correct the problem, they could be

1 taken to court and fined for violation.

2 Q All right, sir. And when you look -- when  
3 you look back as early as 1948 at the API, when you  
4 look at Exhibit No. 9 on page 004 of the exhibit, it  
5 refers, does it not, to maximum permissible benzene  
6 concentration standards, whether they be the state  
7 standards or TLVs in effect back in the Forties. Is  
8 that correct?

9 A Yes, they did.

10 Q But still it concludes, does it not, and  
11 recognize early on that inasmuch as the body  
12 develops no tolerance to benzene and there is a wide  
13 variation in individual susceptibility, it is  
14 generally considered that the only absolutely safe  
15 concentration for benzene is zero?

16 A That is true.

17 Q And that is the standard that you tried to  
18 adopt and recognized as being applicable to protect  
19 the employees of Exxon?

20 A We followed that.

21 Q And if legally you could not accomplish  
22 that, how did you make sure that they were safe?

23 A Well, we did it by double-checking on them  
24 and biological testing in which we used the employee  
25 to make sure that his exposure had been zero or

1 undetectable. And we could run that on the phenol  
2 urine sulfate test. And so we did all of that plus  
3 the medical surveillance that they did with blood to  
4 determine if we saw any bad effects.

5 Q So in your testimony in Skeen and here  
6 today, are you recognizing a difference between,  
7 quote, what is safe because of individual  
8 susceptibility, and what is, quote, legally  
9 enforceable under a TLV or a maximum --

10 A Allowable.

11 Q -- maximum permissible benzene  
12 concentration?

13 A That's right.

14 Q There is a difference, is there not?

15 A There is.

16 Q And there is no inconsistency in what you  
17 have testified to when you refer to one as being a  
18 legal limit and the other one being what you as an  
19 industrial hygienist have recognized as being a safe  
20 exposure or limit?

21 MR. SPEARS: Object to the form of the  
22 question.

23 A Yes. We might use the word legal limit or  
24 biological unit. And mine was a biological unit for  
25 all people. And the control program included, when

1 safety manual and quoting from the API toxicological  
2 review of 1948 would not put in the safety manual a  
3 warning about the chronic benzene poisoning that can  
4 result from repeated or continuous exposure to  
5 relatively low concentrations of benzene vapor? Do  
6 you know of any reason why?

7 A I would not know.

8 Q And if that section dealing with benzene  
9 and reporting to an employee that the only safe  
10 level is zero because of individual susceptibility,  
11 can you think of any reason why that would be  
12 omitted from subsequent safety manuals of Conoco?

13 MR. SPEARS: Object to the form of the  
14 question.

15 A No, I couldn't contribute anything to that.

16 MR. BAGGETT: Or Continental Oil Company.

17 Can we go off the record, and let me run  
18 out to the car and see if I can get that '53 letter,  
19 and that will be it.

20 MR. SPEARS: It's in there, Bill. Didn't  
21 you say it was in there?

22 MR. BAGGETT: No. He refers to it in the  
23 report.

24 VIDEOGRAPHER: Off the record, 1:38.

25 [Recess]

1 VIDEOPHOTOGRAPHER: On the record, 1:45.

2 MR. BAGGETT:

3 Q Professor Hammond, reference has been made  
4 in your report, which is Exhibit P3, to a letter of  
5 February 25th, '53 by you that you discovered in the  
6 safety department of Exxon. Can you tell me what  
7 that letter -- I thought I had it with me today; I  
8 don't. It's attached to the deposition in the  
9 Norman Ellis case and in the Steve Leblanc case and  
10 both of which involve Mr. Spears. I will produce a  
11 copy to all counsel. But could you tell me what  
12 that letter described?

13 A Yes. It described a visit I made to a  
14 pipeline station located up in Wyoming which I  
15 discovered that they were using benzene as a solvent  
16 to extract the BS&W from oil bottoms that came out  
17 of their pipeline storage tanks and that this was  
18 being done in an unventilated area that was only a  
19 one person and open shop, so to speak. But I said  
20 that we could substitute a nonhazardous material  
21 relatively for the benzene and get rid of it. And  
22 then, if not, we would have to put in the medical  
23 surveillance program for all the employees that  
24 worked in that area and used the benzene.

25 Q And, sir, that was consistent with what you

1 have testified here today, and that is, so far as  
2 safety is concerned, you tried to accomplish zero  
3 exposure to benzene?

4 A Otherwise, that we would put in the medical  
5 surveillance for all those employees that worked in  
6 that area, and the only way we would make sure that  
7 they were not being exposed to danger or risk that  
8 we wouldn't want them to be with benzene.

9 MR. BAGGETT: I ask that this safety manual  
10 of Continental Oil Company marked dated July 1, 1953  
11 be attached to the deposition as Plaintiff's Exhibit  
12 No. 25.

13 MR. MYERS: I'm going to object to the  
14 attachment of it. I have not seen it yet.

15 MR. FREEMAN: How about a couple of  
16 questions, Professor Hammond, while Mr. Spears is  
17 looking through that document.

18 First off, let me reserve cross-  
19 examination, Mr. Baggett, for this witness after  
20 today concerning his 1953 letter that was attached  
21 to Exhibit 2. Higman has not been a party to those  
22 prior testimonies. Higman has not been provided  
23 with a copy of that letter.

24 COURT REPORTER: Can I mark that real  
25 quick, before it gets away?

1 MR. FREEMAN: Yes.

2 MR. BAGGETT: Or I take it that I'm not --  
3 that the testimony about that exhibit would be  
4 excluded, if you're not satisfied with it.

5

6

7

FURTHER EXAMINATION BY MR. FREEMAN

8

9 Q Mr. Hammond, Exhibit 22, there has been a  
10 great deal of discussion about your benzene control  
11 exposure document, three pages. To put this  
12 document into context, isn't it true that the  
13 company, Exxon, which you chaired the IH department,  
14 was greatly concerned about the possibility of  
15 benzene exposure to their employees in the mid  
16 Fifties because this benzene plant unit was  
17 preparing to go on-line at the Baytown facility?

18 A I can understand your question, and I will  
19 say that that did accelerate our concern. But this  
20 letter that was written in 1953 that explained what  
21 our agreements were with the operating people in  
22 1948 would clarify that, that we already had the  
23 program that zero levels was the only acceptable  
24 levels, wherever we could reach that, and otherwise  
25 that we needed the education and medical

1 benzene, is there?

2 A Yes.

3 Q Within this document itself?

4 A Yes. We already had put into the  
5 surveillance and dealing with the barge operators  
6 and any of the dock workers and others that were  
7 handling the hydrocarbons.

8 MR. FREEMAN: Object to the responsiveness  
9 of the answer.

10 MR. BAGGETT: Oh, I think it was  
11 responsive, very much.

12 MR. FREEMAN:

13 Q Professor Hammond, can you show me within  
14 Exhibit 22 where it specifically makes this  
15 procedure benzene exposure control applicable to  
16 crude oils less than 2.5 percent benzene?

17 MR. BAGGETT: First of all, that was not  
18 the question that you had asked awhile ago and the  
19 answer that you got.

20 A I don't see it here what I'm looking for.  
21 We covered that by saying and listed all of the  
22 potential exposures and others, because there were  
23 so many we didn't --

24 MR. FREEMAN:

25 Q Are you referring to someplace in Exhibit

1 22. where it says "and others"?

2 A I thought it was in 22.

3 MR. BAGGETT: It has been referred to,  
4 Counsel.

5 A Yeah, refinery streams. Look under III A,  
6 IV, that covers it, on page 2.

7 MR. FREEMAN:

8 Q That's the only place within this document?

9 A Well, it covered all those others.

10 Q Mr. Baggett asked you some questions  
11 concerning the distinctions in your opinions,  
12 Mr. Hammond, concerning legal limits and safe  
13 limits. Now, the ultimate purpose of the legal  
14 limit is not to satisfy the arbitrary whims of a  
15 state or federal bureaucrat, is it, Professor  
16 Hammond? One of the ultimate purposes of those  
17 legal limits, is it not, to not necessarily to  
18 guarantee but designed to protect the vast majority,  
19 the health and the welfare of people who are exposed  
20 to this particular harmful substance?

21 MR. BAGGETT: Excuse me. I object to that  
22 question. The effect of the legal limits is a  
23 question of law in which the jury or the court will  
24 determine, like the Walsh-Healey Act is a question  
25 of law and like TLVs will be -- legal effect of them

1 will be a question of law.

2 MR. FREEMAN:

3 Q Professor Hammond, were not the legal  
4 limits, whatever those legal limits would have been  
5 at the time and however you define those legal  
6 limits at whatever level, were they not designed to  
7 protect the majority of the health and welfare of  
8 the workers?

9 A Yes. They spell that out in the TLV  
10 booklet that you can apply these limits and it will  
11 protect most of the people but not all of them, and  
12 that the few, whether it was 10 percent or 12  
13 percent, I was just equally concerned about their  
14 welfare as I was about the 80 and 90 percent that  
15 this would protect.

16 MR. FREEMAN: Thank you.

17

18

19 FURTHER EXAMINATION BY MR. BAGGETT

20

21 Q Professor Hammond, within the four corners  
22 of the document P23, where they had sampling and  
23 gauging of barges and tanks to be accomplished with  
24 respiratory protection and neoprene gloves and these  
25 other engineering controls, was there anything, was

1 that applicable to barges that came in with  
2 hydrocarbons?

3 A It was.

4 Q When you had monitoring under the medical,  
5 industrial hygiene program where you had urinary  
6 phenols administered to product shipping employees  
7 such as gaugers, truck, railcar, barge and tanker  
8 loaders, was that applicable to people, barge and  
9 tanker loaders involving hydrocarbons?

10 A It was.

11 Q And that includes crudes?

12 A All products.

13 MR. BAGGETT: Fine.

14 VIDEOGRAPHER: Off the record, 1:57.

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SIGNATURE OF WITNESS

I, PROFESSOR JAMES HAMMOND, solemnly swear or affirm, under the pains and penalties of perjury, that the foregoing contains a true and correct transcript of the testimony given by me at the time and place stated, with changes, if any, and the reasons therefor noted on a separate sheet of paper and attached hereto, and that I am signing this before a Notary Public.

\_\_\_\_\_  
PROFESSOR JAMES HAMMOND

THE STATE OF TEXAS]

Subscribed and sworn or affirmed to before me, the undersigned authority, by PROFESSOR JAMES HAMMOND on this the \_\_\_\_ day of \_\_\_\_\_, \_\_\_\_.

\_\_\_\_\_  
Notary Public in and for  
the State of Texas

1 STATE OF TEXAS]

2  
3 COURT REPORTER'S CERTIFICATE

4  
5 I, Wanda G. Kelley, a Certified Shorthand  
6 Reporter within and for the State of Texas, hereby  
7 certify that the foregoing proceedings occurred  
8 before me.

9 I further certify that the foregoing is  
10 a true and correct copy of the transcript of the  
11 proceedings to the best of my ability.

12 I further certify that I am neither  
13 attorney for, related to nor employed by any of  
14 the parties or any attorney of record in this cause,  
15 nor do I have a financial interest in the matter.

16 Witness my hand November 23, 1993.

17  
18  
19 

20 Wanda G. Kelley, Texas CSR 2007\*

21 Nell McCallum & Associates Inc.

22 2900 Smith, Suite 104

23 Houston, Texas 77006

24 (713) 523-3767

25 \*My Certificate Expires December 31, 1994

NO. 92-6203

\*\*\*\*\*  
JOSEPH L. HEBERT AND  
MARIE HEBERT

VS.

HIGMAN BARGE LINES,  
ET AL

\* 14TH JUDICIAL DISTRICT COURT  
\*  
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\*  
\* PARISH OF CALCASIEU  
\*  
\*  
\* STATE OF LOUISIANA  
\*\*\*\*\*

On November 24, 1993, PROFESSOR JAMES HAMMOND was notified by and through CERTIFIED MAIL SERVICE, by Mr. William B. Baggett, that the deposition taken in connection with the above cause was ready for inspection and signature as evidenced by the copy of said correspondence attached hereto and made a part hereof.

As of this the 10th day of January, 1994, PROFESSOR JAMES HAMMOND has failed to appear for the purpose of reading and signing said deposition; therefore, in accordance with the Texas Rules of Civil Procedure, said deposition is being tendered to Mr. William B. Baggett.

Witness my hand on this the 10th day of January,  
1994.

Eileen Walton Cal

Eileen Walton

NELL McCALLUM & ASSOC.

HOUSTON, INC.

2615 Calder, Suite 111  
Beaumont, Texas 77702  
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2900 Smith, Suite 104  
Houston, Texas 77006  
(713) 523-3767  
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**November 24, 1993**

**WILLIAM B. BAGGETT, ESQ.**  
Baggett, McCall 7 Burgess  
P.O. Drawer 7820  
Lake Charles, LA 70606-7820

**CM/RRR # P 921 297 171**

**RE: NO. 92-6203**  
**HEBERT V. HIGHMAN BARGE LINES**

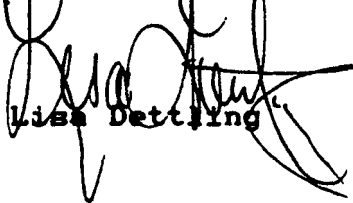
**Dear Mr. Baggett:**

Enclosed please find the original signature page from the deposition of PROFESSOR JAMES HAMMOND VOLUME 2 taken on November 18, 1993, in the above-referenced cause.

Please have the witness read your copy of the deposition, mark any corrections on the sheet provided and sign the original signature page before a notary public. If the signature certificate page is not returned to the above Houston office within twenty (20) days, the transcript will be handled as though signed.

Thank you for your assistance in this matter.

Very truly yours,  
NELL McCALLUM & ASSOC., INC.

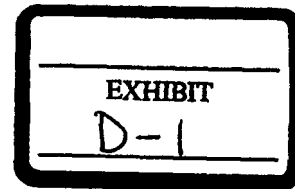
  
Lisa Dettling

**Enclosures**

**cc: Robert Myers, Esq.**  
**Mark Freeman, Esq.**  
**Kenneth R. Spears, Esq.**

**CM/RRR # P 921 297 173**  
**CM/RRR # P 921 297 172**  
**CM/RRR # P 921 297 174**

C O P Y  
HUMBLE OIL & REFINING COMPANY  
Houston, Texas  
February 13, 1958



Dr. T. S. Howell  
Baytown

This confirms our conference between you, Albert Moskowitz, S. D. Bozich and myself on the benzene plant and potential exposure to benzene. Afterward, Albert, Sam and I visited the plant. We found that the concentration range at the eye wash fountain near the oil separator at breathing level was 20-30 ppm. These low results compared to previous values were due to the unusually high wind from the north which was about 40° F. that morning. At two or three other spots downwind from leaks, such as a dripping sampling cock, the average atmospheric concentration of benzene was 10 ppm. We recognized that this was a good day for low concentration because of the unusually low temperature and high wind.

Sam and Albert proposed several corrective changes. The oil separator will be covered with a solid cover and vented through a stack above the second floor platform. A steam exhaust jet to accelerate the draft in this vent stack will be installed if there is no unforeseen problem to this addition. Sampling cocks will be re-piped so as to give a discharge point for flushing of the lines and potential leakage directly into a drain. A skimming line is to be re-routed from a drain on the ground platform to the oil separator.

The product tanks have two potential problems which are being studied. One of these problems will be solved easily by the insertion of an oil seal in the automatic gauge line. The seal will prevent benzene vapors escaping through the automatic gauge. The other problem involves sampling through the manhole on top of the tank. In the warm summer months it is probable that large amounts of benzene vapor would be present in the breathing zone of the gauger under the present arrangement. This is a point where acute exposure is potentially dangerous under all weather conditions and adequate venting or a recovery system should be installed for three product tanks and one high benzene rundown tank.

The laboratory ventilation was adequate.

The men complained of the handicap of the use of gas masks with the full face piece. They reported that this equipment obstructed their vision, added to the amount of benzene lost at the time of sampling and increased their danger of falls. In view of the short period required to sample the products, it is suggested that chemical cartridge organic vapor respirators would serve as needed in this operation. The gas mask should be held in readiness for emergency use as required for units handling highly volatile materials.

Five specimens were to be collected at 2 P.M. February 11. Mr. George Taylor reported he was in position to analyze samples for two of the three shifts beginning with those of the 11th. He will test the other samples after he has done a little exploratory investigation of the best method of preserving those which the employees leave at 2 P.M.

The unit is producing at about 90% design capacity with quality of the product completely satisfactory.

MEDICAL DIVISION  
Original signed:  
J. W. Hammond  
Industrial Hygienist

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |                                                                                                                                                                                                                           |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <p><b>Instructions:</b></p> <ul style="list-style-type: none"> <li>• Complete items 1 and/or 2 for additional services.</li> <li>• Complete items 3, and 4a &amp; b.</li> <li>• Print your name and address on the reverse of this form so that we can return this card to you.</li> <li>• Attach this form to the front of the mailpiece, or on the back if space does not permit.</li> <li>• Write "Return Receipt Requested" on the mailpiece below the article number.</li> <li>• The Return Receipt Fee will provide you the signature of the person delivered to and the date of delivery.</li> </ul> |  | <p>I also wish to receive the following services (for an extra fee):</p> <p>1. <input type="checkbox"/> Addressee's Address</p> <p>2. <input type="checkbox"/> Restricted Delivery</p> <p>Consult postmaster for fee.</p> |  |
| <p>3. Article Addressed to:</p> <p><b>WILLIAM B. BAGGETT</b><br/> <b>Baggett, McCall &amp; Burgess</b><br/> <b>P.O. Drawer 7820</b><br/> <b>Lake Charles, LA 70606-7820</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                             |  | <p>4a. Article Number</p> <p><b>P 921 297 171</b></p>                                                                                                                                                                     |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  | <p>4b. Service Type</p> <p><input checked="" type="checkbox"/> CERTIFIED</p>                                                                                                                                              |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  | <p>7. Date of Delivery</p> <p><b>11/24/93</b></p>                                                                                                                                                                         |  |
| <p>5. Signature - (Addressee)</p> <p><i>[Signature]</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  | <p>8. Addressee's Address</p> <p>(ONLY if requested and fee paid.)</p> <p><i>[Signature]</i></p>                                                                                                                          |  |
| <p>6. Signature - (Agent)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                                                                                                                                                                                                                           |  |
| <p>PS Form 3811, November 1990</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  | <p><b>DOMESTIC RETURN RECEIPT</b></p>                                                                                                                                                                                     |  |

P 921 297 171

70

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INDUSTRIAL HYGIENE  
HEALTH SERVICES

*benzene*

*D-2*

EXXON CHEMICAL COMPANY U. S. A.

EXHIBIT  
*D-2*

INDUSTRIAL HYGIENE STUDY  
OF  
AROMATICS EXTRACTION UNIT  
BAYTOWN CHEMICAL PLANT

Study By:

Mr. J. A. Allen

Mr. E. F. LeBrocq

Mr. B. G. Simpson

Report By:

Mr. B. G. Simpson

Date of Study:

October 1975

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## **I. Summary**

Environmental health conditions were evaluated at the AXU/HXU during October and November 1975..

Results of this study show:

Process technicians are not excessively exposed to high noise levels.

Significant exposure to benzene and toluene is possible when employees are collecting quality control samples and changing rich solvent filters. Installation of a closed sampling loop should eliminate excessive exposure during sample collection. Employees should wear supplied air respirators or organic vapor chemical cartridges when changing the rich solvent filters.

High concentrations of benzene and toluene were found coming from open sewer grates. Employee exposure to these vapors would exceed allowable limits. Introduction of aromatics to the sewer should be eliminated.

Housekeeping on the unit was good.

Safety showers, eyewashers, and safety equipment are well located.

## **II. Introduction**

This report is part of the ongoing environmental health program for Exxon Chemical Company U.S.A., Baytown Chemical Plant.

Industrial hygiene studies measure the working environment to determine the presence of toxic chemicals and physical agents, and evaluate employee exposure. Samples were collected that represent both actual and potential exposure.

Exposure date is evaluated by comparison with recognized standards that consider such factors as frequency of contact, duration and nature of exposure.

Industrial hygiene studies evaluate current environmental health conditions and provide a baseline to compare future operations.

### III. Process Description

#### A. Aromatics Extraction Unit

The Aromatics Extraction Unit (AXU) is a Universal Oil Products Company (UOP) process designed to extract high-purity aromatic fractions at high recoveries from a hydroformer feed containing mixed aromatics and paraffins.

Sulfolane, a solvent, is used to extract the aromatics (benzene, toluene, xylene) from the hydroformer feedstock. Raffinate from the extraction tower is returned to tankage after solvent separation. The aromatic rich solvent, containing dissolved nonaromatic hydrocarbons, proceeds to a solvent stripper tower for removal of nonaromatics.

From the bottom of the solvent stripper tower the aromatic rich solvent is pumped to the recovery tower for separation of the aromatics. The aromatics are sent to tankage prior to final finishing and the dilute solvent streams return to the water stripper and solvent regenerator.

#### B. Hexane Extraction Unit

The Hexane Extraction Unit (HXU) is co-located with the AXU. Feedstock for this unit is a powerformer stream from the LEFU, which has been fractionated to produce a hexane-octane rich cut. The HXU uses a sulfolane process to extract the benzene from the feed. The extraction tower rides "piggyback" on the AXU lean and rich solvent streams. The wash water system is common to both units. Extracted benzene proceeds from the HXU to the solvent stripper tower in the AXU.



#### IV. Unit Evaluations

##### A. Materials

Feedstock, products, and materials necessary to operate the AXU/HXU are listed below. Toxicity data sheets for the materials are found in Appendix A.

|                          | <u>Percent</u> |
|--------------------------|----------------|
| 1. <u>Feedstock</u>      |                |
| Nonaromatic              | 21.4           |
| Benzene                  | 13.7           |
| Toluene                  | 25.5           |
| C <sub>8</sub> Aromatics | 30.7           |
| C <sub>9</sub> Aromatics | 8.7            |
| 2. <u>Raffinate</u>      |                |
| Nonaromatics             | 93.4           |
| Benzene                  | 0.0            |
| Toluene                  | 0.1            |
| C <sub>8</sub> Aromatics | 1.9            |
| C <sub>9</sub> Aromatics | 4.4            |
| 3. <u>Extract</u>        |                |
| Nonaromatics             | 2              |
| Benzene                  | 15.4           |
| Toluene                  | 29.9           |
| C <sub>8</sub> Aromatics | 42.8           |
| C <sub>9</sub> Aromatics | 9.9            |

#### 4. Additives

Breaxit 8014 (Exxon Chemical) - D<sup>e</sup>mulsifier

Sulfolane (Shell Chemical) - Solvent

MAZU DF 100S (Mazu Chemicals Inc.) - Antifoam Agent

Diethanolamine (Union Carbide Corp.) - pH Control

Monoethanolamine (McKesson Chemical Co.) - pH Control

#### B. Air Contaminants

Employee exposure to toxic substances in air was determined by unit area samples, personal monitoring samples and short-term grab samples.

##### 1. Area Samples

These samples show the exposure employees would receive if they were working at the monitored location. This type sample is also used to evaluate unit "tightness" and provide a baseline for future reference. A unit plot plan showing sample locations is in Appendix B.

##### AXU Area Samples

| <u>Date</u> | <u>Sample Location</u> | <u>Location</u> | <u>Air Contaminant Level, Parts/Million (ppm)</u> | <u>Threshold Limit Value (ppm)</u> |
|-------------|------------------------|-----------------|---------------------------------------------------|------------------------------------|
| 10/7/75     | 1                      | 5' N. E410B     | Benzene - 1                                       | 10                                 |
|             |                        |                 | Toluene - Trace*                                  | 100                                |
|             |                        |                 | Xylene - Trace*                                   | 100                                |
|             |                        |                 | Hexane - N. D.                                    | 100                                |
| 10/7/75     | 2                      | 15' S. P451A    | Benzene - 1                                       | 10                                 |
|             |                        |                 | Toluene - Trace*                                  | 100                                |
|             |                        |                 | Xylene - Trace*                                   | 100                                |
|             |                        |                 | Hexane - N. D.                                    | 100                                |

\* Trace - Less than 0.1 ppm.

| <u>Date</u> | <u>Sample Location</u> | <u>Location</u> | <u>Air Contaminant Level (ppm)</u> | <u>Threshold Limit Value, (ppm)</u> |
|-------------|------------------------|-----------------|------------------------------------|-------------------------------------|
| 10/13/75    | 3                      | 2' S. P434A     | Benzene - 1                        | 10                                  |
|             |                        |                 | Toluene - 1                        | 100                                 |
|             |                        |                 | Xylene - 1                         | 100                                 |
|             |                        |                 | Hexane - N. D.                     | 100                                 |
| 10/13/75    | 4                      | 1' S. P420A     | Benzene - Trace*                   | 10                                  |
|             |                        |                 | Toluene - Trace*                   | 100                                 |
|             |                        |                 | Xylene - Trace*                    | 100                                 |
|             |                        |                 | Hexane - N. D.                     | 100                                 |
| 10/13/75    | 5                      | 1' S. P432B     | Benzene - Trace*                   | 10                                  |
|             |                        |                 | Toluene - Trace*                   | 100                                 |
|             |                        |                 | Xylene - Trace*                    | 100                                 |
|             |                        |                 | Hexane - Trace*                    | 100                                 |
| 10/13/75    | 6                      | 1' S. P422B     | Benzene - Trace*                   | 10                                  |
|             |                        |                 | Toluene - Trace*                   | 100                                 |
|             |                        |                 | Xylene - Trace*                    | 100                                 |
|             |                        |                 | Hexane - Trace*                    | 100                                 |
| 10/14/75    | 7                      | W. E461A        | Benzene - 1                        | 10                                  |
|             |                        |                 | Toluene - Trace*                   | 100                                 |
|             |                        |                 | Xylene - 1                         | 100                                 |
|             |                        |                 | Hexane - N. D.                     | 100                                 |
| 10/14/75    | 8                      | W. E461A        | Benzene - 1                        | 10                                  |
|             |                        |                 | Toluene - Trace*                   | 100                                 |
|             |                        |                 | Xylene - 1                         | 100                                 |
|             |                        |                 | Hexane - N. D.                     | 100                                 |

\* Trace - Less than 0.1 ppm.

| <u>Date</u> | <u>Sample Location</u> | <u>Location</u>      | <u>Air Contaminant Level (ppm)</u> | <u>Threshold Limit Value (ppm)</u> |
|-------------|------------------------|----------------------|------------------------------------|------------------------------------|
| 10/14/75    | 9                      | W. E461A             | Benzene - 1                        | 10                                 |
|             |                        |                      | Toluene - Trace*                   | 100                                |
|             |                        |                      | Xylene - 1                         | 100                                |
|             |                        |                      | Hexane - N. D.                     | 100                                |
| 10/14/75    | 10                     | S. P433A             | Benzene - Trace*                   | 10                                 |
|             |                        |                      | Toluene - Trace*                   | 100                                |
|             |                        |                      | Xylene - Trace*                    | 100                                |
|             |                        |                      | Hexane - N. D.                     | 100                                |
| 10/15/75    | 11                     | W. D450<br>2nd Floor | Benzene - Trace*                   | 10                                 |
|             |                        |                      | Toluene - Trace*                   | 100                                |
|             |                        |                      | Xylene - Trace*                    | 100                                |
|             |                        |                      | Hexane - N. D.                     | 100                                |
| 10/15/75    | 12                     | S.E. E420B           | Benzene - Trace*                   | 10                                 |
|             |                        |                      | Toluene - Trace*                   | 100                                |
|             |                        |                      | Xylene - Trace*                    | 100                                |
|             |                        |                      | Hexane - N. D.                     | 100                                |
| 10/15/75    | 13                     | S. T420<br>2nd Floor | Benzene - 1                        | 10                                 |
|             |                        |                      | Toluene - Trace*                   | 100                                |
|             |                        |                      | Xylene - 1                         | 100                                |
|             |                        |                      | Hexane - N. D.                     | 100                                |
| 10/15/75    | 14                     | S. T420              | Benzene - Trace*                   | 10                                 |
|             |                        |                      | Toluene - Trace*                   | 100                                |
|             |                        |                      | Xylene - Trace*                    | 100                                |
|             |                        |                      | Hexane - N. D.                     | 100                                |

\* Trace - Less than 0.1 ppm.

| <u>Date</u> | <u>Sample Location</u> | <u>Location</u> | <u>Air Contaminant Level (ppm)</u> | <u>Threshold Limit Value (ppm)</u> |
|-------------|------------------------|-----------------|------------------------------------|------------------------------------|
| 10/22/75    | 15                     | S. P464A        | Benzene - Trace*                   | 10                                 |
|             |                        |                 | Toluene - Trace*                   | 100                                |
|             |                        |                 | Xylene - Trace*                    | 100                                |
|             |                        |                 | Hexane - N. D.                     | 100                                |
| 10/22/75    | 16                     | W. P413         | Benzene - Trace*                   | 80                                 |
|             |                        |                 | Toluene - Trace*                   | 100                                |
|             |                        |                 | Xylene - Trace*                    | 100                                |
|             |                        |                 | Hexane - N. D.                     | 100                                |
| 10/22/75    | 17                     | W. P413         | Benzene - Trace*                   | 10                                 |
|             |                        |                 | Toluene - Trace*                   | 100                                |
|             |                        |                 | Xylene - Trace*                    | 100                                |
|             |                        |                 | Hexane - N. D.                     | 100                                |
| 10/22/75    | 18                     | W. P461         | Benzene - Trace*                   | 10                                 |
|             |                        |                 | Toluene - Trace*                   | 100                                |
|             |                        |                 | Xylene - Trace*                    | 100                                |
|             |                        |                 | Hexane - N. D.                     | 100                                |
| 10/22/75    | 19                     | W. D461         | Benzene - Trace*                   | 10                                 |
|             |                        |                 | Toluene - Trace*                   | 100                                |
|             |                        |                 | Xylene - Trace*                    | 100                                |
|             |                        |                 | Hexane - N. D.                     | 100                                |

\* Trace - Less than 0.1 ppm.

Results of area sampling show employee's exposure during a full eight-hour shift should be less than 10 percent of the allowable standard.

## 2. Personal Samples

Personal samples were collected on process technicians. These samples measure actual employee exposure during an eight hour shift.

### AXU PERSONAL SAMPLING DATA

| <u>Date</u> | <u>Employee Shift</u> | <u>Air Contaminant Level (ppm)</u> | <u>Threshold Limit Value (ppm)</u> | <u>Comments</u>                                                         |
|-------------|-----------------------|------------------------------------|------------------------------------|-------------------------------------------------------------------------|
| 10/7/75     | Batiste<br>7-3        | Benzene-Trace*                     | 10                                 | -                                                                       |
|             |                       | Toluene-Trace*                     | 100                                |                                                                         |
|             |                       | Xylene-Trace*                      | 100                                |                                                                         |
|             |                       | Hexane-N. D.                       | 100                                |                                                                         |
| 10/13/75    | Frazier<br>7-3        | Benzene-Trace*                     | 10                                 | -                                                                       |
|             |                       | Toluene-Trace*                     | 100                                |                                                                         |
|             |                       | Xylene-Trace*                      | 100                                |                                                                         |
|             |                       | Hexane-N. D.                       | 100                                |                                                                         |
| 10/15/75    | Frazier<br>7-3        | Benzene-Trace*                     | 10                                 | -                                                                       |
|             |                       | Toluene-Trace*                     | 100                                |                                                                         |
|             |                       | Xylene-Trace*                      | 100                                |                                                                         |
|             |                       | Hexane-N. D.                       | 100                                |                                                                         |
| 10/28/75    | Frazier<br>3-11       | Benzene-Trace*                     | 10                                 | -                                                                       |
|             |                       | Toluene-Trace*                     | 100                                |                                                                         |
|             |                       | Xylene-Trace*                      | 100                                |                                                                         |
|             |                       | Hexane-N. D.                       | 100                                |                                                                         |
| 10/29/75    | Batiste<br>7-3        | Benzene - 4.38                     | 10                                 | Collected simulated quality control samples (feed, raffinate, extract). |
|             |                       | Toluene - 15.84                    | 100                                |                                                                         |
|             |                       | Xylene-Trace*                      | 100                                |                                                                         |
|             |                       | Hexane-N. D.                       | 100                                |                                                                         |

\* Trace - Less than 0.1 ppm.

| <u>Date</u> | <u>Employee Shift</u> | <u>Air Contaminant Level (ppm)</u> | <u>Threshold Limit Value (ppm)</u> | <u>Comments</u>                                                                                         |
|-------------|-----------------------|------------------------------------|------------------------------------|---------------------------------------------------------------------------------------------------------|
| 10/29/75    | Allen<br>3-11         | Benzene- 2.27                      | 10                                 | -                                                                                                       |
|             |                       | Toluene- 1.12                      | 100                                |                                                                                                         |
|             |                       | Xylene- 4.00                       | 100                                |                                                                                                         |
|             |                       | Hexane- N. D.                      | 100                                |                                                                                                         |
| 10/30/75    | Burns<br>11-7         | Benzene- 4.23                      | 10                                 | Collected<br>quality control<br>samples (feed,<br>raffinate, and<br>extract).                           |
|             |                       | Toluene - 7.61                     | 100                                |                                                                                                         |
|             |                       | Xylene- 1.93                       | 100                                |                                                                                                         |
|             |                       | Hexane- N. D.                      | 100                                |                                                                                                         |
| 10/30/75    | Batiste<br>7-3        | Benzene- 1.71                      | 10                                 | -                                                                                                       |
|             |                       | Toluene- 1.93                      | 100                                |                                                                                                         |
|             |                       | Xylene- Trace*                     | 100                                |                                                                                                         |
|             |                       | Hexane- N. D.                      | 100                                |                                                                                                         |
| 10/30/75    | Batiste<br>7-3        | Benzene- 20.33**                   | 10                                 | Simulated<br>quality control<br>samples (feed,<br>raffinate, and<br>extract).                           |
|             |                       | Toluene- 4.67                      | 100                                |                                                                                                         |
|             |                       | Xylene- 2.93                       | 100                                |                                                                                                         |
|             |                       | Hexane- N. D.                      | 100                                |                                                                                                         |
| 11/4/75     | Batiste               | Benzene- 6.30                      | 10                                 | Peak sample-<br>simulated quality<br>control sample<br>collection (feed,<br>raffinate, and<br>extract). |
|             |                       | Toluene- 5.65                      | 100                                |                                                                                                         |
|             |                       | Xylene- 6.51                       | 100                                |                                                                                                         |
|             |                       | Hexane- N. D.                      | 100                                |                                                                                                         |

\* Trace - Less than 0.1 ppm.

\*\* Employee also changed rich solvent filter. See additional data under Short Term Samples.

### 3. Laboratory Quality Control Sampling

Personal air samples were collected while employees were sampling the feedstock, raffinate and extract. Quality control sampling takes place on the graveyard shift and requires a total of five minutes to complete. Sample lines are flushed to the pad allowing significant potential for high employee exposure.

The allowable standard for short term exposure to benzene is 25 ppm. Maximum short term exposure to toluene is 125 ppm.

#### SAMPLE RESULTS

| <u>Date</u> | <u>Name</u> | <u>Benzene (ppm)</u> | <u>Toluene (ppm)</u> | <u>Peak Exposure Standard<br/>Benzene/Toluene (ppm)</u> |
|-------------|-------------|----------------------|----------------------|---------------------------------------------------------|
| 10/30/75    | Batiste     | 1.71                 | 1.29                 | 25/125                                                  |
| 11/4/75     | Batiste     | 6.3                  | 3.78                 | 25/125                                                  |

Although the peak exposure values do not exceed allowable limits, unnecessary exposure is caused by flushing sample lines to the pad. Flushing of aromatic hydrocarbons to the pad is not a desirable work practice.

### 4. Short Term Samples (Grab)

Grab samples are used to determine employee peak exposure to transient vapors and during interminant operations. Samples were measured by use of Drager Detector Tubes, charcoal tubes and a portable hydrocarbon analyzer.

| <u>Date</u> | <u>Location</u>                                                | <u>Benzene</u> | <u>Toluene</u> | <u>Peak Exposure Standard<br/>Benzene/Toluene</u> |
|-------------|----------------------------------------------------------------|----------------|----------------|---------------------------------------------------|
| 10/20/75    | Sewer East T-440                                               | 60 ppm         | 400 ppm        | 25/125 ppm                                        |
| 10/20/75    | 10 Ft. Downwind<br>of Sewer T-440                              | 10 ppm         | -              | 25/125 ppm                                        |
| 10/20/75    | East E461                                                      | 25 ppm         | 25 ppm         | 25/125 ppm                                        |
| 10/20/75    | Downwind E461                                                  | 10 ppm         | 10 ppm         | 25/125 ppm                                        |
| 10/20/75    | Roadway Between<br>Pumps and<br>Furnace                        | N. D.          | N. D.          | 25/125 ppm                                        |
| 10/20/75    | P420 B                                                         | N. D.          | N. D.          | 25/125 ppm                                        |
| 11/4/75     | Sample Point<br>(Feed, Raffinate,<br>Extract)                  | 3 ppm          | 2 ppm          | 25/125 ppm                                        |
| 11/4/75     | Column C-4<br>Sewer                                            | 210 ppm        | 200 ppm        | 25/125 ppm                                        |
| 11/4/75     | Column C-5<br>Sewer                                            | 150 ppm        | 150 ppm        | 25/125 ppm                                        |
| 11/13/75    | Changing Rich<br>Solvent Filter<br>Cartridges (20<br>MPH Wind) | 30 ppm         | -              | 25/125 ppm                                        |
| 11/13/75    | Still Air in<br>Trash Barrel<br>for Used Filters               | 210 ppm        | 400 ppm        | 25/125 ppm                                        |

##### 5. Conclusions

Employee exposure to air contaminants based on eight hour time weighted average was found to be within standards for all samples collected except one. The sample in question was collected October 30, and was twice the allowable standard of 10 ppm benzene. Investigation showed the employee had changed the filter elements on the rich solvent filter. Air samples of this operation were collected on November 13 and showed high levels of benzene during filter replacement.

Employee exposure (eight hour time weighted average) was higher when quality control samples were collected.

Exposure to aromatic vapors from the sewer system is another point of contact likely to have caused higher exposure than would be expected from the data on unit area samples.

6. Recommendations

- a. Eliminate introduction of aromatics to sewer.
- b. Install a closed loop sampling line at each quality control sample point.
- c. Ensure filter is well flushed prior to opening the rich solvent line.
- d. Use Drager tubes to check for benzene when changing filters or breaking open lines.
- e. Employees should wear supplied air respirators or organic vapor chemical cartridges when benzene concentrations exceed 10 ppm.

C. Biological Samples

Potential employee exposure to benzene can be determined by the use of area and personal air sampling, however, the final measure is the degree of actual employee exposure.

The human body metabolizes benzene to phenol which is excreted in the urine. There is a direct correlation between benzene exposure and urinary phenol levels. The normal range of phenol in urine for unexposed people is 5-20 mg/liter.

Excessive benzene exposure is represented by urinary phenol concentrations of 80 mg/liter or greater. Samples on the following page are identified as A, beginning of shift, and B, end of shift. Results of samples show no significant employee exposure to benzene.

#### D. Hearing Conservation

##### 1. Noise Survey

Sound level measurements were made at specific locations on the AXU (see Noise Plot Plan in Appendix C). Potential hearing loss is based on the intensity and duration of noise exposure.

The table below lists noise levels measured at specific locations and allowable unprotected exposure time.

#### OSHA Permissible Noise Exposures (Table G - 16 29CFR 1910.95 [a])

| <u>Duration Per Day, Hours</u> | <u>Sound Level dBA Slow Response</u> |
|--------------------------------|--------------------------------------|
| 8                              | 90                                   |
| 6                              | 92                                   |
| 4                              | 95                                   |
| 3                              | 97                                   |
| 2                              | 100                                  |
| 1 1/2                          | 102                                  |
| 1                              | 105                                  |
| 1/2                            | 110                                  |
| 1/4 or Less                    | 115                                  |

#### AXU Noise Survey

| <u>Location No.</u> | <u>Location</u>      | <u>Noise Level (dBA)</u> | <u>Allowable Exposure Time (Hours)</u> |
|---------------------|----------------------|--------------------------|----------------------------------------|
| 1                   | S. W. Corner of Unit | 79                       | 8                                      |
| 2                   | P462                 | 90                       | 8                                      |
| 3                   | P440                 | 90                       | 8                                      |
| 4                   | P460A                | 93                       | 5 1/2                                  |

COST \$ \_\_\_\_\_  
PAID BY PLF. DEF. \_\_\_\_\_  
TBA No. \_\_\_\_\_

IN THE UNITED STATES DISTRICT COURT  
FOR THE SOUTHERN DISTRICT OF TEXAS  
GALVESTON DIVISION

EXHIBIT

D-3

SAMMIE JOE SKEEN, \$  
INDIVIDUALLY AND AS NEXT \$  
FRIEND OF ROCKY NEAL SKEEN \$  
AND ASHBY HOPE SKEEN, \$  
MINORS, As Administratrix \$  
of the Estate of WILBUR \$  
JACK SKEEN, Deceased, and \$  
JOE LYNN TAYLOR, JILL \$  
MARY CROOK, JOHN MATHEW \$  
SKEEN, and JACK CHRIS \$  
SKEEN, HAZEL SKEEN \$

VS. \$

MONSANTO COMPANY, ITS \$  
SUBSIDIARIES OR \$  
AFFILIATES \$

C. A. NO. G-82-468

PROCEEDINGS

BEFORE THE HONORABLE HUGH GIBSON

ON-LINE TRANSLATION

SEPTEMBER 30, 1986

COPY



D-3

1 not be cured if you're not detected early.

2 Q. What disease was that?

3 A. Basically by the attack on the bone marrow which  
4 destroyed -- which produced the -- and destroyed that,  
5 which was the organ that produced the blood supply.

6 Q. Was there a name for the disease?

7 A. There was a name of the disease, depending upon the  
8 particular stage in which you caught it or found it.

9 Q. Can you give us some examples?

10 A. Simple anemia was evidence of it.

11 Q. Now, you've testified now that in small amounts, low  
12 concentrations, for prolonged periods of time, 40 or 50  
13 years ago, benzene was known to cause anemia at least; is  
14 that correct?

15 A. Capable of being able to cause anemia.

16 Q. Didn't cause it in everybody?

17 A. Did not cause it, because of the known difference in  
18 susceptibility of individuals.

19 Q. What is a small amount, 40 or 50 years ago, what was a  
20 small amount of the low concentration of benzene?

21 A. Forty or fifty years ago, the criteria was that we  
22 would get it down to below a hundred parts per million.

23 Q. Forty or fifty years ago, a hundred parts per million  
24 was considered to be a low concentration; isn't that right?

25 A. Depending somewhat upon the technique you went about

1 evaluating it or monitoring it. Many researchers and  
2 people who studied carefully found that they could measure  
3 it much below that and still were getting problems.

4 Q. We'll get to the measurement, but my question is: As  
5 far as health hazards, what was a low concentration 40 or  
6 50 years ago? It was a hundred parts per million, wasn't  
7 it?

8 A. That was about the level at which they could adequately  
9 or quantitatively measure or monitor the product.

10 Q. So in the literature 40 or 50 years ago, if they  
11 discussed low concentrations or small amounts, you could  
12 safely assume that they are talking about something in the  
13 range of a hundred parts per million; isn't that right?

14 A. Yes. And if you examine the literature very carefully,  
15 you realize that they really didn't have very good  
16 information about what the concentrations were.

17 Q. Do you know what the mechanism for causing leukemia is?

18 A. Not entirely. It's a medical question that I would  
19 like to pass over. I'm not a qualified physician.

20 Q. Do you pass that on to somebody that is, like a  
21 hematologist?

22 A. I would pass that on to a specialist other than in the  
23 field of industrial medicine.

24 Q. Would a hematologist qualify?

25 A. I not qualified to answer that, because I'm not

1 could occur to someone being exposed over some lengthy  
2 period of time to 10 parts per million?

3 A. The first symptoms that we could expect to look for, if  
4 there were symptoms of some damage, would be in the blood  
5 system or in the blood counts that we measure.

6 Q. Is it your testimony that an individual exposed to 10  
7 parts per million of benzene over some prolonged period of  
8 time would have some reflection of that in his blood  
9 picture?

10 A. Not unless he's gotten some damage. It would be  
11 reflected and you could measure it easily by measuring the  
12 phenol content of urine or the urinary sulfate ratio, which  
13 would be my approach to the problem rather than the medical  
14 approach, which is blood.

15 Q. Is benzene a human leukemic, that is, does it cause  
16 leukemia in humans at the level of 10 parts per million?

17 A. I'm not aware of any experiences or cases where it was  
18 proven that 10 parts per million caused that.

19 Q. In fact, when I asked you in March if you had an  
20 opinion about the levels at which benzene is a human  
21 leukemogen as known today, that's March 1986, do you recall  
22 your answer is, the best information that we've been able  
23 to establish would be 35 to 40 parts per million and above?

24 A. That's the human cases that have come to my attention.

25 Q. Yes, sir. And you certainly wouldn't be prepared to

1 Q. Does the ACGIH also discuss substances that are known  
2 or suspected to be carcinogens?

3 A. They do.

4 Q. And leukemia is a cancer and, therefore, leukemogens  
5 are carcinogens; is that correct?

6 A. Yes. That's another definition the same way.

7 Q. Do you know what the ACGIH classifies benzene as  
8 today? Is it a known or a suspected human carcinogen,  
9 according to the ACGIH?

10 A. It probably defines it as suspected human carcinogen.

11 Q. And it's never classified it as a known human  
12 carcinogen, has it?

13 A. That is true, I believe.

14 Q. And you've been on that committee since '77 or '78?

15 A. '77, '78, yes.

16 Q. You've not made that change in the recommended or in  
17 the TLV booklets, have you?

18 A. I have not. However, I -- even though I might have  
19 voted against not including it as a human carcinogen, I was  
20 outvoted, because in our company's operations we always  
21 practiced using it as a human carcinogen and my operations  
22 and my recommendations to the company and the protection of  
23 my people was always assume it was.

24 Q. These other experts in the ACGIH committee on which you  
25 sit overruled you; is that what you're saying?

1 value.

2 Q. In any event, what was the date on the one you signed,  
3 the Exxon sheet?

4 A. That one was the 10th month, '77, October 1977.

5 Q. What did Exxon's Material Safety Data Sheet on benzene  
6 look like in 1969 and 1970?

7 A. I don't remember, but we had them. But I don't recall.

8 Q. Do you remember that you had this third page?

9 A. We had that information available in some form or  
10 another. Whether it was the third page or actually typed  
11 in on the form, I don't recall.

12 Q. Your sworn testimony is that in 1969 you were advising  
13 folks that you gave these material safety data sheets all  
14 of the same information that you were in '77?

15 A. Or the equivalence, yes, sir.

16 Q. Is it the same or the equivalent?

17 A. Yes. It may not have been the same wording, but it was  
18 to tell them that prolonged exposure would cause bone  
19 marrow injury leading to severe or fatal blood disorders,  
20 yes.

21 Q. You also told us today that in your position on the  
22 Committee on Airborne Contaminants with the ACGIH, that  
23 your position was that benzene should be listed as a known  
24 carcinogen; is that correct?

25 A. I voted for that.

1 Q. Yes, sir. In the 1977 Materials Safety Data Sheet  
2 which you signed --

3 A. Yes.

4 Q. -- how do you list benzene, under "Chronic," the last  
5 page?

6 A. Benzene is increasingly suspected as a carcinogenic  
7 chemical in man by reason of an association with leukemia  
8 in some instances of excessive occupation exposure.

9 Q. So the Materials Safety Data Sheet which you signed in  
10 1977 listed benzene as a suspected carcinogen?

11 A. Yes.

12 Q. And is there an explanation for that since you told us  
13 it was your view?

14 A. This is for the public or the customer, which is the  
15 general public, that bought the product. And with that  
16 information on there, I dare say that anyone that was going  
17 to be using the product certainly would come back for more  
18 definite information about the product. It was to  
19 stimulate and raise a red flag for them that they had a  
20 very hazardous, dangerous material.

21 Q. But even though you thought it was a known carcinogen,  
22 you said it was a suspected carcinogen because they'd come  
23 back to you, that would raise a red flag?

24 A. I would certainly have expected them to ask me for the  
25 evidence and the data.

1 Q. And what exposure would it take to lower, see any  
2 effect in the urine, assuming there were no dietary  
3 interferences at all, no other interferences, how much  
4 benzene would you have to have to show any difference at  
5 all?

6 A. Mr. Scott, we presented that yesterday on a table of  
7 the significance of what the exposure would be when the  
8 ratio of the sulfate fell below 80, and I'll refer you back  
9 to that information that's been already entered.

10 Q. That's something you would have to look at the books to  
11 tell you?

12 A. That's true.

13 Q. It's not the kind of thing that any of us would  
14 remember?

15 A. Let me mention and emphasize again, that I individually  
16 looked at anything suspiciously if it was less than 80  
17 percent, and found out how and why there was a change in  
18 this ratio.

19 Q. Isn't it true that you had to have exposures greatly in  
20 excess of 10 parts per million to affect the urine sulfate  
21 ratio at all?

22 A. You're very near the break point at 10 parts per  
23 million.

24 Q. It has to be at least 10 parts per million?

25 A. Yes. You're very near, as I say, a little above may

1 levels these folks had during those years, can you?

2 A. I would like for the jury to know that if we kept the  
3 TWA down below 10 parts per million throughout their  
4 workday, throughout their week and throughout their career,  
5 they are not going to have any significant problems in any  
6 of their life. And if we have hypersensitive people that  
7 that would be affected, they'd be detected the very first  
8 week or two that they working there, and they'd be moved to  
9 some safe operation. And they were, I'm sure, but I don't  
10 know of anyone that we -- we didn't have enough people to .  
11 run into that one in a thousand or one in a hundred  
12 thousand that you might have.

13 Q. My point is that you can't tell this jury that the  
14 Exxon folks were exposed only to one part per million or  
15 two parts per million. All you can say is, it was less  
16 than 10, correct?

17 A. We were only working to that goal of 10 parts per  
18 million.

19 Q. All right.

20 A. I'm still convinced there's no problem under 10 parts  
21 per million.

22 Q. All right. I want to ask you about that, because  
23 yesterday Mr. O'Quinn showed you an article by Lamson  
24 Blaney, which you've described as one of the medical  
25 directors of Monsanto in Massachusetts. One of the first

1 statements that he read to you -- one of the first  
2 statements he read to you was right here at the top of the  
3 page of Exhibit No. 1680, Plaintiffs, "The statement has  
4 been made informally that the maximum allowable  
5 concentration for benzene vapors should be zero." Do you  
6 remember that?

7 A. I heard that.

8 Q. You don't agree with that?

9 A. I don't think that's practical that you can live that  
10 way.

11 Q. And you weren't trying to tell this jury that Monsanto  
12 should have known that zero was the exposure level in 1950  
13 or even today?

14 A. No. I don't recommend zero as a limit.

15 Q. All right.

16 A. And I think 10 parts per million and less is  
17 sufficient.

18 Q. Now, on the hypersusceptibility question, what test can  
19 you do on a pre-employment physical to determine whether an  
20 individual is going to be hypersensitive or  
21 hypersusceptible to benzene?

22 A. Only by the history, his history, in regard to whether  
23 or not he's been exposed to benzene or some concentration  
24 of benzene in the past and had any particular reaction.  
25 That's brought out by careful medical history of him.

CONFIDENTIAL

INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

4400 FIFTH AVENUE

PITTSBURGH, PA.



INDUSTRIAL HYGIENE SURVEY

of the

Baton Rouge Refinery

LOUISIANA DIVISION

ESSO STANDARD OIL COMPANY

Baton Rouge, La.

February - April, 1949



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# INDUSTRIAL HYGIENE SURVEY

MADE FOR

ESSO STANDARD OIL COMPANY

BATON ROUGE, LOUISIANA

FEBRUARY 23 - APRIL 20, 1949

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Arrangements for this survey were made in 1948 through the office of Dr. R. C. Page, General Medical Director, Standard Oil Company (N.J.). It is a part of a larger study which will include four plants of the Esso Standard Oil Company, Sarnia Refinery of Imperial Oil Limited, and the Aruba Refinery of Lago Oil and Transport Company. Field work at all the plants will have been completed before the submission of this report. The field work at Baton Rouge embraced the period February 23 to April 20, 1949. Mr. J. F. Morgan was present at the refinery for the entire period of the work, Mr. W. C. L. Hemeon spent two weeks at the refinery, and Mr. George F. Haines, Jr., of the Foundation staff, assisted during a period of two weeks.

Persons in Standard Oil Company (N.J.) directly concerned with the work are Dr. Joseph P. Holt and Mr. N. V. Hendricks; in the Esso Standard Oil Company headquarters, Dr. John S. Denholm and Dr. Clyde M. Berry. At Baton Rouge, the official contact was Dr. Howard Hansen.

During the course of the survey, close association was established with Mr. E. Staurverman, Jr., Mr. Roy E. Brady, and Mr. Stanley Day, of the Safety Department.

The important conclusions of the survey are highlighted in the "Summary" section of the ensuing pages.

## SUMMARY

There are four principal classes of materials of significance in the present considerations.

(1) Materials which are known from experience to cause slowly developing toxic effects when workers are chronically exposed to atmospheric concentrations above certain levels, as lead dust, silica dust, benzol vapor, and the like.

The severity of exposure to this class in conventional manufacturing processes in factory buildings can usually be appraised quantitatively by analysis of the workroom air. Situations in the oil refinery where this could be done were few.

(2) Materials whose primary action is acute poisoning from short-time exposures. The acute poisoning may be effected by a single exposure incident. They usually have no chronic effects at lower concentrations. Carbon monoxide is an example. Asphyxiant or narcotic concentrations of carbon dioxide and aliphatic hydrocarbon vapors are in this category.

(3) Materials, as acid gases, which are irritating to breathe, repulsive, and hence, obvious in their presence; therefore, these warning properties tend to discourage exposures to injurious concentrations, except as they occur in accidents.

(4) Materials as PHN,  $C_9$ , and related aromatics which, because of their physical or chemical relationship to classes of known physiologically active materials, may be suspected of having deleterious health effects but about which there is no evidence from human exposures to permit of their accurate classification.

In the following tables, exposures of refinery employees to materials which are classified above are separated according to the evaluation arrived

at in the course of the survey. Table I summarizes the exposures where it was possible to conclude that a definite health hazard existed.

Table II summarizes potential exposures to substances definitely known to be harmful, but where our observations indicated the intensity of exposure to be within safe limits.

Table III describes the largest and most important class of exposures where there is no experience to guide one to any definite conclusion, but wherein by inference (necessarily somewhat tenuous), we are led to suspect the possibility of hazardous conditions. In these cases, medical supervision of workers is indicated, so that by means of periodic examination of special design, any incipient health effects will be detected before widespread development occurs.

We have included in Table III the already recognized potential carcinogen hazards in exposures to the high boiling cut from catalytic cracking, wax pressing, OLA tars, and unknown substances from alcohol manufacture. Not heretofore recognized is the possibility of oil mist inhalation in various localities. Some measurements of oil droplet concentrations in atmospheric suspension have been made in various locations.

Table IV summarizes exposures to materials which are conservatively estimated to be innocuous or of negligible toxicity at the levels of concentration encountered in practice.

Table V summarizes recommendations for mechanical improvement of conditions in several locations.

In general, and to the credit of the executive attitude at this refinery toward safety and health, many of the hazards discussed in this report had already been recognized. Corrective measures have been instituted widely.

Table I

## HAZARDOUS EXPOSURES TO MATERIALS OF KNOWN TOXICITY

| Operation or Location                   | Substances or Conditions                                                                 | Employee Group Affected             |
|-----------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------|
| Paracril Plant                          | Acrylonitrile--by inhalation in vicinity of latex and coagulation pots.                  | One or two process men.             |
| Catalyst Plant                          | Chromic oxide, various other raw materials and products--by inhalation and skin contact. | The 13 catalyst plant workers.      |
| Sandblast Sheds                         | Silica dust--by inhalation.                                                              | Sandblaster helpers                 |
| Pipe Shop in Chemical Products Division | Metal fumes have produced symptoms of metal fume fever.                                  | Boilermakers, welders, and burners. |
| Brick grinding Shed.                    | Silica dust enters shed from sandblast.                                                  | One man of Mason Department.        |

Table II

## EXPOSURES TO HAZARDOUS MATERIALS JUDGED TO BE WITHIN SAFE LIMITS

| Operation or Location                         | Substances or Conditions                                                                                                                         | Employee Group Affected                                                       |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Butyl Rubber                                  | Methyl chloride in vicinity of reactors and in finishing building. Safe usage by reason of process control, ventilation, and daily air analysis. | Process and mechanical workers in these areas.                                |
| Butyl Rubber Finishing Building               | Talc dust at packaging.                                                                                                                          | Packers                                                                       |
| Butyl Rubber Reactors                         | Aluminum chloride exposure is controlled by wearing respirators.                                                                                 | Process workers in the reactor area.                                          |
| Alcohol Plant                                 | Inhalation of acetaldehyde is at present prevented by use of respirators.                                                                        | A few process workers in alcohol denaturing.                                  |
| Anti-freeze production in Alcohol Area.       | Methyl alcohol exposures are controlled by informed personnel and natural ventilation.                                                           | Process workers and pipe-fitters assigned to the area.                        |
| Paracril Plant                                | Acrylonitrile--in control rooms and in finishing building beyond coagulation pots.                                                               | Machinists, process workers, except attendants at latex and coagulation pots. |
| Light Oil Treating Plant                      | Lead--mist at ground level from aeration in doctor regeneration.                                                                                 | Process workers at ground level.                                              |
| Shell Still Batteries No. 16 and No. 17.      | Hydrogen sulfide exposures slight in receiving houses.                                                                                           | Still operators and helpers at the units.                                     |
| No. 2 D. & S., Hydrogen Sulfide Recovery Unit | Leakage of hydrogen sulfide is effectively prevented in the process equipment.                                                                   |                                                                               |
| Tetra Ethyl Lead Blending Plant               | Tetra ethyl lead--satisfactory control measures are practiced.                                                                                   | Blending plant employees, machinists, pipefitters, and laborers.              |
|                                               | Gasoline anti-oxidants--skin contact is unlikely in present mode of handling.                                                                    |                                                                               |

Table II  
(Continued)

| Operation or Location                                        | Substances or Conditions                                                                                                                                                                 | Employee Group Affected                                                      |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Wax Presses--<br>Plate Repair Shop                           | Method of removing suspected carcinogenic material from plates before repair acts to prevent skin contact.                                                                               | Plate shop personnel                                                         |
| Wax Presses--Refrigeration Unit                              | Paraffin Distillate, Foots Oil--no important exposures occur.                                                                                                                            | Process workers                                                              |
| Grease Manufacturing Plant                                   | Dust of dry grease ingredients. Not significant by reason of low toxicity or infrequent occurrence of exposures.                                                                         |                                                                              |
| Light Ends Plant and Gas Compressor Houses                   | Hydrogen sulfide is generally not a chronic toxic hazard at those places where it occurs in the process streams because of the degree of confinement and the ventilation of such places. |                                                                              |
| Machine Shop                                                 | Metal spray and nitrogen oxides, safe by reason of infrequent use of toxic metals and outdoor location.                                                                                  | Machinists                                                                   |
| Lead Melting Pot (portable)                                  | Insignificant exposure by reason of low frequency.                                                                                                                                       | 1 Boilermaker helper.                                                        |
| General, at Process Units                                    | Mercury, with reference to skin contact with liquid.                                                                                                                                     | M. & I. workers                                                              |
| Underground Lead-sheathed conduits                           | Lead fumes. Infrequent occasion for fume evolution.                                                                                                                                      | Electricians                                                                 |
| General, in furnaces of process units and boiler houses.     | Silica dust in furnace breakdown and repair.                                                                                                                                             | Masons, Laborers                                                             |
| Underground Pipes where digging is required to locate leaks. | Heavy aromatics boiling above 700°F, skin contact.                                                                                                                                       | Laborers--exposures are fairly well eliminated by present control practices. |
| Barges, repair of                                            | Lead fumes from welding.                                                                                                                                                                 | Welders                                                                      |
| Tanks in Tetra Ethyl Lead Service                            | Tetra Ethyl Lead and residues.                                                                                                                                                           | Laborers                                                                     |
| Refinery Lab.                                                | Aniline. Mercury vapor.                                                                                                                                                                  | Lab. personnel                                                               |
| Printing Standards                                           | Volatile solvents and process liquids.                                                                                                                                                   | Machine operators                                                            |

Total Package- B114

35-1/1130

\_\_\_\_\_ 19 \_\_\_\_\_

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Table V  
(Continued)

| Operation or Location                                                 | Substances or Conditions                  | Remarks                                                                                     | Type of Mechanical Remedy Applicable             |
|-----------------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------|
| Sandblast Sheds                                                       | Silica dust.                              | For protection of sandblast helpers and others in vicinity.                                 | Confinement of silica dust.                      |
| Paint Shop                                                            | Paint removers likely to contain benzol.  |                                                                                             | Exhaust booth.                                   |
| Pipe Shop, Chemical Products Area                                     | Metal fumes.                              | Welding non-ferrous alloy pipes.                                                            | Local exhaust system.                            |
| Catalytic Cracking Units                                              | Catalyst                                  | With reference to welders' work at turnaround.                                              | Respirator should be worn beneath welder's hood. |
| Lead Burners Shops; at No. 3 Acid Plant and in Chemical Products Area | Lead fumes                                | General room ventilation does not effect dilution of fumes between torch and burner's nose. | Local exhaust system.                            |
| Refinery Laboratory: Gas Analysis Room                                | Mercury vapor                             |                                                                                             | Improve floor surface to facilitate cleaning.    |
| Old Boiler Shop                                                       | Fumes from pre-heating Hastelloy D tubes. | Question of nickel carbonyl formation.                                                      | Extension of hood over furnace.                  |

## PROCESS WORKERS

### CHEMICAL PRODUCTS DIVISION

#### CRACKING DEPARTMENT

##### Paracril Plant.

The principal process involved here is the polymerization of butadiene and acrylonitrile. Other substances besides the reactants are:

Daxad 11  
PX 441 (di-tertiary-butyl-para-cresol)  
Caustic soda  
Acetic acid  
Lorol mercaptan  
Hydroxylamine hydrochloride  
Candelilla wax  
Superloid

Number of Employees and Their Principal Stations. In the finishing building, three or four men per shift spend most of their time at the station alongside the drying oven. One or two men are active at the conveyor line where rubber enters the drying oven. Three or four men are engaged fairly steadily at the packaging end of the conveyor. One man intermittently tends the control panel behind the coagulation pot. It is estimated that he is in this locality approximately half of the time.

Reactor Control Room. One man per shift works here fairly steadily.

Control Room Over Strippers. One man works here full-time per shift. In addition to the above locations, there is intermittent attendance by the personnel already mentioned to the reactors, pumps, refrigeration unit, feed drums, storage shed, etc.

Exposures Incident to Normal Operation. Attention was directed principally to the possibility of inhalation of vapors of acrylonitrile. This was done for two reasons: First, the probable toxicity of acrylonitrile to man, as

indicated by animal experiments, is greater than with other materials present in this plant; secondly, the properties and the quantities of acrylonitrile, and the conditions of its use in the process, indicate a greater chance for absorption of this substance by the men than for the other substances used.

Appreciable concentrations of acrylonitrile are most likely in the vicinity of the coagulation pot in the finishing building, because at this point the product and reactants first reach an unenclosed vessel. An exhaust hood stands several feet over the top of the pot.

Measurements of acrylonitrile vapor on the platform near the control panel showed 90-180 parts per million in samples collected over a period of several hours on two different days.

Samples collected in the following locations showed negligible or trace amounts of acrylonitrile vapor in air:

- (1) control room at reactors
- (2) control room over strippers
- (3) entrance end of drying oven in finishing building
- (4) operator's desk in finishing building

Concentrations at other outdoor locations, such as the vicinity of recycle pumps, charge pumps, knock-out drums for compressors, and charge drums would also be expected to be negligibly low. The question of the possibility of fairly high exposures at repeated intervals in the act of sampling the reaction mixture for completeness remains open. Sampling commences at the reactors about four to five hours after the start of reaction and continues thereafter for the duration of the reaction. Samples are taken with increasing frequency until the rate of once every 20 minutes is reached. We obtained an estimate of an average frequency of approximately once an hour. There is undoubtedly some vapor exposure at sampling, as evidenced by the strong odor in the vicinity of the sampling lines.

Total Package- B121

35-1/1130

19

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Dollars

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Information is lacking on the effects of prolonged or repeated inhalation of acrylonitrile in known concentration ranges by man. The published maximum allowable concentration for this substance is 20 parts per million. This figure was arrived at after animal experimentation by the U. S. Public Health Service. Guinea pigs and other species showed kidney damage. An observation was made that the action of acrylonitrile resembled that of inorganic cyanides for which 20 p.p.m. had previously been accepted as the limit.

We conclude from our observations at this plant that there is some possibility of chronic intoxication from prolonged work in the vicinity of the latex and coagulation pots. Extension of the exhaust hood face to the level of the top of the pot would effectively reduce acrylonitrile concentrations on the working platform. Close medical supervision of men working in this area is advisable.

#### Steam Cracking Plants, No. 1 and No. 2.

Materials and Processes. Gas oil is cracked in the presence of steam to produce ethylene, propylene, butadiene, an aromatic distillate containing isoprene, aromatic tar, heavy fuel oil, gas oil, and some residual gas. A clay treating plant at OLA-2 removes a gummy polymer from the aromatic distillate.

Exposures. In the routine operation of these units, exposures to inhalation of vapor are infrequent. The men spend most of their time in and around the control houses which are isolated from process materials. The necessity for collecting samples, making valve adjustments, inspecting equipment, and making changes in operation takes the men to areas where vapors may occur. This process equipment is out-of-doors. Time spent in such areas is of short duration. Vapor exposures are of short duration and infrequent.

Skin contact with the process material does not occur in normal

Total Package- B120

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operation. Unusual events may cause spills and leaks necessitating contact, principally with the hands and feet.

Significance of Exposures. The aromatic distillate is important toxicologically because it contains benzene, toluene, and xylene to the extent of approximately 29 volume per cent. Another 12 per cent of the fraction consists of aromatics boiling between 302°F. and approximately 450°F. It is impossible to obtain a knowledge of concentrations of these substances in air which may be encountered in those infrequent occasions when exposures occur because of their transitory nature. Since benzene is the most toxic and most volatile compound in this group, evaluation of exposures to it is of paramount importance. Evaluation under the supervision of the medical department, on the basis of urine sulfate ratio determinations for the group of process people most likely to be exposed is recommended. A discussion of this evaluating technique occurs in the appendix.

The aromatic tars produced at these units are included in the program for control of suspected carcinogenic materials. Pumps, vessels, and lines containing the tars have been labeled and precautions have been put in force. Contact with these tars by process people is infrequent, according to our observation of normal processing activity.

#### Butadiene Extraction Plants.

Materials and Processes. A product stream from steam cracking containing C<sub>4</sub> mono and diolefins goes to butadiene extraction units 1 and 2 for removal of butadiene. The process includes the preparation of cuprous ammonium acetate, its reaction with the hydrocarbons, and the subsequent separation of butadiene. One ammonia refrigeration unit serves the two extraction plants.

Tertiary butyl catechol is added to butadiene as it goes to storage

in the following manner: The inhibitor is removed from the can or fiber drum in which it is received; it is melted in a pressure drum, dissolved in butadiene to make a concentrated solution, and is then metered into the butadiene on its way to storage. A control house for the extraction plant is isolated, materials of great toxicity are not present, and exposures of men by skin contact or inhalation are not frequent in normal operation.

#### Isobutylene Extraction Units Nos. 1, 2, and 3.

Materials and Process. Butylene streams from the petroleum products division and from the butadiene extraction units undergo sulfuric acid extraction. Isobutylene and butylene are the products.

Exposures. Prolonged vapor exposures do not occur in the normal operation of this plant.

Significance of Exposures. The feed stock and products are simple asphyxiants and anesthetics. Very high concentrations for a prolonged period would be necessary for the anesthetic effect to be noticed. Health hazards at these plants consist only of the accident hazard connected with the handling of sulfuric acid. Extensive precautions are taken.

#### Diolefin Extraction Unit.

Aromatic distillate discussed under the heading "cracking plant" is treated at this unit for the removal of isoprene. It will be recalled that in this stream, benzene, toluene, and xylene make up a fraction amounting to 29 volume per cent of the total. Opportunities for exposure are approximately the same as at the cracking plant. Similar medical control is recommended for the men who work here. Vapor concentrations in the air at breathing level of worker at the unit are too transitory to permit appraisal of the hazard on the basis of *air samples or monitoring.*

## BUTYL RUBBER UNITS

There are three similar polymerization units, two of which are operating. One finishing building is in operation.

Materials and Process. Isobutylene and isoprene are polymerized to form butyl rubber. Aluminum chloride is used as a catalyst. Spent catalyst is hydrolyzed, neutralized, and discarded (2,000 pounds of aluminum chloride are received and used every 10 days).

Methyl chloride: This solvent finds large scale use as a carrier for the reactants and as a solvent for the catalyst. Methyl chloride is stripped from the polymer slurry, purified, and reused. (Loss of methyl chloride is in the range of 12,000 to 15,000 pounds per day. Of this amount, 4,000 pounds represents the unaccounted-for loss.)

Caustic solution: Caustic is used in neutralization of hydrochloric acid.

Zinc stearate: Zinc stearate is formed at the plant from stearic acid, zinc sulfate, and caustic. Its production is on a small scale, amounting to six batches in a 24-hour period. Zinc stearate for both polymerization units is formed in one location.

Phenyl-beta-naphthylamine is added as an inhibitor. It is received as a dry powder and about six times a day, a solution containing six shovelfuls of powder is prepared. Its use amounts to about 180 pounds a day.

Xylol mercaptan is used as a plasticizer. It is made up in kerosene solution and is added to the rubber at the extruders in the finishing building.

Talc is dusted onto the finished product prior to packaging.

Exposures.

1. Control houses for the two polymerization units are isolated from the process units. The 12 men per shift who control the polymer units spend the greater part of the time in and around the control houses. They are, therefore, isolated from exposures to vapors escaping from the units. Instruments in the control house are of the receiver type except for the spectrophotometer room in each house, which has stream lines bringing small amounts of the volatile reaction mixture into the instruments. These rooms are well-ventilated by both exhaust and supplied air systems.

2. Manufacture of zinc stearate. This batch-wise process is performed twice a day by one man. Technical stearic acid and zinc sulfate are added by shovel to a reactor. Stearic acid is non-toxic and non-dusty. The technical grade contains other fatty acids as impurities. They are likewise non-toxic. Zinc sulfate is a material of low toxicity. The actual time spent in moving it to a reactor is so short that, even if dust arose, exposure time would be practically negligible.

3. Preparation of PBN solution. Twice per shift one man moves six shovelfuls of the powder into a solution drum. It might be expected that in so doing there would be some contact between the material and the skin, and that he might inhale some dust. PBN itself has not caused any acute toxic effects at this installation. The possibility that one or more of its cancer-forming homologues might be present as an impurity is sufficient to make advisable the use of a respirator during the time the material is being transferred.

4. Preparation of aluminum chloride solution. This irritating and dusty operation, for which a respirator is worn, is performed by one man in about 10 minutes every third day. Handling this material is a nuisance, but not a health hazard.

Table III  
(Continued)

| Operation or Location           | Substances or Conditions                                                                   | Employee Group Affected                                                                                 | Nature of Possible Effects                                                                     |
|---------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Wax Presses                     | Wax, Paraffine Distillate, Foots-Oil, Pressed Oil--as liquid or in the form of mists.      | Lube and Paraffine employees, machinists, and pipefitters assigned to this area.                        | Cancer (?)                                                                                     |
| Wax Presses--Refrigeration Unit | Paraffine Distillate, a suspected carcinogen.                                              | Machinists and pipefitters in repairing coolers.                                                        | Cancer(?)                                                                                      |
| Crude Scale Wax Sweaters        | Crude scale wax and oil, possibly carcinogenic, depending on prior treatment of the stock. | Pipefitters.                                                                                            | Cancer(?)                                                                                      |
| Solvent de-waxing (MEK) Plant   | Vapor of benzol, <sup>?</sup> occurs in low concentrations in working areas.               | Process workers, machinists and pipefitters assigned to the unit.                                       | Upset of urine sulfate ratio in simple exposure cases; blood changes in cases of intoxication. |
| Grease Manufacturing Plant      | Inhalation of mists and skin contact with grease ingredients and products.                 | Grease Plant employees.                                                                                 | Unknown                                                                                        |
| Lube Oil Treating               | Sulfur dioxide or sulfuric acid mist.                                                      | The problem of irritation may be critical in employees in agitator area having unusual pre-disposition. | Abnormal tooth decay; upper respiratory irritation.                                            |
| Phenol Treating Plants          | Phenol vapor                                                                               | Workers at Phenol Plant, especially sample takers and pipefitters.                                      | Unknown<br><i>Skin - Acute</i>                                                                 |
| Thermal Cracking Units          | Oil mist and vapor, including clarified oil from catalytic cracking.                       | Sample takers and other process people, pipefitters assigned to the units.                              | Cancer (?)<br><i>HCCGO.</i>                                                                    |

Total Package B116

35-1/1130

10

\$

Dollars

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Table III  
(Continued)

| Operation or Location                         | Substances or Conditions                                                                                     | Employee Group Affected                                                               | Nature of Possible Effects                                                  |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Steam Cracking—Units in Petroleum Products    | Aromatic distillate because of benzol content.                                                               | Sample takers and other process people, pipefitters assigned to the units.            | The same signs of exposure and intoxication outlined for benzol previously. |
|                                               | Aromatic tars and clarified oil from catalytic cracking.                                                     |                                                                                       | Cancer (?)                                                                  |
| Catalytic Cracking Units                      | Clarified Oil and slurry oil when encountered either as liquid or as mist at hot oil pumps.                  | Process people and mechanical crafts assigned to these units, especially pipefitters. | Cancer (?)                                                                  |
|                                               | Silica-alumina catalyst--dust inhalation, also entry into eyes.                                              | Significant for pipefitters, welders, masons, and laborers.                           | Eye irritation; lung abnormalities (?)                                      |
| Power and Boiler Houses                       | Noise                                                                                                        | Full-time employees of these places.                                                  | Impairment of hearing                                                       |
| Barisol Plant                                 | Carbon tetrachloride, ethylene dichloride.                                                                   | Former process workers and pipefitters and machinists formerly assigned here.         | Liver abnormalities                                                         |
| Machine Shop. Disassembly to re-assembly Shop | Aromatic tars and oils boiling above 700°F, spilled from undrained equipment and accumulating on the ground. | Machinists.                                                                           | Cancer (?)                                                                  |
| Pipe Shop in - Petroleum Products Division    | Lead fumes may be encountered in future work on bonded lead pipe.                                            | Boilermakers, welders, and burners.                                                   | Increased lead in urine and blood as evidence of exposure.                  |

Total Package- B115  
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Table III  
(Continued)

| Operation or Location                                                | Substances or Conditions                                            | Employee Group Affected   | Nature of Possible Effects                                    |
|----------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------|---------------------------------------------------------------|
| Lead Burners Shops at No. 3 Acid Plant and in Chemical Products Area | Lead fumes, especially from bonding.                                | Lead burners and helpers. | Increased lead in urine and blood as evidence of exposure.    |
| Main Electric Shop                                                   | Varsol and Xylenes                                                  | Shop electricians         | Irritation of eyes and nose, nervous and digestive disorders. |
| General, throughout refinery                                         | Solvent vapors from cements for insulating materials.               | Insulators.               |                                                               |
| Disposal Dump                                                        | Oil smoke, fumes, and mist. (Heavy aromatic wastes)                 | Laborers                  | Cancer (?)                                                    |
| Bubble Towers throughout refinery                                    | Hydrocarbons from gas oil to heavy tar. Skin contact.               | Laborers                  | Skin effects. Cancer (?)                                      |
| Tube Cleaning, general                                               | Coke dust                                                           | Laborers                  | Respiratory disorders                                         |
| Vertical Soaking Drums at Thermal Cracking Units                     | Skin contact with tar and coke from thermal cracking.               | Laborers                  | Skin effects. Cancer (?)                                      |
| Condenser Boxes at Thermal Cracking Units                            | Skin contact with tar.                                              | Laborers                  | Skin effects. Cancer (?)                                      |
| Paint Shop                                                           | Inhalation of benzol in use of paint remover. Frequency is unknown. | Painters                  | Upset urine sulfate ratio in simple exposure cases.           |
| General                                                              | Benzol occurring in other paint products.                           | Painters                  | Upset urine sulfate ratio in simple exposure cases.           |
| Asphalt Processing                                                   | Mists and vapors                                                    | Asphalt workers           | Cancer (?)                                                    |

Table IV

## EXPOSURES OF LOW INTENSITY TO MATERIALS OF A LOW ORDER OF TOXICITY

| Operation or Location                              | Substances or Conditions                                                   | Employee Group Affected           |
|----------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------|
| Paracril Plant                                     | Butadiene vapor                                                            | Process and mechanical.           |
| Butadiene Extrac-<br>tion Unit                     | Mono- and di-olefins                                                       | Process and mechanical.           |
| Isoprene Extrac-<br>tion Unit                      | Butylenes                                                                  |                                   |
| Diolefin Extrac-<br>tion Unit                      | Acetone                                                                    |                                   |
| Butyl Rubber<br>Plants                             | Zinc sulfate, stearic acid, and zinc stearate.                             | Process workers in reactor group. |
| Alcohol Plants                                     | Hydrocarbon feed stocks and low-molecular weight products and by-products. | Process and mechanical.           |
| Light Oil<br>Treating Plant                        | Petro Green D Dye.                                                         | Treating Plant porters.           |
| Tetra Ethyl Lead<br>Blending Plant                 | Petroleum dyes                                                             | Blending Plant workers.           |
| Propane de-waxing,<br>de-oiling,<br>de-asphalting. | Propane                                                                    |                                   |
| Wax Filter Plant                                   | Bauxite                                                                    |                                   |
| Lube Filter<br>Building                            | Dust of Attapulugus clay.                                                  |                                   |
| Specialty Stills<br>(1929 Plant)                   | Petroleum vapors                                                           |                                   |
| Generally,<br>throughout<br>refinery.              | Welding fumes                                                              | Welders and burners               |
| Generally,<br>throughout<br>refinery.              | Fumes from burning coke deposits.<br>Good ventilation is provided.         | Welders                           |

TABLE IV  
(Continued)

| Operation<br>or Location   | Substances or Conditions | Employee Group<br>Affected                                                                                   |
|----------------------------|--------------------------|--------------------------------------------------------------------------------------------------------------|
| Catalytic<br>Cracking Unit | Asbestos                 | Placed in this<br>table with reference<br>to exposures at<br>turnaround for<br>welders, masons,<br>laborers. |
| M. & I. Shops              | Varsol vapor             |                                                                                                              |
| UOP Poly Plant             | H <sub>2</sub> Sil Dust  | Laborers                                                                                                     |
| Railroad Car<br>Unloading  | Brick Dust               | Laborers                                                                                                     |
| Bricklaying<br>sites       | Brick Dust               | Masons                                                                                                       |

Table V

## RECOMMENDATIONS FOR MECHANICAL IMPROVEMENT OF CONDITIONS

| Operation or Location                                                     | Substances or Conditions                                                     | Remarks                                                            | Type of Mechanical Remedy Applicable                             |
|---------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------|
| Paracril Plant                                                            | Acrylonitrile vapor                                                          |                                                                    | Improved hood over coagulation pot.                              |
| Butyl Rubber Plant                                                        | PBN                                                                          | Inhalation of dust during preparation of solution.                 | Dust respirator on exposed worker.                               |
| Butyl Rubber Finishing Building                                           | Talc dust.                                                                   | At packaging of finished product.                                  | Improved hoods to capture dust at scales.                        |
| Catalyst Plant                                                            | Dust of chromic oxide and a variety of other materials.                      | Multiple dust sources throughout the building.                     | An extensive exhaust ventilation system for the plant.           |
| Tetra Ethyl Lead Blending Plant.                                          | Gasoline dyes.                                                               | Dusty for short periods during preparation of solution.            | Use of respirator by the one person who shovels dry dye.         |
| Grease Manufacturing Plant                                                | Mist of grease ingredients and products.                                     |                                                                    | Improved hoods over heating, saponification, and mixing kettles. |
| Lube Oil Blending                                                         | PX 441                                                                       | Disagreeable odors and mist at solution preparation.               | Exhaust hood.                                                    |
| Machinists' <sup>AD</sup> Disassembly and <sup>PUMP</sup> Reassembly Shop | Liquid material spilled from pumps, etc., some of which may be carcinogenic. |                                                                    | Installation of floor drain beneath disassembly location.        |
| M. & I. Shops                                                             | Spilled mercury                                                              | Exposure not hazardous at present. Chance for future accumulation. | Improved floor surfaces to facilitate cleaning.                  |
| Main Electric Shop & 9                                                    | <u>Vargol</u> and <sup>Steam</sup> Xylol vapors <sup>leaks</sup>             |                                                                    | Exhaust hood for spraying.                                       |

5. Supervision of reactor performance requires periodic visits several times per shift on the part of the process men to the pump and reactor areas. The pump areas have roofs, but no side walls. The reactors were formerly enclosed in a building. These buildings have had a section of the side walls removed for increased ventilation. At the time when we were searching for areas of possible high methyl chloride concentrations, there was great air movement through these reactor buildings, which precluded the possibility of accumulation of high concentrations.

6. Finishing building.

(a) Attendants at Oliver filters and vibrating screens: This is the location where one would expect most intimate association of men with the vapor of methyl chloride. Vapor concentrations are controlled by proper vacuum on strippers preceding this step in the process, and by exhaust ventilation over each filter and screen. Two men per shift spend part of their time at a distance of about 30 feet from the line of filters and screens. Occasionally each day, men mount the platform at each of the units. Routine spot checks by the chemical products laboratory and our own analysis of the samples collected over one and one-half hour periods showed less than 10 p.p.m. in the immediate area of screens and filters.

We are satisfied that the efforts which were made to control methyl chloride vapors, after the poisoning cases of 1943-44, are effectively operating today.

(b) Tunnel dryers. These are exhausted and vapors discharged outside the building. In our experience, men are seldom close to the dryers.

(c) Extruders and milling machines. There is full-time attendance by several men at these machines. Visible atmospheric contamination probably consists of water vapor, oil mist, PBN fumes, and possibly kerosene and xylol mercaptan.

A deposit of scum was observed on the overhead roof structures in this vicinity, representing the accumulation since the plant was put in operation. Examination of the scum by the chemical products laboratory showed it to consist essentially of phenyl beta-naphthylamine. To obtain an estimate of the amount that might be put into the air by sublimation from the extruders in the course of a day, we learned that 180 pounds per day are used. Of this amount, the major portion leaves the product in water drainage to the sewer from water-rubber slurry and by separation of fine particles for subsequent burning. The loss by sublimation is considered by the process heads to be minor, probably less than 1 per cent of the amount added, or 1.8 pounds per day--equivalent to 500-700 milligrams per minute. Considering the vastness of the room, the exhaust ventilation at some points of escape, and the convection currents from the hot machinery and materials that would tend to remove sublimed material from the breathing zone of workers, it is difficult to believe that vapor exposures are significant. Yet the demonstrated carcinogenicity of several aromatic amines closely related in structure and physical properties to phenyl-beta-naphthylamine, specifically B-naphthylamine, and the possibility that some of these may occur as impurities in the commercial product, make it advisable that this situation be carefully evaluated. In medical examination of workers from this section, particular attention should be directed to detection of cancerous or pre-cancerous manifestations of bladder abnormalities, until it is finally clear that no such hazard exists.

(d) Talc dusting and rubber packaging. About five men work full time on the packaging line. There is a dust exposure on the part of the men who remove slabs of rubber from the conveyer to the paper cartons. Concentrations were found to be in the range of 9 to 16 million particles per cubic foot. Hoods provided for this job are ineffective because of their size and contour; for example, each man must weigh each package as it is filled. The scale is not

enclosed in the hood. He must frequently add a piece of rubber to the package on the scale. Talc dust is dispelled into the air by this operation and is not captured in the exhaust line. The results of dust counts from samples collected at the breathing level of each of the packagers are tabulated in the Table.

Table 1

DUST CONCENTRATION--TALC DUST IN BUTYL RUBBER FINISHING BUILDING

| Sample Designation | Elapsed Time | Sampling Location                                                                                                                                                                                                                                      | Concentration<br>Million particles<br>per cubic foot |
|--------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| 63                 | 8 min.       | At breathing zone of 3rd packer in line of 3, packing at normal rate.                                                                                                                                                                                  | 16                                                   |
| 64                 | 5 min.       | At breathing zone of 2nd packer in line of 3, packing at normal rate.                                                                                                                                                                                  | 12                                                   |
| 65                 | 6 min.       | At breathing zone of 1st packer in line of 3, packing at normal rate.                                                                                                                                                                                  | 8.6                                                  |
| 66                 | 4 min.       | At breathing zone of man dusting cut slabs of rubber for re-run through extruder, dusting by means of broom dipped in dust. There are 4 men working together, dusting and sawing slabs of rubber. This is about 60 feet from the talc dusting machine. | 8.5                                                  |
| 67                 | 5 min.       | General air sample throughout the area described in 66.                                                                                                                                                                                                | 2.6                                                  |

It is probable that concentrations of talc dust which were found in this locality constitute only a nuisance. It is true that there have been reports of pneumoconiosis from inhalation of dust in talc mining and milling, but concentrations responsible for these occurrences were in a much higher range than those we found. Some state codes require that concentrations of talc dust be kept below 15 m.p.c.f. Elimination of the nuisance by improvement in ventilation

(e) Utility men. Several men work at such jobs as preparing stock for re-run. They are frequently in the immediate vicinity of the talc dusting and milling machines.

(f) Miscellaneous groups of supervisors, physical and chemical testing men, etc., work at various places around the west end of the finishing building. Their exposures to dust, mist, and vapors would be infrequent and of short duration because most of their time is spent in areas remote from the processes.

#### ALCOHOL PLANTS

Complete protection of the health of workers in the production of ethyl and propyl alcohol requires that three separate and distinct problems be recognized, evaluated, and controlled.

Accident Hazard. The first of these is an obvious accident hazard connected with the use and handling of large quantities of sulfuric acid. This problem is well understood at the plant. Effective controls are practiced. They consist of provision of protective clothing, safety showers, and certain mechanical features of process units.

Blending Agents. The second problem is connected with the use of certain toxic materials as blending agents and denaturants. Acetaldehyde is the principal denaturant for ethyl alcohol produced at this plant.

It is irritating to the mucous membranes when inhaled as a vapor and, for this reason, will not be tolerated by men for periods long enough to give any evidence of systemic damage.

Denaturing with acetaldehyde takes place in a building under government supervision. We did not see the denaturing process during the course of our survey.

for use in the building, which has only natural ventilation. We believe that use of respirators is sufficient precaution against inhalation of acetaldehyde vapor.

Methyl alcohol is used occasionally as the denaturant for ethyl alcohol and is used quite frequently as a blending agent with iso-propyl alcohol in manufacture of antifreeze.

Continued exposure to vapors of methyl alcohol may lead to chronic poisoning which is characterized by irritation of the mucous membranes, possibly leading to bronchitis and pulmonary affections which may be associated with headache, tinnitus, tremors, local and multiple neuritides, and more or less severe visual disturbances (Flury and Zernik, 1931).

The toxicity of methyl alcohol is well-respected in this plant. We saw the precautions which are provided at the blending site and at the loading racks. Most of the work connected with blending and loading of methyl alcohol takes place out-of-doors. The possibility of prolonged inhalation of significant concentrations of methyl alcohol is remote.

The hydrocarbon feed stock for both alcohol plants and the principal products of these plants are toxicologically in the class of narcotics. Inhalation of concentrations necessary for narcotic action does not occur. There is no evidence of systemic poisoning from ethylene and propylene or from the alcohols and ethers which are derived from them.

Carcinogenic Problem. The third problem at these plants is one which has risen in the Bayway alcohol plant and in the plant of one other company manufacturing iso-propyl alcohol from propylene. Statistical studies have revealed an abnormally high incidence of cancer among men who have worked in these plants for more than ten years. Cancers of larynx, pharynx, and nasal sinuses have occurred. The locations of these lesions suggest that there might be some

way in this company and in one other company to determine, if possible, what substances in the occupational environment may be the carcinogenic agents responsible for these lesions. Without going into details of these research programs, it will suffice to mention that the possibility of air-borne nickel carbonyl having its origin in some of the nickel alloys in the process equipment is being investigated. Another path of the investigation leads to an attempt to identify certain poly-cyclic hydrocarbons which are known as carcinogenic agents in the by-products of the action of sulfuric acid on propylene. The current problem at the Baton Rouge alcohol plant is to determine, if possible, whether the same conditions which give rise to atmospheric contaminants in the working environment at the Bayway alcohol plant exist at Baton Rouge. Several notable differences are readily apparent. For example, the propylene stream coming to the Baton Rouge alcohol plant is much purer than the stream processed at Bayway, at present and in the past. Secondly, a lower concentration of sulfuric acid is used at Baton Rouge. This results in a lesser amount of high molecular weight side products. Thirdly, the physical arrangements of the plant at Baton Rouge, which is a new modern plant incorporating all improvements in design up to seven years ago, are completely different from Bayway's plant. The matter of the enclosure of process equipment is the most striking difference. Whereas at Baton Rouge we find a minimum of enclosure, Bayway has all processing equipment following the hydrolysis step indoors. At Bayway, the control rooms and stations for performing tests on product and reactants are in much closer proximity to stripping stills than at Baton Rouge. Maintenance at Baton Rouge is more successful in keeping the process materials in closed systems because of the newness and improved quality of the equipment.

These remarks serve only to illustrate the kind of differences that might be significant in the final determination of whether two plants have a

If, indeed, the cancer problem at Bayway has an occupational origin, the conditions which permitted its occurrence may have existed in the earlier years of alcohol operations at Bayway, and changes in equipment and process material over the years may have eliminated the causative factors. Occupational cancer more frequently than not requires a long period of time to reach the stage where it is recognized clinically. Even if there are conditions at Baton Rouge favorable to the development of cancer, it cannot be expected to be recognized clinically at this time. Investigation now for possible causative factors is aimed at the prevention of illness in future years. Success, even if completely attained, will not be known.

On the basis of our observations at both Bayway and Baton Rouge, we can suggest that certain steps be taken:

First, that investigation of alloys in use at the plant, their products of corrosion, and the possibility of air-borne nickel carbonyl be carried on simultaneously at Baton Rouge.

Second, we recommend that close attention be paid to the manner of drawing samples at the various sampling locations at the alcohol plants. Because of the frequency of drawing samples and the obvious splashing that occurs, we consider the sampling act to be one of the most important sources of contact between operating personnel and the materials that are being processed. High temperatures and obvious splashing suggest the existence of mist and vapors at the sampling locations.

Third, frequent physical examinations of all the employees at the alcohol plants and selective placement of men are essential. What is apparently a localized site of attack suggests that persons with upper respiratory affections and chronic sinusitis are unacceptable for work at the alcohol plants.

The fourth suggestion is that the medical department establish close

cancer problem would have been greatly facilitated had the medical department, upon becoming cognizant of the problem, had recourse to a log of process and equipment changes over the course of the years. At Baton Rouge, it is still early enough to establish a system whereby all important changes which might have a bearing on future health problems can be made available for joint study by the medical department and the process heads.

#### CATALYST PLANT

This plant is engaged in the batchwise production of a variety of solid, granulated, powdered, and pellet products for catalysis of reactions carried out in several refineries. The type of product depends upon current demand. Production of a specific catalyst may last for several days, several weeks, or several months. About a dozen men are employed in the plant.

A list of chemicals and other raw materials used at the catalyst plant during the last five years appears as Table 2, below. A brief discussion of the toxicity of several of these compounds follows.

#### Toxicity of Some Chemicals Used in the Catalyst Plant.

Molybdenum Trioxide, powder: Ingestion, injection, and inhalation experiments have indicated that acute toxicity of molybdenum compounds, including molybdic oxide, is appreciable, but fairly low. Its toxicology in industrial use has not been sufficiently well studied to warrant an assumption that it is non-hazardous. Uncontrolled dustiness of this compound should not be permitted.

Tungstic Acid: Ingestion and injection experiments with animals have led to the conclusion that this metal is more toxic than molybdenum. Toxicological data from industrial dust exposures to tungsten compounds is lacking. Uncontrolled dust exposures should be avoided on the basis of uncertainty of

Table 2

CHEMICALS AND OTHER RAW MATERIALS USED AT  
CATALYST PLANT DURING LAST FIVE YEARS

| Material                                   | Approximate Weight of<br>Materials Used |
|--------------------------------------------|-----------------------------------------|
| Activated Alumina, 2-4 Mesh                | 1,500,000 Lbs.                          |
| Iron Oxide, Powder                         | 400,000 Lbs.                            |
| Chromic Acid, Flakes                       | 30,000 Lbs.                             |
| Chromium Nitrate, 50 Percent Concentration | 50,000 Lbs.                             |
| Activated Carbon, Pellets                  | 100,000 Lbs.                            |
| Molybdenum Trioxide, Powder                | 200,000 Lbs.                            |
| Superfiltrol Clay                          | 100,000 Lbs.                            |
| Ball Clay                                  | 60,000 Lbs.                             |
| Nickel Nitrate, Crystals                   | 80,000 Lbs.                             |
| Nickel Carbonate, Powder                   | 20,000 Lbs.                             |
| Tungstic Acid                              | 100,000 Lbs.                            |
| Hydrofluoric Acid, 60 Percent              | 15,000 Lbs.                             |
| Magnesium Oxide                            | 15,000 Lbs.                             |
| Phosphoric Acid, 85 Percent                | 15,000 Lbs.                             |
| Cobalt Sulphate, Crystals                  | 80,000 Lbs.                             |
| Naphthenic Acids                           | 130,000 Lbs.                            |
| Nickel Sulphate, Crystals                  | 150,000 Lbs.                            |
| Anhydrous Ammonia                          | 50,000 Lbs.                             |
| Sulphuric Acid, 98 Percent                 | 75,000 Lbs.                             |
| Sodium Hydrosulphide, 45 Percent Solution  | 450,000 Lbs.                            |
| Potassium Fluoride, Crystals               | 500 Lbs.                                |
| Caustic Soda, 100 Percent NaOH             | 25,000 Lbs.                             |
| Copper Nitrate, Crystals                   | 7,500 Lbs.                              |

Nickel Salts: Animal experiments have shown definite toxicity of nickel salts. They cause inhibition of growth of young animals, changes in the pancreas, effects on the respiratory and cardiac nerve centers, and liver and kidney damage. On the basis of minimum lethal doses in injection experiments, nickel is about 50 per cent more toxic than cobalt.

Cobalt sulphate: Cobalt salts are recognized as skin irritants. Toxic manifestations following ingestion include abnormalities in the blood-forming organs. Effects of prolonged exposure to cobalt dusts free from other toxic metals have not been sufficiently well studied to be understood. No per-

Chromic Acid: Dermatitis, chrome ulcers, and perforation of the nasal septum have long been recognized as being incident to exposures to hexavalent chromium compounds. Recently, a high incidence of lung cancer was discovered among workers in a plant manufacturing these compounds. Exposures for prolonged periods to low concentrations of dust and short-time exposures to high concentrations are to be scrupulously avoided. The maximum allowable concentration on the basis of injury to the nasal tissues has been established at 0.1 milligram per cubic meter of air.

There is good evidence in the recent occurrence of nosebleed among several employees that the catalyst plant is in need of effective dust control equipment. At the time of the nosebleeds, the plant was engaged in the production of a converter catalyst from chromic acid flakes and iron oxide powder. The principal dust sources are the dry grinding and mixing vessel on the third floor, the ball mill in which imperfect pellets are ground for re-extrusion, and the various operations of drying and screening the pellets. In the case of the chromic acid, the irritant effects became apparent in a matter of a few weeks after the production of this catalyst was begun.

Effects of inhalation of dust of other chemicals over a period of a few weeks or a few months may not always be so apparent as in the case of the chromic acid. More subtle effects could go undetected until serious illness and disability resulted.

Additional evidence of the need for a permanent exhaust ventilation system for dust control is the amount of settled dust on overhead structures throughout the building. The present use of propeller fans in wall installations is ineffective. The use of respirators is impractical because of the discomfort associated with continued wearing through the often prolonged cycle of a dust-producing operation.

Skin Contact. Irritation of the skin of workers by chemicals used in this plant has occurred in the past. Effective dust control will greatly reduce the amount of skin contact with these materials. At the present time, skin contact occurs even in the locker room used by these workers because of the invasion of dust into all quarters of the building. The use of protective gloves and jackets is effective in preventing skin contact while actually transporting materials.

PETROLEUM PRODUCTS DIVISION

REFINING AND OIL MOVEMENT

Distillation.

This department operates pipe stills and two shell still batteries; 96 men are employed in crude distillation and some 68 on re-run. There is no indication of any potential health hazard in the routine operation of refinery pipe stills.

Attention was drawn to the possibility of petroleum vapor or hydrogen sulfide exposure on the part of the operators of Still Batteries No. 16 and No. 17. Three or four men per shift operate each of these batteries. At these locations, product streams flow through the still house which is the principal station of the operating personnel. Look boxes are provided for each stream. There is a possibility of leakage of vapors from the look boxes or their lines. On two occasions, we were unable to detect the presence of petroleum vapor with a sensitive combustible gas indicator. Details of these tests are given in the following Table.

Table 3

PETROLEUM VAPOR MEASUREMENTS IN NO. 16 AND NO. 17  
BATTERY STILL HOUSES

| Date   | Location and Operations                                                                                                                                                                                                        | Concentration<br>(p.p.m.) |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| 4/6/49 | No. 17 Battery Still House. No. 1 system charging after turnaround; No. 2 system running crude; No. 3 system running mixed gas oil. Several measurements made.                                                                 | Less than 10              |
| 4/6/49 | No. 16 Battery Still House. No. 1 system running mixed gas oil from separators. No. 2 and No. 4 systems handling low octane distillate feed; No. 3 system running heating oil. Tests made at 6 locations among the look boxes. | 0 - 10                    |

Plans are underway and work has already started on providing an enclosure for operating personnel separate from the location of the look boxes. Side walls will be removed from the present enclosures. This is in keeping with the general tendency to open up buildings where there are sources of leaks from process equipment. Other examples are various pump rooms that have been opened up and some gas compressor houses from which the side walls have been removed. In the case of No. 16 and No. 17 Battery Still Houses, execution of these plans should result in complete elimination of any potential health or safety hazards from vapor or hydrogen sulfide.

No. 2 D. & S. and Hydrogen Sulfide Recovery Unit.

These two units are under the direction of the same operators. Hydrogen sulfide comes to the recovery unit from various sources. From this unit, tri-potassium phosphate solution is pumped to No. 3 D. & S., operated by the Light Ends Department, for use there in scrubbing gas.

The hydrogen sulfide-laden solution is sent back to the recovery plant for regeneration. There is no pump handling the spent solution, therefore, leakage at pumps does not put hydrogen sulfide into the air. This scrubbing unit is exceptionally tight. No odor of hydrogen sulfide was detected.

At the base of the flare stack, there is a water seal drum to prevent flash back. Under the operating conditions that we saw, there is some spillage and leakage from this water-seal drum, permitting an appreciable escape of hydrogen sulfide at ground level. This was formerly in an isolated area, but now the new Light Ends Plant stands in close proximity to the source of leakage. A high local concentration of hydrogen sulfide seems possible under weather conditions producing little air movement. We consider this the most important potential site in the refinery for acute accidental or chronic exposure to hydrogen sulfide gas. Accidental exposure to high concentrations of hydrogen sulfide gas.

persons entering the immediate vicinity of the flare stack base to perform mechanical work. Sub-acute effects, such as conjunctivitis or upper respiratory irritation might be suffered by process people constantly in the nearby Light Ends Plant.

#### Oil Movement.

Oil Movement has control of pumps, gauges, pipe lines, storage tanks, barge loading, car loading, lead tetra-ethyl blending, use of inhibitors, and dyes.

Tetra-ethyl lead blending. This operation is performed under safe practice rules, prescribed by the suppliers of tetra-ethyl lead. Medical control by the refinery Medical Department is rigid. Protective equipment and clothing, as well as facilities for personal sanitation, are provided the employees. Two men are employed per shift. Aside from the normal routine of blending lead tetra-ethyl into gasoline, there are periodic calls for cleaning of tanks, pumps, and pipe lines. These jobs are done under the supervision of the suppliers' safety people. Equipment is routinely flushed with lead-free gasoline before it is turned over to the mechanical department. We know of no additional precautions or changes in procedure that are necessary in the handling of tetra-ethyl lead.

Addition of Dye to Finished Gasoline. Two men work on each shift. A dye solution is prepared from the dry dye about three times in 24 hours. The dye is removed from the drum in which it is received by means of a scoop. It is weighed and scooped into the solution drum. It is a dusty job, as shown by the deposit of dye on all structures in the room. Infrequency and short duration of the dust-producing job suggests the use of dust respirators for the prevention of dust inhalation. Prevention of inhalation is desirable, since the exact effects of such inhalation, where a variety of dye materials are used, are difficult to

Addition of Inhibitor to Finished Gasoline. The inhibitors that are currently in use are UOP-5 and DuPont-5. Inhibitor is drawn by vacuum from the drum in which it is received into mixing and metering drums and from there is bled into the streams. This procedure offers only the remotest chance for a man to come in direct contact with the inhibitor.

Light Oil Treating. This includes acid and alkali treating, calcium hypochlorite treating, and doctor sweetening. Of these processes, only the doctor sweetening involves the use of materials or processes that are of interest from the standpoint of employee-health.

Litharge Handling. Fresh litharge is added to regenerated doctor solution by dumping directly from drums into the open regenerator tanks. The size of the tank and the location of the platform and crane prevent free movement to the windward side while dumping. Respirators are worn by men doing the dumping for the prevention of inhalation of fine lead dust. All litharge dumping is done by two porters on "A" shift, with a frequency somewhat less than once a day. These men are on the Medical Department's schedule for twice-yearly examination.

Doctor solution regenerator tanks are in a crowded area in this refinery, differing in this respect from the situation at Aruba. With the thought that employees in the treating plant, other than those who actually dump litharge may be exposed to toxic amounts of lead as dust or as a mist from tanks being aerated for doctor regeneration, we sought to learn the concentration of lead in the mist escaping at the top of the tank. The opportunity to make such measurements presented itself at Sarnia. The results showed that two samples of air, collected in the heaviest concentration of mist at the tank top on the downwind side during aeration following litharge addition, contained 0.17 and 0.27 milligrams of lead per cubic meter, respectively. If we consider lead in a range of 0.1 to 0.5 milligrams per cubic meter to be present at the tank top, we may safely assume that, with dilution occurring before it reaches ground level, and with variation

in wind direction, that no men are constantly exposed to concentrations of lead likely to produce symptoms of lead poisoning.

The validity of this assumption might be tested by performing urinary lead determinations for the group of exposed persons. Such measurements will serve to indicate, far better than atmospheric sampling and analysis at this outdoor location, whether lead absorption is occurring in these individuals.

Addition of Dye to Tractor Fuel. The treating of tractor fuel includes the addition of a dye known as Petro Green D Dye, which is a product of Patent Chemicals Company, Patterson, New Jersey. The same two porters who handle litharge and doctor sweetening occasionally make up two-pound packages from the bulk dye in drums. A lack of dye deposit on the floor and structural members of the room in which this packaging is performed indicates a low order of dustiness in the performance of the job.

## LUBRICATING AND PARAFFINE DEPARTMENT

Wax Presses.

The fact that there is a statistically significant high incidence of cancer among wax press cleaners was demonstrated in another refinery. Cases of scrotal cancer have been discovered among the press cleaners at Baton Rouge. Investigations are now underway by the company to identify a specific carcinogenic agent or agents in the material which enters the presses. Immediate steps were taken to prevent any further contact with the material that may be responsible for the pathologic changes in the men.

The first step was logically to prevent the obvious contact between the skin of the pressmen and machinery or implements on which there was a deposit of paraffine distillate, paraffine wax, or foots oil. One particular zone of contact to which attention was directed is the anterior surface of the thighs and the pubic region. This was based on the observations that pressmen sometimes lean forward against a waist-high, horizontal bar that runs the length of each press on both sides, and that some of the cancers occurred on the scrotum.

To prevent such contact, all press cleaners are now provided with clean work clothes and aprons for each shift and are required to take a shower daily before leaving the plant. These precautions are effective in preventing this particular type of contact. A shower room for press men is conveniently located and maintained in a sanitary condition.

Other skin contacts with wax and pressed oil must have taken place in past years, in the cellars where press cleaners go daily to clean the floors, remove sawdust, etc. preparatory to the entry of pipefitters and machinists.

In spite of the precautions taken to date, there remains full-time opportunity for absorption of materials through the skin of the press cleaners'

hands. Such absorption cannot be ruled out as a mode of entry of the suspected carcinogen. Its prevention has not been effected because of an inability to find a satisfactory glove material that will exclude the contaminant from the hands and, at the same time, permit efficient manipulation of the flat steel blade with which wax is removed from the presses. Frequent washing and wiping with clean cotton waste are temporary, but not wholly satisfactory, precautions.

Another mode of entry of carcinogenic material into the body of man is by absorption through the lungs following inhalation. Following inhalation of chromic acid, cancers were formed in the lung itself. Inhalation of beta-naphthalamine results in the formation of bladder tumors. Skin cancers have occurred in workers with arsenic, where at least a part of the exposure has been to inhalation of arsenic compounds as dust. With this thought in mind, an effort was made to learn whether oil mist might be present in the air in wax press rooms in sufficiently fine particle size to permit of passage to the deeper portions of the lung. Samples of the air were collected by means of the midget impinger with water as the collecting medium. Microscopic examination of the water suspension definitely showed the presence of oil droplets of less than 5 microns diameter.

Table 4, which follows, shows the locations where samples were collected and a rough approximation of quantities present, on the basis of counts that were made in a manner analogous to that used in making dust counts. As shown in the Table, mist was discernible in rooms with both doors closed and filtration in progress, and also in rooms with doors open and actual press cleaning taking place.

A demonstration of the presence of oil droplets in the air in wax press rooms is significant of the fact that inhalation of a potentially carcinogenic material occurs. The importance of this occurrence in relation to the present cases of illness and to the prevention of future cases is a matter that can be evaluated only by a broad investigation into the reasons for mist formation, the

Table 4

## OIL DROPLET COUNTS -- PARAFFIN PRESS BUILDING

| Sample Number | Sampling Time | Location                                                                                                                                                                          | Evaluation (Particles per cubic centimeter of air) |
|---------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| 77            | 10 min.       | In "hot" press rooms Nos. 5, 4, and 3, in which the pressure is on. No men working in these rooms during the sampling time. Sample taken while walking around the filter presses. | 11.3                                               |
| 78            | 10 min.       | In "hot" press rooms Nos. 13 and 14, pressure on. No men working.                                                                                                                 | 21.2                                               |
| 79            | 8 min.        | In "cold" wax press rooms Nos. 30 and 31, pressure on. No men working. At conclusion of sample period, two pressmen entered for the purpose of cleaning the presses.              | 0.0                                                |
| 80            | 11 min.       | "Cold" press rooms Nos. 30 and 31, during beginning stage of press cleaning, starting when pressure is withdrawn and ending with four minutes of actual press cleaning.           | 6.4                                                |
| 81            | 7 min.        | Outdoor sample in vicinity of lube agitators directly north of tank 331, wind of moderate velocity from the south-east.                                                           | 7.8                                                |
| 68            | 10 min.       | In "hot" press room No. 11. Pressure on.                                                                                                                                          | 7.1                                                |
| 69            | 10 min.       | In "hot" press room No. 9. Pressure on. Many visible oil-wax leaks.                                                                                                               | 2.8                                                |
| 70            | 10 min.       | In "hot" press room No. 6, shortly after presses have been cleaned. Both doors open.                                                                                              | 0.0                                                |
| 71            | 10 min.       | In "cold" press room No. 18. Pressure on.                                                                                                                                         | 1.4                                                |
| 72            | 10 min.       | In "cold" press room No. 24. Pressure on.                                                                                                                                         | 7.1                                                |
| 73            | 10 min.       | In "hot" press room No. 9 during cleaning of the filter presses. Both doors open.                                                                                                 | 2.8                                                |
| 74            | 10 min.       | Outdoor sample in vicinity of lube oil agitator tanks.                                                                                                                            | 0.0                                                |

nature of the material in droplet form, its carcinogenic activity under experimental conditions, and methods of eliminating exposures to inhalation of the mist.

Some observations were made at the wax presses in the Bayonne Refinery for the purpose of comparing conditions there with those at Baton Rouge. It was noted that maintenance efforts at Baton Rouge are more successful in preventing leakage of material from the presses. Gross leakage, in the form of voluminous sprays against the press room walls and ceiling were seen at Bayonne, but not at Baton Rouge. The nature of the wax-containing stock and the percentage recovery of wax that is desired have, of course, been the factors that govern the extent of the maintenance effort and may account in whole for this observed difference in performance. Handling of San Joaquin distillate, responsible at Bayonne for most of the press room contamination, has not been undertaken at Baton Rouge.

Another notable difference in the operations at the two plants is the fact that Baton Rouge has but one press per room, while Bayonne has some multiple installations. This may mean that Bayonne press cleaners experience a contact with material as a mist, spray, or leak from presses adjoining the one on which they are working which is lacking in the Baton Rouge operation.

These differences, both of which would seem to indicate less intimate contact of men with material at Baton Rouge, may or may not be significant when applied to forecasting cancer incidence. They may assume some meaning when the identity of the carcinogenic material and its mode of entry are better understood.

#### Plate Shop.

Across the road from the wax press rooms is a shop consisting of one room in which plates and filters are cleaned by means of steam, and two other rooms in which repairs are made to the canvas filters. About 8 men work in this shop on day shift. Filters are brought by the press cleaners to the cleaning room. They are placed on a rack, the room is closed, and live steam is turned

onto the filters on the racks and left on overnight. As each filter is put on the rack for cleaning, the others which have been exposed to steam are pushed down toward the far end. In this manner of rotation, by the time a filter reaches the end of the rack it has been cleaned and is ready for repair. The time actually spent in the cleaning room is only the time required to remove a clean filter from a rack and the time required to turn on or shut off the steam line. Exposure of men to the vapor and mist arising from the steam cleaning is, therefore, infrequent. The actual work of repairing filters occasions no contact with contaminating wax or oil.

#### Refrigeration Unit.

At this unit, actual contact with the materials being handled is limited to the machinists and pipe fitters. No hazardous exposures on the part of the process operators can be foreseen.

#### Crude Scale Wax Sweaters.

Feed for the crude scale wax sweaters consists of wax and oil after pressing has removed some oil, flash-topping at No. 1 vacuum pipe still has removed still more oil, and acid treating and caustic neutralization has improved it. Men are not exposed to the mixture in the sweating room during actual operation. Maintenance men do come in contact with the material when effecting repairs. These will be discussed elsewhere.

#### Refined Wax Sweating.

This process is similar to that described above but handles wax with much lower oil content.

Total Package- \$113  
35-1/1130  
\_\_\_\_ 19 \_\_\_\_  
\_\_\_\_ \$ \_\_\_\_  
\_\_\_\_ Dollars  
\_\_\_\_\_  
10767611

Propane De-waxing, Propane De-oiling, and Propane De-asphalting.

These three processes of the lube and paraffine department appear to have no health significance. There is intermittent exposure to propane in unknown concentrations. Non-volatile materials at these units consist of lube stocks for further treatment and the residues which are wax, oil for cracking feed, and asphalt for fuel. Occasions for skin contact with these materials are infrequent in normal operation. There is no evidence of danger from skin contact, however frequent.

MEK Plant.

Processing materials. The solvent employed in this process consists of methyl ethyl ketone 50%, benzene 30%, and toluene 20%. The solvent is stripped from the oil and returned for reuse. The separation of precipitated wax from the oil solution is accomplished in six large rotary filters. Since this is a low temperature process, the filters are enclosed as completely as possible and surrounded by insulating material. The refrigerant is propane.

Personnel. This unit is operated by five men per shift. One of these men spends his full time in a small room in the filter building. The remainder divide their time between the isolated control house and various parts of the plant.

Control of Exposures. The extremely toxic character of benzene and its volatility make its complete control a prime concern in the operation of this plant. Protection against accumulation of solvent vapor was built into this plant by design engineers. Storage tanks and pumps stand in the open air, leaving the filter room as the only enclosure for benzene vapors. A phase of operating procedure which is of great significance in the control of solvent exposures, although it probably had origin in precautions against

the draining of units prior to repair or replacement and their flushing with inert gas prior to disconnecting.

The ventilation system in the filter building has recently been made the subject of a thorough investigation by the Petroleum Technical Service. The survey indicated that solvent vapor concentrations (as measured with the MSA Benzol Vapor Indicator) in excess of 100 parts per million could not be detected and that the most commonly encountered value was 20 parts per million. In view of these results, and our own which are similar and appear in Table 5 (following), we conclude that in the present mode of operation of this plant, loss of solvent to the atmosphere in the places where men work does not result in excessively high concentrations in the breathing level.

Table 5

MEASUREMENT OF SOLVENT VAPOR IN MEK PLANT

| Date   | Location                                                                        | Result *     |
|--------|---------------------------------------------------------------------------------|--------------|
| 4/5/49 | Lower level of filter building, 10 feet inside the S.W. door.                   | 20           |
| 4/5/49 | On steps of West ladder to upper level.                                         | 0            |
| 4/5/49 | Beneath Filter No. 1.                                                           | Less than 20 |
| 4/5/49 | On steps of East ladder to upper level.                                         | Less than 20 |
| 4/5/49 | In filter room control room where the filter operator spends most of his time.  | 15 - 20      |
| 4/5/49 | Lower level; over drain to sump.                                                | 30           |
| 4/6/49 | Beneath Filter No. 2, near sump                                                 | Less than 10 |
| 4/6/49 | At pump handling wax-solvent from No. 2.                                        | 20           |
| 4/6/49 | Beneath Filter No. 2. At southernmost sump.                                     | 0            |
| 4/6/49 | At sump beneath No. 5 filter.                                                   | 0            |
| 4/6/49 | On upper level. West side.                                                      | 10           |
| 4/6/49 | Inside operators shack.                                                         | 0            |
| 4/7/49 | At 10 locations on lower level beneath filters.                                 | 0 - 20       |
| 4/7/49 | At base of pipe discharging waste to sump, <u>not</u> at man's breathing level. | 100 - 200    |

\* Total vapor, in ppm.

Urine samples from a group of five process men were examined during our survey and showed normal values for the sulfate ratio. The results are given in Table 6, which follows:

Table 6  
RESULTS OF URINE SULFATE RATIO MEASUREMENT  
FOR MEK PLANT WORKERS

| Sample Number | Ratio of Inorganic Sulfate to Total Sulfates | Organic SO <sub>3</sub> gm/liter |
|---------------|----------------------------------------------|----------------------------------|
| 12007         | 0.85                                         | 0.259                            |
| 1541          | 0.84                                         | 0.269                            |
| 5940          | 0.90                                         | 0.110                            |
| 11374         | 0.84                                         | 0.400                            |
| 12279         | 0.90                                         | 0.273                            |

The high degree of toxicity of benzene and the fact that leakage of solvent does occur, requires that continuing checks be made on the concentrations in the air. The PHS proposal that routine measurements with the Benzol Vapor Indicator be made is a sound one. The frequency of the measurements should be fixed through correlation with the production schedule and results obtained. The instrument itself is satisfactory, provided that it is checked about once a month against known concentrations of the solvent mixture in a test chamber.

It is desirable also to periodically examine the urine of the 21 process people at the unit and mechanical people regularly assigned to the unit to detect any variation of the ratio of inorganic to total sulfate from the normal range. Such a variation will be detectable in advance of symptoms of poisoning, should excessive exposures occur, and will supplement the atmospheric tests as a

method of measuring exposures. A discussion of urine sulfate ratio determinations as a means of evaluating benzene exposures is included in the Appendix.

#### Wax Filtering.

In this process of filtering wax through bauxite and bauxite roasting, a dust source is the base of the regenerator tubes, where the heated bauxite falls to a conveyor belt and is carried to the hopper. The only excursions into this dusty area are for the purpose of replacing wooden pegs on the shake-out apparatus and for loading fresh bauxite from sacks to hopper. The former requires about five minutes several times per shift, possibly hourly. The latter is done infrequently and requires relatively few minutes. Occasional inspection of the operation and replacement of belts accounts for other trips into the dusty places.

The regenerator runs 24 hours to fill one charge. Two 24-hour regenerator periods may follow one another closely and then not again for the remainder of the week.

About seven or eight men are present at this unit during a 24-hour period. They spend most of their time in the room on the northwest corner of this building, ground floor. This room is closed off from the dusty area of the building, but some dust enters to settle on desk, ledges, instruments, etc.

Typical dust counts are:

1. At base of bauxite chutes during regeneration: 23 m.p.c.f.
2. In control room, immediately after blowing out the chutes with compressed air: 4 m.p.c.f.
3. In room containing hopper to receive new bauxite, during regeneration: 1 m.p.c.f.

This dust contains no crystalline free silica, therefore, no silicosis hazard exists. Dust concentrations where the men spend the major part of their

### Lube Filter Plant.

Filtration of lube stocks through fixed beds of Attapulga clay and the regeneration of the clay by the downward passage through a kiln is a process which has no industrial health significance. Clay dust occurs in some parts of the buildings which house the two filter plants and the clay regenerator. This dust contains no crystalline free silica. There is no silicosis hazard. Our observations and dust counts made in the plant show a low degree of dustiness most of the time. Concentrations are not sufficient to constitute a nuisance. Results of the dust counts are given in the Table that follows.

Table 7

#### DUST COUNTS AT LUBE FILTER PLANT

| Sample Number | Sampling Time | Location                                                                                                                                           | Dust Counts (m.p.c.f.)* |
|---------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| 79            | 5 min.        | Sample taken at level of elevator motor in regenerator building. No men working in this area at this time, except two carpenters at a lower level. | 1.0                     |
| 80            | 10 min.       | On floor level beneath regenerative furnaces, around the base of No. 2 furnace.                                                                    | 0.0                     |
| 82            | 8 min.        | General air sample on level around top of filters. No visible dust sources.                                                                        | 0.1                     |
| 83            | 6 min.        | General air sample on level around base of lube oil filters. No visible dust sources.                                                              | 0.0                     |

### Phenol Plant.

At the Phenol Plant, adequate precautions for the prevention of skin contact with phenol are in effect. They consist of provision of all the necessary protective clothing and emergency showers. The personnel at the plant are aware of the accident hazards. Our attention was drawn to the existence of phenol vapor in certain areas of the plant, as evidenced by the odor. Chronic phenol poisoning from prolonged inhalation of low concentrations of vapor has been demonstrated in animal experiments. It results in respiratory difficulty, digestive disturbances, and central nervous system disorders. Damage to liver and kidney also occurs. Toxicological data for man from industrial exposures are lacking. It is difficult to say, on the basis of available information, what concentrations of phenol in the air of work places can cause chronic illness.

The principal sources of phenol vapor are leakage at pumps handling fresh phenol feed, de-phenolizer feed, etc., and a tank which collects drainage from all sources of liquid leakage. The need for heating the leakage as it is collected and drained from the units, in order to keep it liquid, causes greater vaporization than would be expected from cold phenol. These sources of phenol leakage are outdoors. Two rows of pumps which serve these plants are in open areas adjacent to the control room. Eight men per shift operate the two phenol plants. They spend approximately equal time in areas where phenol vapor is noticeable. In all cases, the time amounts to approximately no more than one hour per shift. Most of their time is spent in the control rooms which have fresh air supplies and in outdoor locations around the plant, remote from the sources of phenol vapor.

The following table shows the results of measurements of phenol vapor in the air in various locations.

Table 8

## PHENOL MEASUREMENTS

| Sample Number | Location                       | Date   | Phenol Concentration (parts per million in air) |
|---------------|--------------------------------|--------|-------------------------------------------------|
| 66-64         | South pump group No. 2 plant.  | 4/4/49 | < 4                                             |
| 71-67         | At drain to sump. No. 1 plant. | 4/4/49 |                                                 |
| 73-72         | Control room. No. 1 plant.     | 4/4/49 |                                                 |
| 1             | South pump area. No. 1 plant.  | 4/8/49 | 11                                              |
| 2             | Same as 1.                     | 4/8/49 | 6                                               |

In air samples collected at a point between two pumps which were visibly leaking hot phenol mixtures, concentrations were found to be in the range of 6 to 11 parts per million. These concentrations exist in the area where the greatest amount of phenol would be expected. On the basis of these results, one can reason that in the control house, where the men are present for most of the working day, the concentration of phenol vapor will not exceed 1 or 2 parts per million. The occurrence of detrimental effects from continued inhalation of this range of concentration would not seem possible when one considers the ability of the normal human body to detoxify phenol by means of sulfates and glycuronic acid. However, it is advisable that close medical supervision of these men be exercised. Any nervous disorder or history of chronic digestive or respiratory difficulties among the phenol plant workers should be sufficient to raise the question of occupational origin.

### Lube Oil Treating.

The plant area containing acid agitators, sludge kettles, caustic wash, and water wash vessels is noted for the presence of sulfur dioxide and sulfuric acid mist. It is evident that the treaters' exposure is the greatest of all personnel, for they must supervise the treating and sludge hydrolysis. They are required by these duties to mount several times a day to the top of the agitator vessels. In so doing, they cannot always remain to the windward side. Their reaction is typical of personnel at operations of this kind. They become inured to irritant concentrations that would offend persons not constantly exposed. As a group, if there are effects on their health, these might be expected to manifest themselves as increased incidence of tooth decay and upper respiratory affections of an acute nature superimposed on predisposing conditions, such as asthma, catarrh, etc. Permanent systemic damage from such exposures are not known.

The other category of exposed persons, those who work in the neighborhood and are intermittently exposed to somewhat lesser concentrations, are more apt to be irritated by occasional high-exposure incidents. These exposures are nuisances rather than health hazards, except in cases of individuals made highly susceptible by predisposing illness affecting the respiratory or heart functions. Such individuals are known in other refineries. They can suffer respiratory difficulties and distress bordering on prostration. Their transfer to plant areas uncontaminated by acid gases is the simplest solution to their difficulties.

### Lube Oil Blending.

The manner of transfer of lube oil additives from tank car, to storage, to blending tanks by pumps does not furnish occasions for intimate contact of these substances with the men. An exception is the weighing and addition of PX-441 to small batches of heated oil to make a concentrated solution. The high

temperature causes fume evolution which is disagreeable. Installation of a canopy exhaust hood over the mixing tank would eliminate the obvious cause for complaint in this operation, which is performed frequently.

#### Grease Manufacture.

Exposures on the part of the five to eight men per shift who operate the grease manufacturing plant consist of: (1) inhalation of mists rising from heating tanks, and with steam from saponification kettles, and mixing kettles; (2) inhalation of dust during the receipt, storage, and addition of dry ingredients; (3) skin contact with grease ingredients and products. The evaluation of these exposures must take into consideration the fact that many products are produced only occasionally and with great variation in amounts.

#### Inhalation of Mists.

Much of the mist arising from heating of the starting materials in grease manufacture is traceable to tanks containing purified vegetable oils and animal fats. For such exposures, there is no indication of hazard. The saponification reactants likewise are regarded as insignificant. At the mixing tanks, there is occasion for entry into the air of some of the large variety of chemicals and additives. In many cases, these are harmless. An exception is that of the suspected carcinogenic agent whose presence is known to the medical department. These exposures are so unpredictable in duration that medical experience with the men involved will have to be the basis for their evaluation.

It is a fact, as illustrated in other grease plants within the company, that mist escaping from saponification and mixing kettles can be effectively captured by properly designed and well-maintained exhaust ventilation systems. Where such systems exist, inhalation of mist becomes negligible in the plant.

### Inhalation of Dust.

Dust exposures in grease manufacture are of minor importance because the dusty material which is handled most constantly and in greatest amount (lime) is non-toxic in quantities absorbed as dust and other materials of higher potential toxicity (lead, asbestos, mica) are handled either in small amounts with negligible frequency or in a manner that does not cause the dispersion of great quantities in the atmosphere. Asbestos, for example, after receipt and storage, is added to grease batches with a frequency that was estimated at 6 to 8 times per month. Its handling does not require violent tearing apart in the dry state with consequent dispersion of dust. Occasional exposure to the moderate dustiness of normal handling is not the type of exposure that is known to have caused asbestosis in workers of other industries.

Red lead comes in small cans and is added infrequently to grease batches. The act of dumping from the can into the mixing vessel is the only dust dispersing operation in its handling. It is difficult to conceive of toxic amounts being absorbed by any workman in this manner.

### Skin Contact.

Contact of the ingredients and products with the skin of the hands, arms, and faces of the workers in the plant occurs frequently. Its occurrence is due chiefly to deposits of these materials on equipment from misting. Deleterious effects from such skin contact cannot be predicted merely from a knowledge of the effects of the individual compounds on the skin of man for, in the case of a grease mixture, the inclusion of the additives and chemicals in a matrix of soaps and oils makes the chance of their unobstructed contact with the skin questionable. Evaluation of the dermatitis hazard rests, therefore, in the

department. In the absence of any evidence from this source, it is safe to assume that no problem exists and that the company meets its responsibility to its workers by providing them with adequate cleansers and washing facilities.

## CRACKING DEPARTMENT

Thermal Cracking

1,000 pound Coils: No. 21 and No. 22 Units.

Materials and Process. Feed stock is gas oil from various sources, clarified oil from PCIA, and pitch bottoms (from pipe stills). Products are gas (C-1 to C-4), naphtha, cycle gas oil, and tar.

Exposures. Exposures to inhalation of vapor and mist from the materials that are being processed can be expected to occur in the act of sampling process material, in the neighborhood of pumps where leakage occurs, and in the neighborhood of pumps which give rise to oil mist. Such exposures are significant health-wise when the material consists of clarified oil or the tar produced from cracking clarified oil. These are suspected carcinogenic agents. The control of oil mist inhalation in a program for complete prevention of occupational tumor formation is discussed in the section dealing with Wax Press Rooms.

Collection of oil mist in an impinger and evaluation of the results by a procedure analogous to that used in dust counting gave the following results:

Table 9

CONCENTRATION OF OIL MIST IN VICINITY OF PUMPS AT THERMAL CRACKING UNIT

| Sample Number | Sampling Time | Location                                                                                           | Droplets per Cubic Centimeter of Air |
|---------------|---------------|----------------------------------------------------------------------------------------------------|--------------------------------------|
| 64            | 8 min.        | No. 21 - 1,000-pound cracking coils, in doorway to control house near hot pitch feed pump.         | 1.59                                 |
| 65            | 4 Min.        | Adjacent to hot pitch feed pump, two feet from shaft which appears to be chief source of oil mist. | 0.0                                  |

These evaluations serve only to demonstrate the presence of oil mist in the location cited.

Number of Men. Operating personnel consists of six men per shift.

Location and Features of Control House. The control house in which the men spend most of their time consists of two rooms adjacent to one another and close to pumps. Mist from hot oil pumps can enter through open door on west side of control room. Pump site is covered by a roof and enclosed on two sides. Re-flux pumps handling light fractions (naphtha) have fair amount of leakage, but are located good distance from control house and are not enclosed. Materials for measurement are brought into the control house (no transmitter-receiver type instruments here). Activation of recorders is by means of natural gas. Brown and Foxboro instruments in shop bleed tests showed escape of 0.02 and 0.32 cubic feet per minute respectively. There is an estimated total of 15 such instruments for the No. 21 and No. 22 units. Tests with benzol vapor indicator gave no deflection around the instrument panel. Full scale reading was obtained when the intake was placed at the meter face.

The location of hot oil pumps just outside the door of this enclosed control house affords the opportunity for the entrance of fairly high concentrations of oil mist and vapor of varying composition and of unknown significance health-wise. Escape of vapor and gas from instrument lines inside the house is thought to be of insignificant importance because of the small amount of leakage that can be tolerated from the standpoint of process control.

Sampling. Helper at the unit takes a sample from the "hot bottoms" line about four times per shift. The line must be bled for several minutes before drawing the sample. The person drawing the sample cannot always stand to windward side because of the location of the draw-off pipe over the drain to the sewer.

The three-sided shed where the gravity test is made, effectively encloses vapors from the hot oil being tested, causing increased concentrations in the operator's breathing level.

The location of the end of the draw-off line, with respect to the opening to the sewer line and to the position that must be taken by the man prior to and during sampling, affords too great an opportunity for splashing and volatilization of the material that is being drawn. Less confinement at the site of gravity testing is desirable.

Since sampling and testing are the acts providing the most intimate contact of process men with the material, an effort towards improvement of these arrangements is suggested.

750-pound Coils: No. 19 and No. 20 Units.

Process. Feed stock and products are similar to those of No. 21 and No. 22 units. (Note: When clarified oil from PCIA is used as feed, it is supplied under sufficient pressure by pumps at PCIA. We have inferred from this that there is no pump here handling unaltered clarified oil--hence, no mist of this substance as received.)

Number of Men. About nine men per shift operate 17, 18, 19, and 20 cracking coils.

Location and Features of Control House. The control area is not as completely enclosed as that at No. 21 and No. 22. Instrumentation is the same. Proximity of pumps and invasion of mist from hot oil pumps through open doorway is about equal. Results of oil mist counts are as follows:

Table 10

## CONCENTRATION OF OIL MIST IN VICINITY OF PUMPS AT THERMAL CRACKING UNIT

| Sample Number | Sampling Time | Location                                                                                                                                                                                                              | Droplets per Cubic Centimeter of Air |
|---------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| 66            | 10 min.       | No. 20, 750-pound cracking coil, near hot oil pumps handling gas oil from various sources.                                                                                                                            | 7.44                                 |
| 67            | 8 min.        | No. 20, 750-pound cracking coil, adjacent to pump handling cold gas oil and another running pitch bottoms. Wind is from north-east and some mist from hot oil pumps may reach this position through the open doorway. | 1.23                                 |
| 68            | 7 min.        | No. 20 unit, in doorway between hot oil pump room and control room, directly downwind from hot oil pumps.                                                                                                             | 7.44                                 |

Conclusions Regarding Exposures of Men.

Exposures by skin contact and inhalation of mist or vapor is possible at sampling locations. The sites were not inspected, nor was the frequency noted; this is, therefore, an inference from observations at other units.

Mist from the hot oil pumps to the north was found to invade the space (semi-enclosed) where process men spend most of their time reading instruments and filling out charts and data sheets. This is not a continual exposure, depending on wind from the northern quarter or lack of wind.

Unusual situations, one of which we witnessed, such as a broken valve, occasionally will cause spillage or leaks that result in skin contact before repairs can be effected by the pipe fitters.

## Steam Cracking

### Process.

Feed stock for this process is virgin heavy naphtha. The products consist of a dilute butadiene stream, an aromatic distillate, residue gas, aromatic tar, fuel oil, and a C<sub>5</sub> cut which goes to isoprene extraction. Clarified oil from PCLA is used as a quenching agent.

Number of Men. Three men per shift spend most of their time in the control house which is closely associated with the feed and water pumps.

Association with Toxic Substances. The substances at this unit which deserve closest scrutiny are the tar bottoms, clarified oil, and the aromatic distillate.

The tar fraction and the clarified oil are included in the suspected carcinogenic materials for which special precautions against skin contact have been planned. They are discussed separately.

The aromatic distillate is described as containing 56 per cent aromatics. Initial boiling point of the fraction is 300°F. and final boiling point, 475°F. Leaving the cracking coils, this distillate is handled by a pump near the control house. It undergoes fractionation at No. 4 D & S; after separation here it is put through a clay treating process similar to that at OLA 2, in the chemical products area. It finally goes to Tank 961 on the western side of the run-down tank area. The boiling range of this fraction includes the boiling points of C<sub>9</sub> and higher mono-nuclear aromatics. Any problem of toxicity of this fraction would be of the order of toxicity of cumenes, etc. and not of the type of benzene, toluene, and xylenes. Observations at this unit and at Tank 961 failed to disclose any occasion for prolonged breathing of this fraction.

There are several reasons why the operations at these units are of

interest to those concerned with the maintenance of employee health: (1) Chronic toxic effects of  $C_9$  and related aromatic hydrocarbons are not sufficiently well-understood; (2) the exact extent of occasionally repeated vapor exposures of men at these units could not, of course, be determined in the course of this survey; (3) the process is similar to that at OLA-1 and OLA-2. There is no assurance that changes in feed stock or processing conditions will not result in the production of the more volatile aromatics of the type of benzene.

#### Catalytic Cracking

Three catalytic cracking units are operated. No. 1 is the first fluid catalytic cracking unit to be put in operation anywhere and differs radically in design and operation from No. 2 and No. 3, which are identical.

#### Materials and Process.

Feed stocks for the catalytic cracking units include reduced crude from end-fired stills, virgin gas oil from crude distillate, various residual stocks from the production of lubricating oil, and cycle gas oil from thermal cracking. Products are gas (to  $C_4$ ), light naphtha, heavy naphtha, and heavy cycle gas oil. A finely-powdered silica-alumina catalyst is handled as a fluid.

Number of Men. 90 persons are employed on three shifts in the operation of the three catalytic crackers.

#### Significant Exposures.

(1) Catalyst dust: Unloading of fresh catalyst from the cars in which it is received is a relatively dust-free job. Twenty-seven to thirty carloads of catalyst per month are received. Removal from storage and return of regenerated catalyst

units themselves when the high velocity of the catalyst stream causes corrosion in pipe lines. This occurrence is not infrequent, especially on the No. 1 PCLA. When leakage occurs, exposure to the dust is suffered mainly by maintenance men who are called upon to repair the lines.

The toxicological information now available indicates that this material is unlikely to cause silicosis. This may be due to its being so lean in very fine dust fractions compared with naturally produced dust; or to its relatively high rate of solubility. In any case, we conclude that any exposures we learned about are of no significance health-wise.

(2) Heavy catalytic cycle gas oil: This fraction occurs in two forms at the unit. The first is known as slurry oil and contains catalyst in suspension. The second is clarified oil which is the same oil stock after removal of catalyst. These substances are the principal materials involved in the program for control of skin contact with carcinogenic oils. This phase of their activity is discussed in a separate section.

Two other factors concerning the handling of these oils are worthy of consideration. The first is the existence of fine mist in the vicinity of hot oil pumps carrying either slurry or clarified oil. We demonstrated the existence of such a mist and observed that there is occasion for men to spend at least short intervals of time in areas where mist is present.

An air sample collected by means of an impinger at PCLA No. 1, three feet from the shaft of a pump handling hot clarified oil was evaluated in a manner analogous to dust counting and showed 21.3 droplets per cubic centimeter. At the time of sampling, there was a visible mist arising from the shaft of the pump with each stroke. Mist also arose from the cylinder block upon which oil had been spilled from a sampling line.

Inhalation of oil mist affords equally good opportunity for contact as

carcinogenic agent that may be present into the body of a man. A careful review of all the localities where such misting occurs and the correlation of this occurrence with the presence of men seems to be warranted.

The remaining consideration is the immediate formation of blisters upon skin of men where spillage of slurry oil has occurred. It is true that in many cases, these blisters would appear to be thermal blisters from hot oil. There is good evidence, however, that some of the properties of the oil may be responsible. In those cases where heat can be ruled out as a cause of blister formation, question arises as to whether this is a unique effect of slurry oil or whether it is a manifestation common to several other petroleum fractions, notably kerosene. An associated question is whether this occurrence of blisters may be related to the irritant effects on eyes and respiratory system following exposure to catalyst dust, a possible relationship lying in the adsorbed oil on spent catalyst.

## UTILITIES AND LIGHT ENDS

Light EndsPetroleum Vapor.

The principal effect of the inhalation of vapors of saturated and unsaturated light hydrocarbons is narcosis from prolonged breathing of concentrations in the range of a few thousand parts per million. We know from refinery surveys that such concentrations do not prevail for prolonged periods in areas where men work. However, industrial hygiene codes of some states and the National Conference of Governmental Industrial Hygienists include tolerable limits of 500 or 1,000 parts per million as definitive of good working conditions. It is a matter of interest, therefore, to obtain some estimation of concentrations that are encountered in the light ends plant of this refinery. For this purpose, the 1929 Gas Absorption Plant, whose units are now used as specialty stills, was chosen. The control house of this plant was described to us by personnel of the light ends division as the most "gassy" in the refinery, the reason being its location in the midst of the process units.

The fractionation towers at the 1929 Gas Absorption Plant handle principally virgin heavy naphtha, separating  $C_3$  and  $C_4$  from  $C_5$  and heavier; they also were handling propylene polymer, separating a small amount of  $C_4$  from the remaining heavier polymer. Readings in the range of 25 to 50 parts per million were obtained downwind from a sewer opening beside water cooling coils with a sensitive combustible gas indicator. Elsewhere about the plant, in the control house, at the base of No. 4 Specialty Still, at No. 3 Rectifier, and downwind from a leaking valve 50 yards from the control house, readings were essentially zero. These readings show the effect of the mild breeze, which was blowing on the day the measurements were made (April 12, 1949), in diluting the vapor soon after it

The examples typify our findings of petroleum vapors around outdoor process equipment.

#### Hydrogen Sulfide.

In the compression and distribution of gases containing hydrogen sulfide and their subsequent recovery for use, the hazard has been recognized and effective precautions to prevent its escape in places where men work are generally quite good. A fairly recent development has been the removal of sections of side walls at No. 1 and No. 2 Gas Compressor houses. Ventilation thus provided is in addition to the local exhaust ducts at the compressors.

At the various units of the light ends plant, when men encounter hydrogen sulfide it is most often as a barely perceptible amount in outdoor pump locations where natural ventilation and lack of confinement prevent its accumulation. If we disassociate from our consideration the necessary precautions against accidental inhalation of amounts sufficient to cause immediate symptoms of acute poisoning, such as would occur in equipment failure, it would seem that there is no problem of hydrogen sulfide poisoning. No areas where men work for prolonged periods in amounts sufficient to cause chronic poisoning could be noted in this survey, except as noted in the discussion of the flare stack adjacent to the new light ends plant.

#### Acid Recovery Plants.

The processes of hydrolyzing acid sludge, recovering weak acid, and concentrating this acid to 85-90 per cent by vacuum distillation is associated with the obvious possibility of accidental acid burns for which the proper precautions have long been practiced. There is nothing else significant to employee health about this type of work.

Boiler Houses and Power Houses.

The best approach to the question of possible damage to hearing in places where high noise levels exist, such as the power houses, is to make a hearing inventory among the men who are exposed, in order to detect any changes with the passage of time. Measurements of noise levels in the work places do not give a satisfactory basis for predicting damage to hearing. Satisfactory standards do not exist, chiefly because of great variation in response between individuals at given noise levels. The matter can be resolved by determining the state of a person's hearing in a pre-placement examination and determining in subsequent yearly examinations any changes that occur.

## MAINTENANCE AND CONSTRUCTION

PIPE DIVISION

The Pipe Division of M. & C. Department was subjected to careful study in the course of the survey because personnel of the division forms a numerically large segment of the plant population and because the performance of the functions of the division places its men in intimate contact with process material. Pipefitters comprise 23 per cent of M. & C. employment and about 9 per cent of the total refinery personnel. After the General Labor Division, it is the next largest M. & C. division.

The Pipefitters enter into nearly every phase of processing from the initial installation of a unit through its normal operation, routine maintenance and general inspection, turnaround, dismantling, or change of design. In their work of blanking off lines for removal or repair of pieces of equipment, they can suffer an exposure to whatever material is in the unit. The magnitude of the exposure is dependent chiefly on the effectiveness of draining or flushing by the process people before the unit is released to the pipefitters. Typical exposures of this nature range from the short-time breathing of gasoline vapors in an instance where a pump or valve on a gasoline line is removed from service to an occasion where pipefitters render prolonged assistance in removing a large number of heating tubes from a crude reboiler in acid service at the alcohol plant. The former is typical of an exposure where the hazard to health is of a low order of magnitude, the latter, one of doubtful or uncertain magnitude.

Of the 765 men employed in Pipe Division, close to 200 are regularly assigned to process units. These men have fairly steady assignments and are subject to fairly steady environmental conditions. Turnaround work and shifting demands of building and reconstruction gives to most of the men in the Division a

those two who were formerly assigned (those with the longest tenure can be identified by the machinist foreman) should be given the routine physical examination required of the press cleaners. Equal facilities for the practice of personal hygiene are necessary for the maintenance machinists.

#### Butyl Rubber Reactors and Finishing Building.

There is a low incidence of exposures to methyl chloride by the machinists. In the reactor building, natural ventilation through the open side walls is usually good. In the finishing building, routine greasing of the screen shakers and the filter mechanisms requires exposures of short duration. Repair work on these units is performed while the flow of materials is shut down and while the ventilation system is still operating.

#### Paracril Plant.

Exposure of machinists to acrylonitrile and other volatile substances in the paracril plant do not exceed those of the operating personnel, which were shown by air analysis to be within acceptable limits, except in the vicinity of the latex pot and the coagulating pot.

#### Gas Compressors.

Since maintenance of gas compressors in various parts of the Petroleum Products Division and the Chemical Products Division accounts for a large part of the total time spent by maintenance machinists, there is a certain degree of importance attached to the possibility of gas inhalation at these units. In our examination of the compressor buildings, we failed to see any localities where accumulation of amounts of gas sufficient to produce chronic intoxication was a likely occurrence. There undoubtedly have been some exposures in the past and may be occasionally at the present time. Most of the obviously dangerous

exposures have been eliminated, either by providing exhaust systems over the escape points or by opening up the building to permit natural ventilation. Methyl chloride and hydrogen sulfide concentrations have been reduced by these two methods, respectively. A review of all such installations from the standpoint of chronic exposures to low concentrations of gas is recommended.

Contact with Heavy Catalytic Cycle Gas Oil and OLA Tars.

The machinists are among the crafts which have had and will continue to have opportunity in the daily performance of their duties at the process units which handle these materials and at field tank pumps for contact with these substances. Future contact is regulated as a part of the general program. No unusual or unforeseen incidents relating to contact were observed in this study.

Machine Shop

Main Shop.

The main shop was found to be without any apparent industrial health problems. Lighting and sanitation facilities are excellent. Use of solvents is limited to Varsol, which is handled in such a way that, even though its toxicity and volatility were great, exposures would not be significant.

Disassembly and Reassembly Shop.

Pieces of equipment come to this location directly from the process units or from an Oakite cleaning in the tanks of the heat exchanger cleaning shop. Those pieces of equipment which have been in service at units handling the heavy catalytic cycle gas oil, OLA tars, or re-run tars bear a special

identification tag. When they are disassembled, some of this suspected carcinogenic material may be released. We saw slurry oil spill out of a slurry pump which had been through the Oakite cleaning. There is a problem of its disposal. The nearest drain to the sewer is about 60 feet from the place where heavy equipment is disassembled.

#### Metal Spraying.

About 15 different types of metal are sprayed in a shed with open sides near the machine shop. Stainless and mild steel wires are most frequently used. The amount of lead spraying seems to be too small to be of any importance toxicologically. It was described to us as consisting of about one small job a month for a part of acid service at the Chemical Products Area. Bronze is no longer used.

Incidents of poisoning by nitrogen oxides generated by the heat of the spraying torch, that are described in the literature, have occurred in enclosed spaces where it has been possible for concentrations of these gases to accumulate over a prolonged period. It is safe to assume that such accumulations could not occur in this open shed.

## BOILERMAKER DIVISION

Riggers.

The work of the riggers, who numbered 67 in the entire plant, did not come in for close scrutiny in this survey. It was adjudged that in the performance of their mission of moving and erecting heavy equipment, their exposures to toxic and hazardous material are slight. Riggers are not active on a job until after process men have taken a given piece of equipment off stream and pipefitters have blanked it off from the flow; actual close work with the equipment is of short duration.

Opportunity for skin contact with acids or high-boiling aromatic hydrocarbon exists. For protection, riggers are furnished protective clothing, which they carry with them to a job. Contaminated riggers' clothing is laundered by the refinery in accordance with the general program for prevention of prolonged contact with substances implicated as possible cancer-formers.

Welders and Burners.

106 welders include 98 electric welders and 8 gas welders. All of these men are first class mechanics and their work is limited to welding. Fitting of parts to be welded is done by other crafts.

The burners number 66, consisting entirely of first class mechanics. Work inside drums, towers, etc. amounts to a considerable percentage of the total work of welders and burners. An important aspect of this inside work is that pieces of equipment in which inside work must be done are routinely cleaned by sandblasting before the welders and burners enter. This practice effectively limits their inhalation of atmospheric contaminants to those products of the welding or burning process, i.e., fumes or gases from the base metal, welding

Welding on ordinary structural grades of steel with coated electrodes results in the escape to the atmosphere of fumes containing iron oxide and oxides of several metals found in the electrode coating. Manganese, titanium, and silicon are common. The gaseous products consist of carbon dioxide, carbon monoxide, water, and nitrogen oxides. These fumes and gases originate in the extreme heat of the arc and are thus given an initial velocity upwards that tends to disperse them to less than harmful concentrations in any but the most confined spaces. Given a fair sized enclosure and some natural movement of uncontaminated air from outside the contaminants will disperse in a satisfactory manner. In cases where the welding is performed in a confined space with no ventilation the symptoms are primarily those of nose and throat irritation, and cough.

In welding on galvanized steel, the proportion of zinc oxide in the total fume is greater than that of iron oxide. Metal fume fever may result unless total fume concentrations are kept at a much lower level than is necessary in the case of welding on uncoated steel. Good ventilation of the space is effective in preventing the occurrence of metal fume fever.

Welding on lead or cadmium-coated base metal may constitute major health hazards. Cadmium fumes are not believed to constitute a chronic poisoning hazard, but do represent a very serious accident hazard where concentrations are high due to poor ventilation. Exposures of only a few hours duration are sufficient to cause serious lung involvement and even death. Protection may be provided either in the form of local exhaust ventilation or the wearing of a fume respirator beneath the welder's face shield. No instances of these types of welding were noted in the refinery.

Welding on stainless steel involves exposures to fluorides from the rod coating. Excessive exposure to these fumes causes irritation of the nasal passages, and not infrequently nosebleed. This is generally believed to be caused by the formation of hydrofluoric acid. In our opinion, there is no likelihood of

fluorosis from such exposures. Fluorosis is a development of bone abnormalities resulting from many years exposure to large concentrations of fluorides.

We were unable to obtain a first-hand impression of fume conditions in any of this welding work. However, the exposure being basically of nuisance type, scientific evaluation is not required and ordinary inquiry will suit all purposes.

Ventilation for inside welding work is provided by Lamb "air siphons" furnished by the boilermakers and installed by pipefitters. An estimated 30 or 40 "siphons" are available in the entire refinery.

Surfaces painted with red lead are encountered in minor repair work on barges, an infrequent job, and on new structural steel, also infrequent. An electric blower is provided to furnish local exhaust on the barge work. Red lead is removed from new structural steel by burning and brushing prior to welding. The short duration of these jobs and their lack of frequency make it unlikely that there is any hazard to burners or welders from inhalation of lead fume from work on steel that has been painted with red lead.

Protective clothing is provided for work in acid areas. It is stored in division tool rooms or kept personally by individual welders.

Coke deposits are sometimes cut from inside equipment by burners' torch. Ventilation equipment is called for and used because of the smoke and heat in confined quarters.

Cutting and melting of lead scrap is done by one man with a portable lead pot, working occasionally at various locations. Several efforts to witness this job failed because of its discontinuous operation. This man should be included in physical examination schedule for lead burners.

The Pipe Shop (Petroleum Products Division) is operated jointly by pipefitters and welders. Pipe welding is done in a structure having open sides. An estimated 95 per cent of the work is on new pipe, limiting fume exposures to the innocuous type of black iron welding. Lead-lined pipe is not seen at this

shop. Fume exposures are not serious at this shop at this time, although certain positions may put a welder's head for a time in the region of heavy fume from the arc. This might assume a more serious nature if in the future the new pipe containing a bonded lead lining, which was described to us at the acid plant, should be brought to this shop for cutting or welding of flanges. Provision of local exhaust equipment for removal of the fumes from their point of origin to a distance from the welder's breathing zone would then become necessary.

Boilermaker Shop, 572 Area, in Chemical Products Division north of No. 4 Finishing Building, employs one welder and one burner. There was nothing in the layout of the shop nor in the description we obtained of its work to suggest the existence of occupational disease hazards.

Pipe Shop, Chemical Products Division.

At the welding shop, Chemical Products Division, west of No. 1 Alcohol plant, five welders and three burners, all on "A" shift, are employed at fabricating and repairing pipe sections. Fume exposures are limited mainly to fumes from the metal being welded and the rod and coating. No estimate could be obtained of the relative proportions of work on new and used pipe. It was ascertained that residual material in used pipe was removed by burning at a point remote from the shop and in a manner that results in no fume or vapor exposure to the man doing the burning. In this shop, welders complained of illness from welding on certain types of alloys described as "Red Copper," "Red Brass," and "Everdur." In welding such material, heat is applied by means of a carbon electrode in the usual welder's electrode holder. Pipe sections undergoing this process are of such sizes and shapes that it is impossible for a welder to always stay out of the zone of most dense fume from the arc.

The illness they described is suggestive of metal fume fever, being an acute illness having its onset several hours after work has ceased, and being characterized by chills, fever, vomiting, and headache.

The Everdur alloys contain copper, 95 to 98 per cent; silicon, 1.5 to 4 per cent; and about 1 per cent manganese.

Red Brass usually contains 85 per cent copper and 15 per cent zinc.

There are no chronic effects from metal fume fever. The acute illness can be prevented by installation of a local exhaust system in this shop to carry away the fumes from their points of origin.

#### Boilermaker Shop. "Old Boiler Shop."

Activities in this shop consist of:

Electric welding--one or two arc welders perform various repair jobs.

Burning--three machine burners work in this shop full time. A variable number of hand torch burners are present.

Gas welding--the gas welding shop in this building is the site of employment of the eight gas welders included in the employment list for the Boilermakers Division. The work consists of oxy-acetylene welding of non-ferrous alloy parts, using principally un-coated rods of composition similar to the base metal. A considerable proportion of the work load consists of effecting repairs to Hastelloy D heating tubes used in acid service at the alcohol plants, IIA units, and acid concentrating plants.

The shop is provided with a local exhaust system for removal of fumes from the actual welding. Hastelloy D tubes which contain 85 per cent nickel must be pre-heated to about 600°F. in a furnace at the shop before welding. Some 20 heating tubes per month are handled here, and three is the maximum number in any one day. When these tubes come to the shop with a coating of some residue of carbonaceous material from the unit from which it was removed, there is an

evolution of fumes, at least in the first stages of heating to the correct temperature for welding.

The possibility of the formation, under these conditions of combustion, of nickel carbonyl has been raised. Nickel carbonyl, a volatile material possessing a high degree of acute toxicity, has been responsible for the development of lung cancer in the nickel refining industry. We are not in a position to comment on the possibility of its presence in the fumes from heating these tubes. Inhalation of these fumes can be greatly diminished by the installation of a hood over the furnace port.

#### Welders at Catalytic Cracking Unit Turnaround.

At turnaround of catalytic cracking units, the services of welders and burners are required for about 3/5 of the turnaround period. Welders work three shifts a day, six days a week, and burners on two shifts, 6 days a week. An estimated sixty per cent of the work is inside work and, of this, forty per cent is considered dusty work. A high proportion of the work inside is on stainless and chrome steel. Dust sources are residual catalyst, especially in the precipitators where it is easily disturbed from its resting places on the shakers, refractory and insulation dust in the regenerators, and settled dust remaining after sandblasters have left the tower. Dust elimination efforts have gone a long way toward cleaning up the vessels for the turnaround mechanics. Additional protection from inhalation of these dusts can be offered these welders and burners by providing them with a filter-type respirator designed for dust and fume. Types that will fit beneath the welder's hood are available.

The danger of contracting illness from inhalation of these dusts in the concentrations prevailing during the turnaround is thought to be rather small for the following reasons:

- (1) Exposure time for an individual welder or burner over the course

of a year will amount to probably no more than one month. (There are about four turnaround periods of about 15 days normal duration on the three units.) All boilermaker crafts are rotated on catalytic cracker turnaround;

(2) Catalyst dust and most of the refractory dust that is encountered is relatively non-hazardous by reason of its composition and particle size.

### Lead Burners

#### Lead Burner Shop at No. 3 Acid Plant.

About four men work part-time in a shop which is open on three sides. This affords good natural ventilation and prevents accumulation of lead fumes in the lead shop. It does not prevent the inhalation of fumes rising directly from the burning or bonding torch. Measurements of atmospheric lead during burning and bonding at Aruba showed that concentrations in air at the nose of the man can exceed the recommended limit even in outdoor locations, because of the proximity of the man's nose to the source of fume. With this experience and with the results of the urine lead determinations that were made at Aruba, we recommend that some exhaust ventilation be provided for lead burning in this shop.

#### Lead Burning Shop in Crafts Building in Chemical Products Area.

Three men work about half-time in this shop. This room has fairly good natural ventilation. The same remarks regarding inhalation of fumes coming directly from the torch apply here.

#### Outside Lead Burning and Bonding.

About half of the time of the seven lead burners and seven helpers is spent performing jobs at the process units. Many of these jobs require work in spaces somewhat more confined than the shops themselves. Examples are re-boilers at the alcohol plants.

### Medical Control Measures.

Lead burners and their helpers are examined twice yearly by the Medical Department for symptoms of lead poisoning. We suggest that the examinations be supplemented with urinary lead determinations, so that evidence of absorption may be detected before symptoms of poisoning occur. As a part of this survey, we obtained urine specimens from 12 lead burners and helpers. As a group, these men showed normal excretory values. The results are shown in the following Table.

Table 11

#### RESULTS OF LEAD DETERMINATIONS IN URINE OF LEAD BURNERS AND HELPERS

| Name          | Sample Number | Amount (Cubic Cent.) | Specific Gravity | Concentration (Milligrams of Lead per liter) |
|---------------|---------------|----------------------|------------------|----------------------------------------------|
| Chapman       | 3016          | 230                  | 1.020            | .170                                         |
| Christof      | 3249          | 110                  | 1.028            | .097                                         |
| Elkins        | 1830          | 155                  | 1.025            | .120                                         |
| Fisher        | 3093          | 115                  | 1.027            | .132                                         |
| Kelley, B. A. | 328           | 380                  | 1.010            | .055                                         |
| Kelley, B. F. | 1030          | 295                  | 1.012            | .058                                         |
| Kelley, O. D. | 251           | 295                  | 1.023            | .098                                         |
| Martin        | 844           | 175                  | 1.030            | .153                                         |
| Nettles       | 1372          | 180                  | 1.020            | .115                                         |
| Thomas        | 3012          | 93                   | 1.026            | .192                                         |
| Whitney       | 3464          | 95                   | 1.026            | .102                                         |
| Williams      | 134           | 475                  | 1.004            | .095                                         |

Periodic urinary lead determinations will reveal any changes in the exposures, which at the present time are not excessive.

### Utility of Lead Urinalysis.

The measurement of the amount of lead excreted in the urine is a useful means of evaluating exposure to lead and, therefore, a valuable adjunct to medical techniques in supervising the health of lead workers. It will be the

respiratory systems of the members of the group of exposed persons as collecting devices for the lead in the atmosphere. By its mechanism of collection it eliminates any forms of lead in air that do not contribute to actual lead absorption, such as coarse dust particles. Furthermore, it averages out exposure with time, eliminating the intermittent high or low concentrations that might be found in sporadic air sampling and analysis. The amount excreted in the urine is proportional to the amount absorbed within certain limits of individual variation.

The influence of individual variation makes it necessary to use urinary lead concentrations as measures of group exposures rather than as measures of individual exposures. The knowledge of exposure obtained from urinary lead determinations can be utilized to point out the need for environmental control of the contaminant, and for indicating the frequency of, or even need for, medical examinations in the detection of early signs of lead poisoning.

Normal urine, from persons with no industrial exposure to lead, contains 0.02 to 0.10 milligrams of lead per liter, dependent largely on the dietary intake. Amounts of lead in the range 0.15 to 0.20 milligrams per liter are considered indicative of exposure at a borderline level of actual toxicity, with a probable degree of safety.

Extensive experience indicates that the collection and analysis of "spot" samples of urine, containing about 100 ml., is a satisfactory procedure for determination of exposure. It has an advantage over the collection of 24-hour specimen in that its collection can generally be closely supervised and the danger of contamination of the sample lessened.

Precautions against contamination are the use of chemically clean vessels and stoppers and scrupulous cleanliness during voiding of the sample. In a 100 ml. sample, containing 0.15 mg. of lead per liter, the analyst will have to work with only 15 micrograms of lead. The possible influence of dust or other foreign matter in the sample is obvious.

We were told at the acid plant of the contemplated use of steel pipe with bonded lead lining. The use of this pipe may introduce increased exposure to lead fumes because it will not be possible to remove the lead lining at will, prior to making changes in the shape or length of pipe sections, as can be done with the lead inserts now used. The urinary lead determinations will be valuable in determining whether this expected increase of exposure actually occurs.

1. continued

## METER AND INSTRUMENT DIVISION

Shops.

The shop men routinely overhaul, clean, and repair meters and instruments. There is a main shop in the Petroleum Products Area and a shop in the Crafts Building of the Chemical Products Area. Smaller shops are located in the East and West Esso Laboratories Areas, and in the RIA Mechanical Shops.

In the shop work, mercury is the principal hazardous material encountered. Measurements were made of the concentration of mercury vapor in the air of each of these shops, except the RIA Mechanical Shop. In none could we find concentrations as great as 0.1 mg. per cubic meter of air, a concentration considered a safe upper limit for 8-hour daily exposure. Results of all measurements are shown in Table 12 (page 71).

The main Meter and Instrument Shop, which handles the greatest volume of mercury, has a system for collection and recovery of spilled mercury, the effectiveness of which is shown by the absence of visible deposits on the benches or floor and by the extremely low atmospheric concentrations found.

The trial of this system in the main shop is expected to lead to similar installations in the other shops. There is need of such a system in the Chemical Products Area Crafts Building and in the East and West Esso Laboratories shops. Although low atmospheric concentrations were found in these places, the difficulty of removing spilled mercury from this type of floor makes it appear that sufficient accumulations may occur to give rise to higher concentrations with the passage of time.

It is well to remember that the occurrence of mercury vapor in hazardous concentrations in laboratories and shops is more likely to result from evaporation of spilled mercury having extremely large surface area, than from the actual manipulations with liquid mercury in the shop or laboratory work.

Table 12

MERCURY VAPOR MEASUREMENTS---  
METER AND INSTRUMENT SHOPS

| Sample Number | Location                                                                                                                                                                                                                                      | Air Volume (Cu.Ft.) | Mercury Concentration (Mg./cu.m.) |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------------------------|
| 1             | Main Meter and Instrument Shop. In vicinity of meter racks. Sample intake near floor.                                                                                                                                                         | 20                  | 0.08                              |
| 2             | Main Meter and Instrument Shop. In room used as office and storeroom. Visible deposits of spilled mercury on floor. Sample inlet at clerk's desk.                                                                                             | 26                  | 0.08                              |
| 3             | Shop in East Pilot Plant Area. New location for this shop. No visible deposits on this rough concrete floor. Sample intake on top of work bench at workers' breathing level.                                                                  | 15                  | trace                             |
| 4             | Shop in West Esso Laboratories Area. Shop located here for 3 months. Signs of spillage around mercury reservoir under bench. Rough concrete floor. No floor drain. Sample intake moved during sampling to three locations at breathing level. | 10                  | trace                             |
| 6             | Shop in Crafts Building in Chemical Products Area. Visible deposits of spilled mercury on rough concrete floor. Floor drain has no trap for recovery of mercury.                                                                              | 20                  | 0.08                              |

The use of Varsol for cleaning purposes in these shops is not considered hazardous in view of the amounts used and low volatility of this product.

Outside Men.

The principal duties of the outside men are inspection of thermocouple wells and orifice plates, trouble shooting at instrument locations, including repair at the site, and inspection and repair at time of turnaround.

These routine duties take the meter and instrument men into areas of

exposure to process material of highly diversified character. Quantitatively, their exposures are considered somewhat less than that of process operators at the respective units. They are furnished protective clothing to prevent skin contact with heavy aromatic distillate, acids, and alkali. That they are sometimes exposed accidentally to high vapor concentrations is evident from the account of a "fainting" incident that occurred in the MEK plant and the fact that cases of poisoning with methyl chloride occurred among meter and instrument men when its use was new.

Exposure to mercury vapor in confined spaces by outside M & I men is not steady enough to cause any concern.

Skin contact with liquid mercury occurs on meter and instrument repair jobs. The frequency of its occurrence was not ascertained. It is not a serious potential source of industrial disease, because (1) the supervisors and the men know that it should be avoided and do so as much as is possible; (2) washing facilities are available and are used after encountering liquid mercury on the job.

#### Shift Men.

Shift men of the Meter and Instrument Division work out of the main shop and the Chemical Products Area Craft Building Shop and on the current turn-around jobs. Their work does not differ from that of the straight day men in the same area.

## ELECTRICAL DIVISION

The greater part of the time of these men is spent away from the proximity of process material. Repair of refrigeration units, as in drinking fountains and air conditioning equipment, wiring and lamp replacements in the offices, maintenance of power lines overhead and beneath the ground are jobs that require no consideration in a review of health factors.

In work at the units, such as installation of lamps, maintenance and replacement of motors, temporary power and light wiring at turnaround, etc. the electricians' contact with process material is generally neither intense nor prolonged.

They work out of the main shop and way stations. Two or three men at a unit turnaround is the usual number.

### Line Gang.

The line gang is composed of 13 rated men and one laborer. The work is mostly outdoors on overhead lines. Occasionally they are employed at pulling cable in underground conduits and, in bad weather, they may be employed at lamping in and around process units. Their employment is non-hazardous from the industrial health standpoint.

### Electricians Assigned to Process Units, Laboratories, and Offices.

Five men are regularly assigned to process units, two at the catalytic cracking units and three at butyl rubber polymerization.

Twelve electricians are assigned to laboratories and offices. They may be excluded from consideration of health hazards.

Main Electrical Shop.

in line  
check

Four men are present full time at the main electrical shop. Their work is primarily that of motor cleaning and repairing. Approximately 100 motors per month are handled in this shop. Varsol is the regularly used cleaning agent. Its use in this shop is probably the greatest opportunity that exists in the refinery for toxic manifestations from repeated daily inhalation and skin contact, should there be any such manifestations from this substance.

According to a description furnished by the Refinery Laboratory, Varsol consists of a narrow cut fraction boiling between 300 and 400 degrees Fahrenheit. Its aromatic content was given as follows:

|                       |       |
|-----------------------|-------|
| Varsol B (105)        | 15.5% |
| Varsol C (106)        | 15.5% |
| H1 Flash Varsol (107) | 13.0% |

This boiling range would indicate that benzene, the most toxic of the aromatic hydrocarbons, is absent and that toluene and Xylenes are also absent. Aromatic substance in the analysis would presumably consist of ethyl benzene, propyl benzene, isopropyl benzene (cumene), ethyl toluene, etc.

These compounds are in a class about which little is known toxicologically, except for the acute effects of single large doses. It would seem that the low aromatic content, low volatility, and natural ventilation at the shop would result in a toxic vapor exposure of a low order of magnitude. Determination of just what the exposure amounts to and what its effects may be on the men as determined by close medical observation would be desirable undertakings.

Pedigree Products No. 150 Thinner is used in the shop to the extent of about five gallons per week as a thinner for insulating paints and varnishes which are sprayed, for cleaning spray equipment, and for cleaning the hands. This product is described by its manufacturer as consisting of commercial xylenes. Its use constitutes an exposure of undetermined toxicological significance. Although

the toxicity and volatility of xylenes are low, spraying of paints containing them as a thinner and intimate skin contact in washing the hands may produce undesirable effects in the men. Respiratory protection for the operators of spray equipment and substitution of a less irritant skin cleansing agent are logical starting points for elimination of any hazard that exists. In periodic medical examinations of these workers, attention should be directed at discovering any eye irritation, dermatitis, or central nervous system changes.

#### Skin Contact with Suspected Carcinogens.

Skin contact with heavy aromatic oils and other petroleum products from handling contaminated extension cords and floodlights that have seen service at process units is avoided by routine cleaning with steam by one man on "B" shift at the electric shop.

The regular duties of electrical maintenance men do not subject them to contact with acids or heavy aromatic oils and tar. Any contact is accidental, involuntary, and infrequent.

#### Underground Lead Work.

Lead sheathing in underground electrical conduits is relatively scarce in this refinery, being used for one voltage. Maintenance work on lead sheathing in underground conduits is done by one man. It was estimated that he is engaged for no more than one week per year at this type of work.

Because of its infrequent occurrence and the nature of the work, no lead poisoning hazard can be foreseen in this work.

#### Occurrence of Nitrogen Oxides.

Vacuum tube rectification at the catalytic cracking units eliminates the possibility of exposure to nitrogen oxides, which is said to occur in other plants.

## MASON DIVISION

This division includes 63 brick masons, 56 concrete and sandblast workers, and 72 insulators.

Masons.

The tearing down and removal of furnace brick at the No. 22 thermal cracking unit was observed in order to determine the degree of intensity of dust exposure in this type of work. Four dust counts made in the breathing zone of man performing this work showed concentrations ranging from 0.4 to 2.5 million particles per cubic foot, which are beneath hazardous levels. In work of this kind, there is usually some degree of natural ventilation. The work is intermittent. Some unit turnarounds require a minor amount of brick replacement. Dust encountered in this work would be expected to contain free silica to the extent of 25 to 30 per cent, as found in the Aruba survey. The job, therefore, is not considered to constitute a positive silicosis hazard.

Laying of new brick requires some cutting to shape at the site. For this purpose, the division has three clipper saws. They are equipped with dust exhaust but no collectors. The dust is discharged to the air at the rear of the apparatus. This effectively prevents the prolonged inhalation of dust by the operator. Persons in the area are, of course, exposed to the discharged dust. Their exposure is occasional since the saw is portable. The new type of saw with wet dust suppression, which is on order, will effectively prevent this nuisance practice of discharging dust to the air. wet unit

The replacement of brick in the catalyst regenerators in fluid catalytic cracking units is known as a dusty job. The greatest source of dust is the disturbance of residual catalyst in the chamber. Of secondary importance is

asbestos dust, which is present to an unknown extent. It is probably minor because there is no process whereby the asbestos is broken down to fine particle size. The overhanging "Jointless" firebricks used in this installation can be excluded from consideration as an important source of dust for the method of installing them is not dust producing. The longevity of the brick in this service, and the normal frequency of four turnarounds per year serve to classify this dust exposure as occasional.

Replacement and laying of brick in acid areas constitutes a large part of the brick masons' employment. The brick has a low free silica content. Cutting and shaping is done mainly outdoors. The dust exposure is not considered hazardous. Use of Basalite adhesive can result in exposure to irritant fumes, unless precautions are taken. The irritant property of the fume is so intense that chronic exposures are necessarily avoided by the men themselves. *Formally by the*

#### Concrete and Sandblast.

There is an interchange of men between concrete and sandblasting jobs which makes it difficult to determine just how many persons in the course of a year spend sufficient time in the vicinity of sandblasting to require physical examination by the Medical Department. The tendency toward increasing requirements for sandblasting inside process equipment prior to mechanical work at unit turnarounds makes it necessary that a continuing check on exposed personnel be kept by or for the Medical Department.

At units where we observed sandblasting inside towers, drums, or other equipment, the dust was well enough confined so that only the man handling the blasting hose was in a high concentration. He is, of course, protected with an approved supplied-air mask and helmet. There may be, and probably are, occasions where escape of dust is in the direction of attendants at the sand blast machines.

This is a situation which can only be evaluated by repeated observation and measurements at the scene.

At the sandblast shed next to the salvage yard, blasting of small parts from the process units, such as bubble caps, is done almost daily. The open sheds provided for this work provide no confinement of the dust. The shed where men must stand to attend the machines is sufficiently close to the blasting to receive at most times a high dust concentration. The attendants use no respiratory protection. Dust counts in this area, as shown in Table 13, which follows, ranged from four to 14 million particles per cubic foot. These concentrations are excessively high for free silica dust. Attendants at these units should be required to wear dust respirators during the whole time that sandblasting is being done. A more satisfactory long-range solution to the problem will be to provide a modern enclosed sand-blast shed with dust recovery system at the proposed new location at the Mechanical Crafts new buildings.

Table 13

DUST CONCENTRATIONS IN VICINITY OF SANDBLAST SHED

| Sample Number | Sampling Time | Location                                                                                                                                                  | Dust Count (Million particles per cu.ft.) |
|---------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| 68            | 5 min.        | Around perimeter of brick-crushing shed.                                                                                                                  | 7.4                                       |
| 69            | 5 min.        | At entrance to shed just east of sandblasting shed. This is the regular station of the man tending the machine for the sandblasters.                      | 14                                        |
| 77            | 5 min.        | Inside the shed mentioned in No. 69.                                                                                                                      | 14                                        |
| 78            | 7 min.        | Same location as No. 77.                                                                                                                                  | 7.3                                       |
| 82            | 5 min.        | Along side the eastern-most sandblast shed. No blasting being done in this shed at this time. Dust comes from two sandblasters working in the other shed. | 4.2                                       |

Brick and Asbestos Grinding.

Chick

no longer done

In a shed adjacent to the sandblast shed, a crushing machine is used several days each month to provide ground brick to be used as aggregate. Its use for grinding asbestos was described to us as very infrequent. Although an exhaust fan and duct are connected to this machine, there is considerable escape of fine dust within the room during its operation. Another important source of dust at this location is the sandblast shed next door. We feel that even in times past, when brick grinding was a continuous daily job to keep the polymer plant catalyst tower supplied, the high silica dust from sandblasting could have been a more important health factor than the occasional asbestos dust and brick dust in this shed. Use of a dust respirator in the brick grinding shed should be required.

Insulators.

Eman

We saw no operations in the refinery where insulators would be exposed to high concentrations of dust, harmless or otherwise, from the material with which they work. They do use a large variety of cements, thinners, solvents, and adhesives of unknown composition. There are some occasions where high concentrations of volatile constituents of these products will be encountered. The Medical Department should have some means of acquiring knowledge of the particular products that are in use and what the principal constituents are, so that proper medical control can be exercised.

## GENERAL LABOR

Refinery Disposal Dump.

Fourteen men are employed and the majority have worked here more than ten years. All types of liquid and solid wastes from refinery processes, to the extent of 100-150 truckloads daily are disposed of here by open pit burning of combustibles. Since combustion is only of bon-fire type, considerable smoke results and there is undoubtedly opportunity for major vaporization of materials surrounding the area of the actual fire. Dumping of heavy aromatics is said to be one of waste materials, and this suggests the good possibility of exposure of men to smokes containing injurious materials in vapor or mist form. Obviously, the men will attempt to take advantage of wind direction to avoid smoke, but this redeeming feature was minimized by our informants. At the time of our inspection, the wind was favorable for avoidance of smoke. The variety of waste materials handled and atmospheric conditions makes it impossible to appraise these conditions on a scientific basis, beyond the suggestions outlined above. General Labor supervisors rate the occupation as one of the worst problems they have.

Ethyl Lead Tanks Cleaning.

This hazard is recognized and precautions taken to comply with requirements and recommendations of the Ethyl Corporation (as well as duPont), which includes gas testing before entry into tanks, use of special protective clothing, supplied-air respirators, and periodic medical examination.

Exposure to Powder Catalyst Dust. Cleaning Reactor Chamber (PCLA).

A number of men are exposed for an estimated average of three months per year. The dust is very irritating to the upper respiratory tract and to the eyes.

It was generally agreed that men wear the respirators provided, faithfully, and this is a good index of the irritating qualities of the dust--since voluntary wear of respirators is only done where discomfort it imposes is of lesser extent. Goggles provided are worn but not as faithfully as respirators and, frequently, minor eye injury cases are reported to the Medical Department.

#### Cleaning Bubble Towers.

Inspectors, as well as laborers, cannot totally avoid skin exposures to various deposits in bubble tower and plate cleaning and inspecting, even though they wear rubber suits. These men literally must lie in the material where space is often no more than 15 inches deep. Some examples of this type of exposures are in the bubble towers of Cracking units 17, 18, 19, 20, 21, and 22, Pipe stills 1-8, PCLA 1, 2, and 3, ALA 1, 2, and 3, etc.

The deposits encountered in such places consist of a wide variety of materials from gas oil and naphtha used for flushing prior to entry to heavy polymers and coke deposits of unknown composition.

Exposures of this type to skin contact with materials of unknown composition and toxicity constitute one of the category of exposures of questionable importance. Fuller understanding of the effects of such exposures can only come with continued medical observation. The desire for complete health protection of refinery personnel dictates the necessity for avoidance of such exposures as much as possible and limiting the occurrence of possible ill effects by restoring cleanliness of person and clothing immediately following each exposure incident.

#### Cleaning Reactors. Light Ends Plant.

Renewal of polymerization catalyst occurs at a rate of about once in three months and lasts for about two days. The job is performed by a group of

ten men at an out-of-doors location. The material they encounter is coarse and granular, hence non-dusty. No significant exposures can be seen in the performance of these duties.

#### Tank Cleaning.

A certain amount of unavoidable skin contact occurs when laborers enter a tank to remove sediment remaining after pumping out the tank. These exposures are in the same category with those described in the section above, entitled Cleaning Bubble Towers. Respiratory protection is afforded by the use of hose masks. Spent clay from the lube filters is used to "dry up" the last of the sediment to facilitate its removal by wheelbarrow. This practice constitutes no dust hazard by reason of the granular form of the material used.

#### Tube and Soaker Cleaning.

An important segment of the duties of general labor consists of cleaning tubes at the furnaces of the various refining units. Some eighty men are employed on this job over three daily shifts.

There is no doubt that this is a dust-producing operation.

It is likewise evident that there is no accumulation of dust concentration at the breathing level of the cleaners, because their position is open to the outside air on three sides and above. There is usually a fair amount of air movement about their position. When dust production ceases, dust at the breathing level is quickly dissipated. The production of dust is fairly constant after the tubes have been opened and cleaning equipment has been put in place. Total exposure time, as for most M & C operations outside of shops, is variable and, hence, unknown. The effects on health from inhalation of these dusts, if and when it occurs, are likewise unknown.

### Cleaning Soaking Drums at Thermal Cracking Units.

Cleaning out vertical soaking drum at cracking coil No. 22 was done by means of a mechanical auger inserted from the bottom. Water wash flows down through the drum. This cleaning rig is used on 19, 20, 21, and 22 coils. Four laborers comprise its crew.

There is no dust exposure because of the use of water. There is opportunity for skin contact with materials in the drum while fitting the bit and while cleaning the sludge and coke away from the rig. We were told that one man is sometimes put into the drum from the top for scaling with a hand tool.

These contacts would be an important exposure in cases where the unit has been feeding clarified oil from catalytic cracking. There is an opinion in some quarters that the aromatics boiling over 700°F. are not destroyed, but concentrated, in the heavy tar fraction when clarified oil is fed to thermal cracking coils. This opinion should be tested by means of some animal toxicological experiments.

### Dismantling Condenser Boxes.

Four laborers were engaged in dismantling a condenser box on the No. 22 unit. There was a copious flow of heavy tar from the coils as end-connections were removed. Skin contact was plentiful. Some pipefitters were also involved in this occurrence, which was described as unusual by the pipe-fitter foreman, as gas oil is usually encountered in dismantling these coils. In this instance, the tar may or may not be considered potentially carcinogenic, depending upon its source and prior treatment. The occurrence serves to point up the necessity for establishing some procedure whereby every unexpected incident that results in prolonged contact of material over a large area of men's bodies shall be reported to the Safety Department or some other responsible agent for determination

of whether the regulations concerning clothing, showers, and medical examination for potential carcinogens shall be applied.

Exposures to Heavy Aromatics.

General Labor foremen have given earnest consideration to the problem. A question was raised that, in digging ditches to uncover pipeline leaks, the men may encounter a deposit of aromatics seepage. Alertness to this occurrence, which obviously exists in the division, is essential to success of the program for prevention of contact. Actual supervision of the use of protective boots and gloves that are provided for such occurrences is the other essential for success.

Another question is that of replacement of work clothing which men will wear for long periods in normal practice. This is one of the many details that must be worked out in the plan for providing clean work clothes when there has been contact with suspected carcinogenic material.

Skin contacts with heavy aromatics, on the part of general yard labor, has been considerably lessened by the provisions for flushing out lines before work is done on the catalytic cracking units. Similar provisions are being arranged at thermal cracking units where clarified oil is cracked.

Total Package- B112

35-1/1130

19

\$

Dollars

107171

## CARPENTER AND PAINTER DIVISION

Paint Shop.

*new paint shop*

The use of paint remover for stripping office furniture and other items occurs with sufficient frequency to require precautions against injurious inhalation of vapor. It is urged that special ventilation be provided for this work. It can be arranged by installation of a large propeller exhaust fan, e.g., 24" to 30" diameter, and placing of all paint remover work immediately adjacent to this fan. The present system of placing furniture outdoors for removing paint is not an assurance of safety against inhalation of the vapors of benzol, toluol, or chlorinated hydrocarbons which may be present because it depends on the vagaries of the winds and is not at all practical during extended rainy periods.

Painters.

*2-11-51  
2-11-51*

The relatively minor role of painting by refinery personnel is indicated by the fact that about 32 men actually do painting. Of this number, five or six men are part-time spray painters. (Major paint jobs on new construction, tanks, and process equipment is done by contractors.) Respirators are provided for all indoor spray work, which is very infrequent. No red lead is sprayed by refinery personnel.

An item of major interest to the Medical Department is the possibility of the occurrence of benzol in some of the formulations used. Since the sources of paint products, and even the composition of products from the same source, are subject to variation, a check on benzol exposures can best be obtained by random application of urine sulfate measurements to the members of the group.

## M I S C E L L A N E O U S

LABORATORIESRefinery LaboratoryAniline.

Daily routine aniline point tests are made. We could see no practice in the conduct of these tests that would result in breathing appreciable amounts of aniline vapor or any skin contact with aniline, except, perhaps, accidentally. The amount of aniline required for a test (approximately 10 c.c.) is drawn from a reservoir in an exhaust hood. It is mixed with material being tested on a laboratory bench away from the hood. After the test, used aniline is discarded, there being no facilities for re-distillation. Our only suggestion regarding the protection of workers from aniline is that the physical examination of these people be increased in frequency from once to twice a year, to conform to practice in the other refineries that we have seen.

Mercury Vapor.

Those laboratories in which metallic mercury is used were visited in company with Mr. Day, of the Safety Department, for the purpose of observing the extent and manner of use and the disposition of spilled mercury. Hygienic practice in the use of mercury consists of controlling accumulations of vapor or dust in the working environment. This can be accomplished by providing a reasonable amount of room ventilation and in keeping the floors and work benches free of spilled mercury. Evaporation takes place from finely divided droplets dispersed on a floor surface at a much greater rate than it will from mercury reservoirs on laboratory apparatus, because of the greater surface exposed to the air. The American Standards Association has adopted the value of 0.1 milligram per cubic

meter of air as the maximum permissible concentration. It constitutes a good bench mark for control of mercury vapor exposures. It expresses an easily attained level of control.

The results of measurements made in the various laboratories are known to the Safety Department. They are summarized in the Table below (page 88) for convenience.

Only the Gas Analysis Room of the Refinery Laboratory showed a concentration bordering on the level of what constitutes good practice. In this instance, replacement of the contaminated floor mats and cleaning and painting of the contaminated floor will effectively reduce the atmospheric concentration to the level prevailing in the other laboratories. The Gas Analysis Room of the Chemical Products Laboratory is in a much worse condition as regards spilled mercury on the floor and beneath the work benches, but accumulation of concentrations in the air is prevented by the excellent ventilation system.

Table 14

## MERCURY VAPOR DETERMINATIONS--LABORATORIES

| Sample Number | Location                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Mercury Concentration (Mg. per cu.m.) |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| 5             | Refinery laboratory. Gas Analysis Room. Fairly smooth concrete floor. Rubber mats. Not much ventilation. Sample intake at breathing level in two locations.                                                                                                                                                                                                                                                                                                                  | 0.18*<br>Greater than 0.1             |
| 7             | Plancor 572 Lab. Sample at breathing level near POD apparatus. No visible spilled mercury.                                                                                                                                                                                                                                                                                                                                                                                   | Less than 0.02*<br>0.0                |
| 8             | Refinery Laboratory. Leonard's Lab. Small use of mercury. Good ventilation. No visible deposits.                                                                                                                                                                                                                                                                                                                                                                             | 0.0                                   |
| 9             | Distillation Group Laboratory:<br>(a) Near vacuum still<br>(b) Near glass still                                                                                                                                                                                                                                                                                                                                                                                              | 0.0<br>0.0                            |
| 10            | Fuel Products Lab. Mercury is washed here for use in test at treating plant. Sample taken near washing apparatus in open cage locker.                                                                                                                                                                                                                                                                                                                                        | 0.0                                   |
| 11            | Chemical Products Main Laboratory:<br>(a) Analytical Lab. In vicinity of Polarimeter at breathing level<br>(b) Gas Analysis Lab. Visible deposits of spilled mercury on the floor, on rubber mats, underneath laboratory benches. Six exhaust ducts with intake one foot off floor, good air supply to room. Sample taken at breathing level.<br>(c) Special Problems Lab. B. Small use of mercury; good air movement.<br>(d) Special Problems Lab. A. Small use of mercury. | 0.0<br>0.0<br>0.0<br>0.0              |

\* Results obtained by a chemical method utilizing absorption in iodine and a colorimetric determination. Air volume 20 cubic feet. All other results were obtained by use of the General Electric Mercury Vapor Detector.

## PRINTING STANDARDS

The shop, design section, and office of this division employ about 33 persons in a one-story frame building.

Materials Handled.

The use of AzO dyes in the Ozalid process and of photographic chemicals constitute possible sources of dermatitis in susceptible individuals with which the Medical Director is fully aware. There are several solvents and process liquids in use which are of interest because of the likelihood that these, and similar preparations that may come into use from time to time, contain substances of known toxic properties, such as methyl alcohol and carbon tetrachloride.

Those currently in use are:

Ditto Direct Process Liquid  
Multilith Blankrola  
Multilith Repelax  
Multilith Repelax  
Multilith Plater  
Multilith Decoxit

Ventilation.

Besides the doors and windows which are usually open, ventilation of the working space is furnished by a 48-inch attic fan, a wall exhaust fan at the location of the photographic reproducer, and the exhaust fan connected with the hood over the Ozalid Process. It is estimated that the ventilation rate exceeds 12,000 to 15,000 cubic feet per minute. This ventilation rate will suffice to keep concentrations of vapor of liquids commonly used in formulations of this kind below 100 parts per million in the air, should the total evaporation rate amount to as much as 2.5 gallons per hour. According to our observations of the processes, the evaporation rate of liquids in this shop is much below this

figure. Concentrations of vapor in the air are thus maintained at a level safely below that which would cause harm to the personnel.

If there were acute exposures to high local concentrations of harmful solvents at any of the machines, these would have manifested themselves by symptoms of nausea, dizziness, or irritability.

## ASPHALT PLANT

We did not make a study of the facilities at this refinery for oxidiz-  
ing, blending, and packaging asphalt. In view of the experiences at other  
refineries within the company, it would be advisable to examine these facilities  
from the standpoint of production of vapors or mists in oxidizing, aromatic  
vapors in cutback blending, and asphalt mist at drum filling, wherever such  
atmospheric contaminants may prevail for extended periods in areas where men  
are at work.

## A P P E N D I X

## PREVENTION OF EXPOSURE TO HIGH BOILING AROMATICS

We have reviewed the basic information which indicated the necessity for a program of control of exposure to catalytic cracking or steam cracking fractions boiling above 700°F.; we are also acquainted with the exposition of this program to employees on February 23 and 24, 1949, and with the general rules for personal conduct and hygiene with respect to persons encountering these fractions in the course of their duties. We have reviewed the Safety Department's survey of exposures to high boiling aromatics in the refinery, which includes recommendations for further action and additional precautionary measures.

These studies indicate that the Refinery is in a favorable position with respect to prevention of skin contact with these oils by employees and early detection of any skin changes brought about by contact. The first and most important favorable point is that the employees are fully informed of the reasons for precautions. They have thus been put in a questioning frame of mind. Possibilities for exposure that were overlooked in the original directives and survey have been suggested and will continue to be brought out by the several hundred alert supervisors and workers that are affected. The list of proposed improvements in the Safety Department's survey contains several examples, notably the necessity for providing better means for flushing out slurry heat exchangers and steam generators at the catalytic cracking units, especially those that must be worked on while a unit is in operation. Some details of procedure still remain to be accomplished. Slurry pumps, in present practice, are not satisfactorily drained of the oil before removal to the machine shop for disassembly. There seems to be a chance for small parts from service in heavy aromatic oils to reach the sand blast shed for cleaning without warning labels.

With widespread knowledge of the problem, the prospects are excellent for the development in time of totally effective procedures.

The adequacy of facilities for taking showers and for provision of protective clothing assumes a great importance in this program for prevention of skin contact. We find that the refinery is well-equipped with shower rooms and that they are well-distributed for easy accessibility by those who may be in need of such facilities during a working day or at the end of the working day. Any tendency toward further centralization will have a detrimental effect on the ready accessibility of the rooms after the occurrence of a spill or a splash of the oil fractions that are to be avoided. Maintenance of these shower rooms in a clean and sanitary condition is generally quite good. There are a few exceptions:

(1) The colored room at the road oil stills. The location of this washroom under a water tank makes light and ventilation a difficult problem but maintenance on a par with facilities elsewhere could still make it a good place to take a bath.

(2) The colored room beneath tank No. 291 (next to No. 2 boiler house) is likewise ill-kept.

(3) The colored room at the Plate Shop suffers from overcrowding.

General Labor foremen say that 99 plus per cent of Negro laborers take showers on their own time at the end of the working day. This habit should be encouraged in every practical way. Good maintenance of the shower rooms is most important.

In the matter of dividing potentially exposed personnel into frequent and infrequent groups, we question the inclusion of nearly all process employees at PCIA units, QHIA, and OIA in the frequent category, while the number of Mechanical employees is minimized. In our experience, the process employees

spend more time at places where these oils are handled but experience less skin contact than Mechanical employees who may less frequently be in areas of exposure but more often are exposed. A simple time study on these groups should clarify the respective exposures.

In addition to what has been done to lessen skin contact with these high boiling aromatic oils, we propose that a complete program for prevention of exposure should include the prevention of inhalation of vapor or mist of these fractions. We were able to demonstrate the presence of oil mist in the vicinity of hot clarified oil pumps at the catalytic cracking units. We feel that there should be a concerted effort to identify and evaluate every occurrence of oil mist in places where men work and where the stock consists of oils that are presently included in this program for prevention of skin contact. The toxicological potentialities of inhalation of a mist of a substance that is potentially carcinogenic cannot at present be adequately defined but seems to deserve a great degree of important consideration. Initial efforts should be directed to the areas of slurry and clarified oil pumps at catalytic cracking units; feed pumps at thermal cracking units receiving clarified oil; quench oil pumps at steam cracking units; the tar product pumps of steam cracking units; and the use of steam lines for flushing away surface deposits that have resulted from spills or leaks.

All sampling locations at units handling these oils should be examined for the purpose of ascertaining whether the person who draws the sample can accomplish his mission without suffering exposure to mist or splashes of the stock he is sampling.

## BENZOL EXPOSURES

While potential exposures to benzol in various locations (summarized below) may have been over-emphasized, the uniquely toxic character of the vapor warrants special attention.

Various investigations in the consuming industries, especially in coated fabrics plants, where enclosure of equipment and ventilation were thought to be good, disclosed cases of benzol poisoning at concentrations of 75-100 p.p.m. The action is particularly insidious; many fatalities from chronic exposure to low concentrations are known.

Time for the survey did not permit detailed appraisal of this hazard in the several possible exposure locations. We did not feel that any were particularly significant, especially for average individuals in good health. The possibility of unfavorable developments, however, in an occasional susceptible individual could not be ruled out, and this is the reason for the general recommendation for medical supervision for workers potentially exposed.

### Urine Sulfate Test.

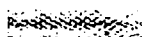
This test provides a convenient method for measuring the degree of a worker's exposure to benzol vapors during a given day, and is particularly applicable to appraising the exposures of workers in the listed locations.

### Summary of Potential Benzol Exposure Areas.

Solvent De-waxing (MEK) Plant  
Steam Cracking Plants No. 1 and No. 2  
Diolefin Extraction Unit  
QELA Steam Cracking Coils  
Paint Shop

EXHIBIT

# 16



# Transcript Quality Assurance Checklist

Deposition scheduled by: \_\_\_\_\_

Notice prepared by: \_\_\_\_\_

Subpoena prepared by: \_\_\_\_\_

Subpoena served by: \_\_\_\_\_

Setting confirmed by: \_\_\_\_\_

Deposition reported by: SLK \_\_\_\_\_

Transcript edited by: \_\_\_\_\_

Transcript proofread by: \_\_\_\_\_

Deposition videotaped by: \_\_\_\_\_

Transcript copied by: M \_\_\_\_\_

Exhibits prepared by: M \_\_\_\_\_

Transcript bound by: JS \_\_\_\_\_

Transcript page-checked by: \_\_\_\_\_

Transcript billed by: \_\_\_\_\_

Transcript packaged by: \_\_\_\_\_

Transmitted for signature by: \_\_\_\_\_

Notice to opposing counsel by: \_\_\_\_\_

Transcript delivered by: \_\_\_\_\_