Talk to Medical Directors, United Technologies, Hartford 12/15/77

Draft

~~I must apologize to you right at the outset of this talk~~. ~~Being a foreigner I have been involved in something called FLEX~~ - the ~~Federal of Licensing Examinations Board or something and I just finished the exams last week. This is the second time I have taken it which indicates to you how much I know about basic sciences and biochemistry and all the things that have appeared on this scene since I graduated~~. The time I have had to prepare this talk has not been very great and I apologize to you because ~~what~~ I am going to ~~do~~ "read" ~~in brief~~ a paper that was published this year in the British Journal of Industrial Medicine of which I was a co-author. I was only a co-author by virtue of the fact that I was ~~able to be~~ employed in a factory in the United Kingdom which has preserved its personnel records ~~from~~ since the turn of the last century ~~onwards~~ and which has good medical records going back to the late 1940's-early 1950's. ~~and which~~ These had previously been studied by my predecessor, John Knox in association with Richard Doll who is now the Regius Professor of Medicine at Oxford University and whom I am sure you all know of as a leading epidemiologist ~~in the field~~. It was Sir Richard Doll who, in 1955 (based upon studies of the population I am about to describe to you), ~~It was Richard Doll who~~ proved that there was indeed an association between lung cancer and exposure to asbestos. ~~Before we start~~, I think it would be ~~is always~~ worthwhile to ~~go through the old pot boiling mechanisms of telling~~ describe ~~you exactly~~ what asbestos is ~~well not exactly but just giving~~ and give you some idea of the material ~~what~~ we are talking about. ~~Unlike the Chairman of Turner & Newall, the company which I worked for which was a large company with 30,000 employees in the United Kingdom and many subsidiaries throughout the world including mines in Canada, and Southern Rhodesia and factories in many countries.~~ Your background data will then be better than that of the son of

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PLAINTIFF'S EXHIBIT
UC-4216

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ACL Doc 18809 · Page 1 of 21 asbestosclaims.law/library/18809/1

of an international asbestos company
Chairman who went out to Rhodesia to see for himself where the asbestos came from and after breakfast said "Let's go and look at the plantation!" ~~If we could just have the first slide and the lights off then I could illustrate to you just briefly that~~ Asbestos is a

SLIDE 1. fibrous mineral silicate and ~~that~~ there are a number of varieties that are of commercial importance. I am not going to go into ~~the~~ the arguments ~~and the details~~ about the differences in biological effects which exist between the various forms of asbestos. Chrysotile asbestos which comes from Canada, Southern Rhodesia, the Soviet Union, Cyprus, ~~South Africa~~ Swaziland and the United States, is the type of fiber which comprises about 95% of the world's usage of this material. It is a hydrated fibrous magnesium silicate. Crocidolite, which is a blue ~~pellet~~ fiber, ~~comes from~~ is mined in South Africa at the present time ~~from~~ in the Northwest Cape Province and ~~from~~ the Northeast and Transvaal. It used to be mined in Australia but that ~~mining~~ no longer takes place and there was a disastrous experience there with regard to ~~accounts~~ the incidence of mesothelioma among the miners. Amosite is not ~~an acceptable~~ a recognized mineralogical term because it merely ~~stands~~ is an abbreviation for "Asbestos Mines of South Africa" ~~and that~~ It is unique in that it only comes from this one part of the world i.e. ~~and that's from~~ the Northeast Transvaal. The amosite and crocidolite from the Northeast Transvaal often ~~occurred~~ occurred in the same rock seam ~~in the rock~~ and therefore it is ~~not always~~ possible ~~to say~~ that amosite ~~is~~ may be ~~not~~ contaminated with ~~some~~ crocidolite and vice versa. ~~That is possible~~. There are deposits of amosite in India but I don't think they have been commercially exploited yet, ~~but there are some there of that type of fiber~~. ~~Its~~ Amosite ~~really is part of~~ belongs to the ~~cummintinate grunatic~~ cummingtonite-grunerite (?) series and just to digress for a moment the importance of the CG series (or the fact that amosite is part of that series) became apparent when the Reserve Mining Company found itself ~~enbattled~~ embattled with EPA, the State of

A009004

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ACL Doc 18809 · Page 2 of 21 asbestosclaims.law/library/18809/2

Minnesota and various others ~~people~~ regarding the dumping of mine tailings from its Taconite mines in Silver Bay into Lake Superior, ~~and/Dr. Selikoff early waltzed into Minnesota and waltzed out again and really upset the whole apricot there and that battle is still going on with Reserve Mining~~. I am sure you are familiar with that story. ~~That was CC~~ The fiber in the tailings and the lake which is apparently similar to commercially used amosite. ~~Apart from the fact that a lot of the fibers initially discovered were Diatimatic skeletons (?~~ Anthophyllite isn't very widely used in industry. It's one of the oldest known ~~used~~ asbestos fibers particularly in Finland where for thousands of years it's been incorporated in the building of Sauna baths. ~~If you like to go into that sort of occupation~~. ~~However~~, ~~it isn't terribly important~~. Biologically it is a very ~~very~~ interesting fiber because no cases of mesothelioma have as yet been described ~~with the~~ in association ~~of~~ with anthophyllite exposure, ~~and we can forget about the other two except the bottom one~~ SLIDE 2 Tremolite ~~which~~ is a fibre which is often found in commercial talc or industrial talc. ~~Just to give you some idea of the fact that chrysotile crocidolite/is blue amosite is sort of~~ really an ~~in between color~~. ~~Those are both iron containing fibers this~~ is ~~magnesium and various anthophyllite which is also an~~ _____.

SLIDE 3 MINE IN CANADA ~~This (a mine up in Canada) showing what has happened to the country side~~. This is a composite slide ~~and this is~~ which shows what we did with asbestos in Rochdale in England. ~~That is a~~ The rock, ~~it was opened~~ is crushed and graded at the mine and then ~~was opened~~ to some extent. It ~~was~~ is further opened at the factory in the process ~~of what we~~ called fiberizing, ~~and~~ After carding it is formed into ~~was used as~~ a sliver and then twisted spun into a yarn. ~~and that is the process and then~~ The yarn ~~would be~~ is woven or sold to customers. Cloth ~~would~~ can be used for various purposes such as wrapping around insulation sections, laminating with resin for friction materials, sound curtains etc. ~~Another think~~ I think you should appreciate ~~if you will read in the paper if you have it or wish to read it to~~ the fact that in the United Kingdom, Regulations were made in 1931 which took affect

A00905

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ACL Doc 18809 · Page 3 of 21 asbestosclaims.law/library/18809/3

in 1933, ~~when and~~ prior to the making of those regulations, which were called the Asbestos Industry Regulations, ~~and which therefore only apply to the asbestos industry and that also is important from the point of view of what happens subsequently however those regulations resulted after~~ a study ~~which~~ was conducted by ~~Marywhether~~ Meriwether and Price in 1929 and published in 1930 ~~which~~ and it became is ~~one of the most famous study in this field and is~~ a milestone in the history of the ~~xxxxxx~~ British asbestos industry. What they found was that in people who had been employed for 20 or more years, ~~xxx~~ - 81% had pulmonary fibrosis. We are talking about asbestosis, ~~and it's important to remember that asbestosis was it is~~ a 20th Century disease. The first case of asbestosis was not described until the beginning of the Century in London by Montague Murray. ~~and therefore this is a 20th Century occupational disease.~~ The first evidence that exposure to asbestos was going to cause a problem to the health of ~~x the~~ workers was the finding of asbestosis and the regulations that were made in 1931 and that took affect in 1933 were designed to reduce the incidence of pulmonary fibrosis. Lung cancer was not then associated with asbestos exposure apart from speculative case histories that first began appearing in 1935. No epidemiological study was done to confirm this suspected ~~xxxxx~~ association until the work of Richard Doll in 1955, although a same ~~Morrywhether~~ Meriwether in 1947 had shown that 13% of asbestosis cases diagnosed in the United Kingdom were dying of lung cancer or had died of lung cancer. That leads to another speculation. ~~again which I don't intend to dwell upon and that~~ Is the development of ~~where~~ asbestosis ~~is~~ a prerequisite for the development of lung cancer or ~~that~~ can lung cancer occur in an asbestos ~~workerx~~ without asbestosis, ~~is nevertheless an occupational disease and we would only enter in many arguments~~ into especially in view of the known multiplicative effect which cigarette ~~xx~~ smoking has on lung cancer in asbestos workers.

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ACL Doc 18809 · Page 4 of 21 asbestosclaims.law/library/18809/4

However, I show that simply to point out what the situation was in 1930 with regard to asbestosis. In 1929 Pulmonary fibrosis This was of crippling and killing people and worked. 81% of those with more than 20 years exposure, were suffering from this condition. By comparison in 1975 only 0.77 or 0.8% of the entire group were compared with 26.2% in 1929 were found to have asbestosis and the 20 year and over group the incidence were down to 5%. This which obviously is still xx unacceptable but what you have to remember is that some of the those cases in this population were in fact exposed before the 1931 regulations. They were still working employed and as this xxx x is a table of prevalence not incidence and consequently they were there and were included counted. It does indicate quite dramatically that those regulations in industry had reduced the incidence of asbestosis. If we go to the paper know we will see that This co-hort whose mortality experience that we are describing in the paper has been the subject of x 3 previous reports and the last of these reports was published in 1968. the one prior to this and They dealt particulary with mortality from lung cancer and respiratory disease in workers exposed to the high dust levels which preceded the 1931 asbestos industry regulations. They attempted to examine the dependence of lung cancer incidence on the age and duration of asbestos exposure. The last one In the 1968 paper the cohort was divided into 6 groups. with the Group 1 had more than 10 years of exposure before 1933 but xxxxx groups 1, 2, 3 and 4 had all had more than 20 years total exposure but group 1 had greater than 10 years exposure before 1933. Group 2 had between 5 and 10 years exposure before 1933 when the regulations took affect. Group 3 had less than 5 years exposure and Group 4 had had no exposure before 1933. Group 5 was all males and had had more than 10 years exposure but less than 20 with no exposure prior to 1933 and group 6 was all females and they xxx had all been exposed after 1933 for more than 10 years. When you look at For Cancer of the lung and pleura, you see that the observed was 15 and the expected 15 cases were observed where were expected was 1.6 so there is about an 11 times

A00967

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ACL Doc 18809 · Page 5 of 21 asbestosclaims.law/library/18809/5

excess incidence of lung cancer in ~~that~~ the group which ~~has~~ had the longest exposure prior to the improvements which came with regulations. ~~As you go down you see that that diminishes. When you get to this~~ In the group ~~here~~ with no exposure before 1933 but with more than 20 years service, the difference is not statistically significant. That was a very ~~interesting~~ satisfying observation but the authors were wise ~~and they~~ pointed out that no ~~further~~ firm conclusions could be drawn because little carcinogenic effect ~~xx~~ would be expected for 20 years after first exposure and some of the follow-up had not been for long enough. ~~If we just go through two more slides dealing with that cohort or with those figures here were~~ In have the men and women all exposed ~~xx~~ since 1933 ~~and you can see that~~ for cancer of the lung and pleura ~~xxx~~ there was no statistically significance difference between observed and expected and ~~in~~ the women there ~~was this difference and that was only~~ were 2 cases ~~and~~ but it was not possible to state what the meaning of that was because of small numbers. What we are dealing with here is men and women employed 10 years or longer since 1933. ~~This is the group with less than 20 years or 10 to 19 years and you see no difference in the observed to the expected rate of incidence of lung cancer.~~ In men employed 20 years or more those who worked before 1933 ~~as we have said before~~ there were lung cancers observed 11 to 0.8 expected (11 to 1) and for all neoplasms observed 15 to 3 expected, ~~and since~~ In men exposed only since 1933 there were observed 3 to 2.9 expected ~~and so~~ therefore, it appeard from this information, that people who had worked since 1933 were ~~now~~ no longer at risk and, if you accepted this, because that the dust levels ~~that~~ had been brought down had been achieved a disappearance of the lung cancer. Furthermore this was against a diminishing background of incidence of asbestosis ~~and~~ as ~~you saw~~ in 1975 the prevalence of asbestosis was only ~~a~~ 0.8% in the factory population studied compared with 26% in 1929. The report published in 1977 is concerned with the ~~post 1933 population~~ the post-1932 population mainly, which, ~~as I said~~ although exposed to dust levels ~~which~~

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ACL Doc 18809 · Page 6 of 21 asbestosclaims.law/library/18809/6

~~were~~ higher than the present ~~xxxxxx~~ permitted levels, ~~this population~~ was employed during the time of improving dust controls and plant modernization. The study is based on 1,106 men and women ~~only~~ (284 women) and the cohorts ~~has~~ have been roughly sub-divided in the same way except that you will see there are only 5 groups instead of 6. ~~and group the previous group 3 and 4 have been combined. It I think that's what happened. I don't want to go into it too carefully.~~ Again we got years in asbestos areas 20 or more, 10 or more before 1933 and than 20 or more less than 10 we have taken out the less than 5 group from that and then we have ~~xxxx~~ gone on so that will be from _____ to 10 instead of just 5 to 10 and then we go on to 20 or more with no exposure after 1933 and that's the group we are particularly ~~xxxx~~ interested in 10 to 19 and then females with 10 or more. Well there may be some ~~xxxx~~ females who have done 20 years. We get ~~1~~,106 with a total of 16,000 person years of observations.

Table 1

Re-examination of our personnel records since the ~~xxx~~ last report in 1968 showed that a further 23 workers were eligible for inclusion in cohorts 1 and 2 and in addition 205 workers who ~~have~~ had completed 10 years employment since June ~~16~~ 1966 were added to cohorts 3, 4 and 5. So the study comprised 822 men and 284 women and the followup was until the 31st of December 1974 using the factory ~~xxxx~~ personnel records and the National Health Service Central register. Only 2% of workers could not be traced and 13 ~~and that's~~ (1.2%) ~~were~~ recorded in the National Health Service Central registery as having imigrated or were not currently registered with ~~the~~ a GP. As you know everyone in the UK is registered with a GP, ~~you don't have to be, but most people are~~. ~~From this you can see that a very small percentage are not. Especially among the working population who are not able to afford private treatment~~. The remaining 1,071 (96.8%) have been

A00903

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ACL Doc 18809 · Page 7 of 21 asbestosclaims.law/library/18809/7

followed-up to the end of 1974. The number of deaths in each group which have been attributed to lung cancer (and lung cancer includes deaths due to mesothelioma), ~~and the number of deaths in each group attributed to lung cancer~~ other cancers, respiratory disease and other causes are shown in the next slide and although it looks complicated it isn't really. If you simply look at ~~that~~ the column ~~which is~~ for the ~~xxx~~ cause of death, ~~which is~~ headed lung cancer and mesothelioma, other cancers, respiratory diseases and other causes, and if you will just look at the ones ~~which~~ show ~~is~~ statistically ~~xignifixantixx~~ significant ~~there~~ you will see that ~~again~~ in Group 1 (which ~~we knew before~~ previously ~~we~~ had the ~~10 or 11~~ 15:0.8 observed to expected ratio) ~~xxx~~ in ~~xxxxp~~ the respiratory diseases again there is a 3.6 observed to expected ratio and all causes the ratio is about 2 to 1 so there is an excess mortality in this population which is largely attributable to lung cancer but some of which is attributable to other respiratory diseases which might reflect a ~~xadi~~ residue of asbestosis in ~~xhx~~ this population. The expected numbers ~~for those of you who are interested~~ were calculated from National death rates by 5 year periods and 5 year age groups. To insure that the expected ~~members~~ number are not underestimated, imigrants and those lost to follow up were assumed to be alive on December 1, 1974. Deaths before the 1st of January 1931 or after the ~~xxxx~~ age of 85 are ignored and expected members are calculated accordingly. In Rochdale itself lung cancer mortality was lower than the national average ~~among the men~~ for males, which is interesting, ~~in that~~ This is the ~~xxxx~~ largest asbestos textile factory in the world. Rochdale ~~has~~ with a population of about 80,000 people ~~and it~~ had a lower than average lung cancer mortality. It doesn't prove anything but ~~you xx know for those who say that~~ if asbestos is an environmental pollutant which is going to cause an excess incidence of lung cancer in the general population ~~x~~, this doesn't seem to make sense. The

Table II

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ACL Doc 18809 · Page 8 of 21 asbestosclaims.law/library/18809/8

standardized mortality ratio ~~is~~ in Rochdale is 87 and ~~similar~~ for women ~~104 that's~~ (1959 to 1963 Registrar General 1971.). Workers first exposed before 1933 ~~that's the~~ cohorts 1 and 2, suffered from excess of lung cancer and respiratory disease, particularly those with 10 or more years exposure prior to 33. ~~and~~ There is also some excess mortality from lung cancer and mesothelioma (36 observed and 19.3 expected; ~~the~~ P ~~is less than~~ < 0.01) and respiratory disease (35 observed 25 expected; P ~~equals~~ 0.03) in those who entered after the 1st of January 1933 ~~that's~~ (cohorts 3, 4 and 5 combined). ~~You combine these 3 cohorts~~. This excess is very much less than in the first two cohorts. ~~What it indicates is that in even~~ In those people ~~with longer follow up now these people~~ who were first exposed after 1933, the longer follow up indicates that there is still an excess mortality from lung cancer, mesothelioma and respiratory diseases. In the 1968 study there was a slight excess of circulatory disease in cohorts 3 and that hasn't increased (27 observed 20.6 were expected). In cohorts 4 and 5 there was a matching deficit (50 observed 60.10 expected). The ~~incidence~~ inference that this was probably a chance observation seemed confirmed. There were 16 deaths attributable to gastro-intestinal cancer comapred with 15.7 expected. This cohort, ever since it has been formed and ~~it has been~~ followed, has not yielded an excess incidence of ~~g~~ deaths from gastro-intestinal carcinoma. It is also interesting that in a paper published in the same issue of the British Journal of Industrial Medicine, Elmes in Belfast, following up his insulation workers finds the incidence of gastro-intestinal carcinoma is declining as the ~~xxxxx~~ time goes by and ~~that he~~ thinks that this might be due to improvements in earlier years. ~~now that he is following the population further ahead in time~~. However this excess incidence of gastro-intestinal carcinoma in asbestos workers appears to be something that is related to the most heavily

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ACL Doc 18809 · Page 9 of 21 asbestosclaims.law/library/18809/9

exposed ~~gx~~ worked groups. ~~and~~ Although this group of textile workers in the earlier years was probably as heavily exposed as any, it has progressively been getting less and less exposure and ~~this~~ an excess of gastro-intestinal carcinoma has ~~b~~ never been found ~~in Rochdale~~ ~~so~~ I think ~~itx~~ ~~you~~ we will ~~only~~ find that gastro-intestinal carcinoma is associated only with ~~it in some way with~~ very severe exposures. That is just my personal opinion. No excess, indeed, for ~~any of those that is~~ statistical gastro-intestinal carcinoma approached/significance in any cohorts and no peritone~~um~~al mesothelioma was reported. To distinguish exposure immediately after 1933 from that under present conditions cohorts 3, 4 and 5 were divided into those first entering or first ~~x~~ being exposed from 1933 to 1950 and those starting later. The reason we took 1950 was because ~~in 1951~~ we regard~~ed~~ 1951 ~~it~~ as the start of the modern period in that factory. ~~because~~ It was the year in which ~~the~~ routine dust sampling was initiated. Although ~~Merrywhether~~ Merivale had, way back in the 1930's, ~~had~~ tried to give some indication as to what he considered to be an unacceptable ~~dusty~~ dust level, the instrumentation and the techniques were not available to assess dustiness ~~numerically~~ and ~~to asses~~s accurately. It was only in 1951 when the thermal ~~percipitator~~ precipitator came into use in that factory, ~~and then subsequently~~ was followed by the long-running thermal pe~~r~~recipitator and then, in 1961, by the membrane filter method, that it was possible to attempt to measure ~~what~~ the exposure ~~of~~ of these people and to control the environment ~~according to~~ using measurable/dust levels rather than ~~according to~~ best achievable visible results, ~~visibly~~. Observed and expe~~x~~cted deaths for those first exposed between 1933 and 1950 are shown in Table IB ~~but~~ ~~I think before we get there, no we got there,~~ men ~~Men and women first exposed 1933 to 1950 there were 616 Men and women first exposed 1951 or later lung cancer 33 to 50 of observed 30 expected 16 with a 2 to 1 ratio~~. Here we find that the 1968 authors were

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ACL Doc 18809 · Page 10 of 21 asbestosclaims.law/library/18809/10

wise to add a word of caution about the length of follow up. It had only been 20 years and 20 years may not be long enough because here we ~~had~~ have emerging ~~now~~ something they didn't find, and that is a slight excess ~~& its by no means the six significant excess of 11 to 1 that we have had previously & but there is still a slight excess~~ of lung cancer in those persons exposed between 1933 and 1950. What about 1951? ~~Well we have it again~~. We ~~x~~ have a ratio of 1.9, observed to ~~That is only~~ 6 cases ~~to~~ observed to 3.2 ~~x~~ expected. The numbers ~~might~~ are at this stage ~~be~~ small and therefore this has to be followed up ~~and~~ We have to increase the numbers and ~~the length of we have to~~ lengthen the follow-up, ~~But even~~ but in those first exposed people who first entered since 1951 ~~up to 1974 which gives you~~ (24 years following) still show this slight excess. Again the statistical significance is not as great as for the ~~other half~~ remainder of the cohorts ~~not exactly the half other 2/3 approximately of the six cohorts~~, but here we have evidence that the lung cancer has not been totally eliminated in this population. There have been very few deaths among those first exposed in 1951 ~~x~~ or subsequently and if we look at table 4, one of the things that is going to crop ~~x~~ up about those 6 cases after 1951 is whether they smoked or not. ~~It is as important for the others but~~ We don't have the information available in all the medical records but we do ~~x~~ for ~~cases who died after~~ a certain period of time since ~~when~~ smoking histories were added. In fact, the lack of information on cigarette smoking in the earlier studies was a serious omission, but there were no smoking data is recorded ~~records kept~~ in the medical records ~~of x cigarette smoking~~ until ~~I went there in~~ 1966. ~~I then started meticulous smoking recording smoking habits~~. ~~From that one could see that~~ In 1976 if you divided ~~broke~~ the population into age groups smokers, ex-smokers and non-smokers ~~I wont go into how those are defined just suffice to say that that's the way they were at the time~~. There were 22% who were ~~xxx~~ non-smokers, 13% who had given up smoking and ~~xxxx~~ x there were

0913

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ACL Doc 18809 · Page 11 of 21 asbestosclaims.law/library/18809/11

65% who still smoked. ~~and~~ These were comparable to the national figures, ~~in a way~~. This population was no different ~~xxx it~~ in its smoking habits from the general population. ~~What do you do about smoking? I don't know~~. Table ~~I~~ IV shows deaths ~~of~~ from lung cancer (including ~~peritineal~~ mesothelioma) in the men and women first exposed 1933 to 1950 and men and women first exposed 1951 or later. They are distributed according to ~~the day by day~~ date of first exposure and time since first exposure. ~~If you look at that 10 to 14 years since first exposure 15 to 19, 20 years or more~~ In the the 20 years or more ~~xx~~ group the ~~o~~ ratio~~n~~ is 2 to 1. ~~In those two groups it probably is not significant.~~ In Men and women first exposed 1951 ~~or later 20 years or more if you take xxxifxxxxxxxxx~~ that group 15 to 19 ~~because one of them was just about 19 years which is close enough to 20 makes it 5 instead of 3 and 2 you got~~ there are 5 observed, 1.8 expected (2.7 ~~as your~~ the ratio of observed to expected.) The 6 employees who were first exposed after 1950 who died of lung cancer were all men and they were all smokers. 5 worked in areas where dust levels were high in 1951 and one of them may have been exposed to asbestos dust from 1925 to 1930 in a previous occupation. He was a welder in a shipyard. No case of mesothelioma has occurred in the population first exposed after 1950 but that may not be long enough for follow up, ~~x~~ although in view of the long latent period, ~~not~~ none would yet be expected. ~~An approximately~~ A multiplicative effect of asbestos exposure and cigarette smoking ~~x~~ on lung cancer/incidence has been suggested. As you know, Selikoff has suggested that an asbestos worker who smokes has a 92 times greater chance of dying from lung cancer than a non-smoking non-asbestos worker. ~~or to put it another way, that~~ an asbestos worker ~~who smokes~~ has ~~x~~ an 8 times greater chance of dying from lung cancer than a nonexposed person. ~~an asbestos worker, who does not smoke~~. But without detailed smoking histories which have been collected for the future, we can't quantify what the effect of smoking were in this particular study. Asbestosis was

A00914

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ACL Doc 18809 · Page 12 of 21 asbestosclaims.law/library/18809/12

found by the Pneumoconiosis Medical Board ~~at examinations of~~ in three of the six cases. They all came to post-mortem. All asbestos workers in Rochdale ~~x~~ who die~~s~~ have their ~~x~~ deaths reported to the coroner either by their doctors, ~~to the coroner or~~ the hospital, ~~report to the~~ coroner or by the ~~xixxxx register~~ Registrar of Births, marriges and deaths. This has been done since 1930. The post mortem rate when I once looked into it was ~~merely~~ nearly 70%, ~~of our ex employees~~ which is pretty high. ~~and~~ I used to go nearly to every post mortem that took place. ~~xxxxxxxx~~ There is a lot of interesting work which will come out of the post mortem work which was done in Rochdale. The numbers ~~xf~~ are too small for the magnitude of excess of lung cancer in those first employed after 1950 to be estimated with any precision. The implementation of the asbestos industry regulations started a drive to improve dust levels and as I explained to you the ~~xxxxxxxx~~ process ~~were~~ of fiberizing ~~xxxxxxx~~ where the fiber came from the mines, ~~xxx~~ was opened, mixed and ~~there were~~ involved certain operations such as mixing, opening, bag~~-~~slitting, mechanical bagging. ~~Then they went on the to~~ The carding ~~xx~~ process followed. ~~and~~ If you are familiar with the textile industry the carding is simply a matter of teasing out the fibers, layering them all in one direction ~~and you do this~~ by passing them through two rollers moving in opposite directions with ~~chopped~~ sharp needles projecting from ~~them so you~~ to tease them out. ~~and you got~~ A fine web is formed which subdivides and spun (or twisted) and ~~then you take that web and you spin it and~~ There are different grades of yarn, ~~fine or whatever and then you beaning~~ (?) ~~x is a winding is the~~ _____ ~~and if you ever get confused with the weaving loom as to what the wheft and the wharp are the wheft goes from wheft to white and the wharp goes whap and down and you x can't forgot it that way and that's how you weave.~~ Yarn is woven into cloth. ~~Platting~~ Plaiting is obviously used for packings. ~~You do things with platting~~ Plaiting can be impregnated ~~like impregnating with~~ xxxxx grease or graphite and this ~~got~~ is used in valves for packing. ~~stuck into valves.~~ xx ~~You can see here years 52, xxxx 60, 61 66,~~ 20315

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ACL Doc 18809 · Page 13 of 21 asbestosclaims.law/library/18809/13

I ~~think these are average levels and~~ in those are particles per cc and ~~after 61 you got the membrane filter technique and you are getting~~ down to ~~fiber per cc~~. ~~That~~ The operation, I'll show you in a moment, is totally closed. Of course that is the way to deal with ~~it anything~~ anything dusty. If you close it you ever got no dust. ~~But those gradually went down 6 fiber in 1961 to 3 in 74.~~ This factory population was used and studied by the British Occupational Hygiene ~~k~~ Society in 1966 and on the morbidity study which was done at that time ~~not a mortality but a morbidity study~~ the present hygiene standard for asbestos fiber was developed. ~~and To horror~~ the dismay of the people who developed it it became widely accepted throughout the world and is now the current US standard (or threshold limit value) for asbestos of ~~fi~~ 2 fiber/cc. Originally it was a cumulative standard of 100 fiber/ years/cc. ~~so~~ If a man worked for 50 year in 2 fiber/cc he stood a 1% risk of ~~k~~ getting asbestosis. The standard was not designed for lung cancer. Although there ~~is was~~ is some indication as that I have shown you, if that the incidence of ~~you reduce~~ asbestosis is reduced ~~you also reduce~~ the incidence of lung cancer is also reduced ~~but you~~ we may have to reduce the exposure levels further still below 2 fiber/cc if we are going to eliminate the lung cancer. However no population in the world has been followed for long enough which has been purely ~~exposed~~ exposed to 2 fiber/cc or less. No population has been followed for long enough to say that 2 fiber/cc is or is not a no effect level for lung cancer. ~~and as you know~~ There is a lot of controversy about whether there is or isn't either a safe or no effect level for any carcinogen. As you can see, in certain operations dust levels came down dramatically ~~by~~ quite by 1974 in the whole weaving operation there were less than 1. ~~There have been less than 1 for a long time.~~ In that weaving shed there has never been a case of lung cancer associated with asbestos exposure that I know of and asbestosis doesn't occur in that weaving shed. ~~and that's why~~ The old timers, people who were involved in reporting the data to the British Occupational Hygiene Society in 1966 (and some of them had been at the factory for a long time) using ~~Using~~ their "gut feeling" felt that 2 fibers/cc was a reasonably level because of the health experience

A90916

Union Carbide trial exhibit UC-4216: Draft Talk to Medical Directors, United Technologies, Hartford, on Asbestos a... Published by AsbestosClaims.Law
ACL Doc 18809 · Page 14 of 21 asbestosclaims.law/library/18809/14

of that weaving shed. No single population in the world has been followed-up for long enough at a 2 fiber/cc or ~~xxx~~ less level to enable us to say, based upon human experience, ~~whether~~ this is an adequate level or not. ~~Let's look at~~ Table ~~6~~ III shows ~~which is~~ the mean dust levels ~~table~~ and the number of men exposed to them over the period of observation. From 1936 to ~~1951~~ 1951 ~~obviously I told you~~ we did not ~~didn't~~ have dust counts. ~~In 1936 they didn't xxxx xxx start having~~ dust counts were not routinely done until 51. ~~that is xxdx but it is~~ Based on calculations made by the committee of the British Occupational Hygiene Society (~~and~~ the ~~status~~ ~~station~~ statistician involved was Geoffrey Berry of the Medical Research Council's Pneumonociosis Unit in Penarth) ~~and~~ they arrived at a ~~mean~~ means of ~~calculating~~ calculating ~~based upon present~~ levels ~~what~~ that would be a reasonable estimate of exposure in those years when dust counts were not available. ~~So you can see as the years go by the dust counts come down not much until 1952~~. ~~Again,~~ 1952 was also ~~is~~ the beginning of a period of modernization of the factory ~~which was~~ and was completed in about 1954, ~~and~~ A lot of engineering work was done, ~~a lot of~~ many jobs were changed, ~~a lot of~~ many processes were ~~laterned~~ altered and ~~that~~ it all resulted in a better working environment. In 1969 new Regulations were made. Those ~~x~~ new regulations were ~~called~~ ~~xxx~~ no longer ~~x~~ called the "Asbestos Industry Regulations" but the "Asbestos Regulations" and they applied not only to the asbestos industry, but to anybody using asbestos where ~~xxxx~~ asbestos dust was ~~giving~~ given off in ~~excess~~ such concentrations as ~~is~~ was liable to be harmful to the health of the exposed person. As opposed to the American method of doing it, the British ~~xxx~~ have not put a figure in the asbestos ~~standard in the~~ regulations, there is no legally enforceable figure. The way it has been done is ~~by~~ to publishing, as an addendum to the standard, ~~if you like~~ guidelines for the benefit of those people ~~xxx~~ who ~~to whom the standard applies~~ have to apply the standard. ~~which~~ The guidelines indicate what the current thinking of the factory inspectorate is ~~at the present time~~ with regard to the dust levels ~~they are going to enforce~~ to be achieved. ~~That means that~~ If they want to ~~change~~ vary ~~those~~ this levels ~~to xxxxfy tomorrow~~ (and they have already changed them once since 1969), all they have to do is ~~pull that piece of paper out of circulation and publish another~~ amend the published guidelines. It ~~xxxx~~ doesn't require an act of Parliament or any

A00917

Union Carbide trial exhibit UC-4216: Draft Talk to Medical Directors, United Technologies, Hartford, on Asbestos a... Published by AsbestosClaims.Law
ACL Doc 18809 · Page 15 of 21 asbestosclaims.law/library/18809/15

forms' consultative
~~sort of consultated~~ mechanisms to do this, although ~~xx~~ obviously ~~they~~ would
with all exposed
consult before it. It realy makes it very much simplier to operate the
don't have to play the "numbers game" and
regulations when you ~~haven't got a number which you could be punished for~~
~~if you go .1 below or .1 above which~~ is the difference ~~xhx~~ between the
OSHA standard ~~xhx~~ and the British standard. ~~However, that xh just shows~~
In Table VI
~~you the changes that took place~~. You will see that ~~the number of men~~
~~goes on increasing and then it starts declining and so this is obviously~~
losing
~~because the cohort we are going to begin to lose people out of the cohort~~
people a
now and there are obviously fewer in 1972 who have been exposed for long
period of time than there were in 1960 because we are losing them. ~~As you~~
were
~~can see that~~ In 1972 , 32% ~~are~~ exposed at less than 2 fiber/cc. In ~~1976~~ 1936
100% were exposed to ~~xxxxxxx~~ greater than 5 fiber/cc and only 3% now remain
~~in it 1972~~ in 1972 ~~who are~~ exposed ~~xhx xxx xxpxxxd~~ to greater than 5
demonstrates
fiber/cc. What this is ~~really showing you~~ is that with time the number
of people ~~xxxing~~ exposed to high concentrations is declining. It is ~~just~~
interesting to present it that way. ~~There are a number of~~ _____
Same thing Way
~~always in this type of thing~~. ~~World War took place and~~ During the ~~war~~
the regulations were relaxed. Factory inspector's didn't care too much
about what the levels were. The government wanted production, asbestos
and was
was essential it had to be ~~made~~ produced. Overtime worked, ~~xhx~~ women were brought
of
in to work instead of men and long hours blackout restrictions made
supplies adequately
it impossible to operate ventilations ~~and all sorts of things~~. ~~You have~~
~~this period in World War which~~ I don't know what effect that is going
this
have in years to come.
to ~~be~~ on the follow up. // It is difficult to interpret the relevance of
present day
the results which I have reported to you to ~~modern~~ conditions. What
the result
we are looking at is a ~~hotchpoth~~ of bad conditions in the past and
a continued exposure of the same population to changing conditions. What
we need is a long term follow up of people exposed ~~eventually at this~~
to
~~level here~~ less than 2 fiber/cc for 20 or 30 years. // Dust levels don't come
down in a day. It takes a long time to get down to less than 2 fibers/cc
The next slide Graph shows
~~and that~~ is ~~just~~ a ~~plot of in~~ the way in which the levels in the factory

AU0518

Union Carbide trial exhibit UC-4216: Draft Talk to Medical Directors, United Technologies, Hartford, on Asbestos a... Published by AsbestosClaims.Law
ACL Doc 18809 · Page 16 of 21 asbestosclaims.law/library/18809/16

have been coming down. Even people exposed after 1950 ~~are~~ were having substantially higher levels of exposure than are at the present time permitted by law. The thing to remember is that what we are interested in is diseases with an excess incidence of mortality. ~~That your factory may be build here and start producing here and that is when you start fire the shot~~. You ~~didn't~~ don't usually begin to see any difference in mortality experience, ~~you may see a slight difference~~ with a latent period of after 20 years but you may have to ~~go~~ follow up people for 30, 40 or 50 years ~~with occupational cancers~~ from occupational cancer before ~~that~~ an excess mortality becomes apparent. This is why it is important ~~that you~~ to keep records of medical findings, ~~you~~ to keep personnel records which are accurate with regard to ~~date~~ date of employment and types of employment and if possible the type of materials ~~we~~ to which people ~~are~~ were exposed, ~~which are hazardous or which may be considered hazardous in the future and that you~~ Maintain a strict control of your environmental monitoring and dust sampling and ~~that you~~ record these meticulously ~~varying~~ bearing in mind that some time they will have to be related to the health experience of a group of people. It is only if you are meticulous about all that, that in the future we will clear up a lot of the arguments and lot of the mess which we are in at the present time, simply because our ~~predecesors~~ predecesors had no concept of this type of approach ~~to~~ to occupational medicine. Occupational medicine ~~in the past~~ for many years was the transfer of general practice into the factory ~~at~~ with a captive population ~~and~~ you could treat ~~them~~. ~~What it is~~ In my opinion ~~is~~ that ~~part~~ part of it ~~that's~~ is a fringe benefit. ~~What is~~ More important to me is to establish a system of keeping records to enable me to abstract from these records ~~contain~~ information and analyze it statistically ~~and~~ to obtain an idea as to how ~~this~~ this population compares with another population or with the general population. If you can do all this ~~so that~~ you will find out ~~have an idea~~ whether your industry ~~you are~~ is ~~in~~ in any way ~~impeding~~ impeding or ~~impairing~~ impairing the health of ~~the~~ persons employed ~~person~~ by it. ~~and~~ I promised that I would show you that improvement had taken place at Rockdale. ~~and~~ That doesn't show up very well, but that's a man and those are his legs and what he ~~has~~ is holding is a pitchfork.

A00919

Union Carbide trial exhibit UC-4216: Draft Talk to Medical Directors, United Technologies, Hartford, on Asbestos a... Published by AsbestosClaims.Law
ACL Doc 18809 · Page 17 of 21 asbestosclaims.law/library/18809/17

There is a hole in the floor and he is standing on a big wooden drum. This is asbestos and he is using his pitchfork to blend it on a open floor throwing it up in the air and letting it settle. It's blowing all over the place. That was taking place in the factory that I have just talked about until 1954 and in some American factories that I visited in 1970 I saw that taking place then and in some American factories that I visited in 1976 something very similar was still taking place. And therefore that is another caveat. You have got to be very careful when you read the world literature because working conditions in different countries vary and when some people describing describe the horror and the disease associated with asbestos, they conditions under which those people worked have to be taken into account. I could show you lots of horror slides. I have been around the world and seen conditions and I have got slides to demonstrate the differences between the U.S., somewhere like South Africa, Ham, Mombasa, India, + Britain. It depends upon the degree of sophistication of Government Regulation and of dust control as to what is going to happen to those people but authors of papers describing the effects seldom pay attention to that, and they will talk about asbestos or asbestos textiles or asbestos cement and never show the pictures of the factory or tell you what the conditions were like. So, for OSHA or NIOSH to say that the Rochdale population was always exposed to 2 fiber/cc and hence the 2 fiber/cc standard is no good because they are still getting lung cancer is a lot of men well there are ladies present!// That's what happened to this job-it was totally enclosed. The drum is now enclosed. and It revolves and mixes the fibre. and There is a bag opening procedure whereby the bags are fed on to a conveyor belt and fiber go into the drum after mixing it and tips it into another bin down on the floor which is also all enclosed and there should be no dust. That's the way it was in 1954. When I walked into that factory in 1966 I was taken on a tour and they

A00920

Union Carbide trial exhibit UC-4216: Draft Talk to Medical Directors, United Technologies, Hartford, on Asbestos a... Published by AsbestosClaims.Law
ACL Doc 18809 · Page 18 of 21 asbestosclaims.law/library/18809/18

looked at me and asked I where ~~the and I said~~ where ~~do you want~~ to start. ~~and~~ I said ~~I'll~~ start at the beginning where the fiber comes in. ~~and [redacted] I found soon I take my camera and~~ I took my camera and that's what I found. This of course is very good fiber. ~~that~~ It is the best fiber in the world it comes from Rhodesia. Turner & Newall owned the mines in ~~k~~Rhodesia and since UDI they have not had any of that fiber. They have not had any of the profits and they have been cut off from their mines because of ~~the British~~ sanctions. ~~[redacted]~~t I ~~xxx~~ wasn't allowed to visit Rhodesia while I worked for Turner & Newall. However in ~~xx Raybestos~~ American's factories there is plenty of this stuff. The United States hasn't bothered about sanctions. Anyway this was 1966 these were ~~rolled up~~ burlap bags. Every now and then you could see holes in them. Shippers used to love this stuff because it was made ~~xxxx~~ beautiful ~~balaced~~ ballast. They could put a few bags in a corner here and a few bags ~~and a corner~~ in a hole there and they could trim their ships with it ~~and~~ That's the way it ~~just~~ used to arrive in loose bags. The dockers had no respect for these bags. They had big hooks and the way they lifted ~~that it is~~ them with to plunge a hook into the bags swinging them over their sholders ~~xxx~~ + ~~chuck~~ it over the side to someone else. ~~and have~~ A horrible mess used to result and these ~~things~~ bags used to arrive at the factory where ~~and~~ the chaps in the warehouse ~~they~~ did not have quite as big hooks so the little holes are there ~~and they used to pull these things off and what you found was a stack like that and that represented about~~ You can't imagine the size of this warehouse. It was a huge warehouse full ~~f~~ of ~~h~~ fiber stacked to the ceiling. It ~~was~~ held 18 months supply because they knew UDI was coming and so they brought ~~xx~~ as much as they could and as much as they could stuff into the warehouse. There were bags bursting, there was fiber all over the place, ~~xxxx~~ that's what you found It was an impossible situation and it was very very bad. That's ~~the way it is what you find~~ today. The bags are now made of polypropylene or polyethylene ~~polypropylene or polythyne~~ and they are pressure-packed at the mines. They ~~Those~~ are all solid, hard ~~they are~~ like bricks, they are palletized and very often they are covered with an additional plastic cover. ~~And~~ That is an example of fiber ~~comes~~ from Cassiar up in Canada.

A00921

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There are 2 mines; there is one in North British Columbia and one in the Yukon Territory at Clinton Creek. It's a nice part of the world to go to in January! // What we have therefore is a story that is unfolding. This is a rather old slide and it tells you about asbestosis beginning at the beginning of the century. The incidence declines in textile workers from 1930 onwards. I haven't mentioned insulation workers at all but the lung cancer incidence noted to be increasing in the late 50's early 60's often in insulation workers to a large extent Asbestosis and lung cancer increasing as in occupation this is in the U.K. while it was declining among textile workers. Mesothelial tumors were recognized in association with asbestos in the late 1950's-early 1960's. Asbestos use increased markedly during the War and accelerated afterwards so that asbestos became a universally utilized material. It was cheap, easy to find and not expensive to mine and it was used in just about everything you could think of. With regard to mesothelioma in case you think we haven't had any in that factory, we have. I don't want to get into a long argument about it but that factory did also process crocidolite fiber and in my opinion crocidolite fiber is the most hazardous type of fiber and the one mostly associated with mesothelioma. While I was there I collected 27 cases of mesothelioma, and I hadn't seen any in people exposed after 1950. The average lapsed interval was long. At the present time Prof. Doll is initiating a study of mesothelioma incidence at IBM. Just before I left we completed going through our personnel record cards back to 1918 and collected something like 30,000 records of people who had ever been employed. The group in Oxford are now going to check through those. They will probably take a random sample to start with and trace them to see what they can find with regard to mesothelioma. Have we underestimated our experience? That is the next study which is going to emerge from this particular factory. I have taken up a lot of your time. I think it's over the hour and I must apologize. That is all I have to say.

A00922

Union Carbide trial exhibit UC-4216: Draft Talk to Medical Directors, United Technologies, Hartford, on Asbestos a... Published by AsbestosClaims.Law
ACL Doc 18809 · Page 20 of 21 asbestosclaims.law/library/18809/20

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