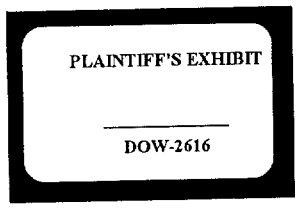

"INDUSTRIAL TOXIC CLAIMS"

MEDICAL ASPECTS

Address by William J. Nicholson, M.D.
Associate Professor
The Mount Sinai Medical Center
New York, New York
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Thank you very much!

What I would like to discuss this morning are some features of the problem of asbestos as it emerged and reached the proportions that we now see it, firstly, because it's of prime importance, certainly, from your current point of view, but also because it is one of the best examples of the problems of occupational carcinogens, and how the history has been one largely of missed signals, where medical researchers, where governmental regulators, took little cognizance of the effects as they were seen. The use of the material expanded considerably with the exposures increasing, further disease developing, until at the point that we now find ourselves, we have a vast backlog of individuals exposed who will develop disease even though we might prevent exposures in the future, but in fact because of the material that is in place and products in buildings, in ships, in vast other areas. The control of that exposure in the future also will be a difficult task.

This (slide being shown) is a photograph of a historic tissue specimen. It is actually the slide of a piece of lung that was taken from an individual who died in 1900. He had been examined by a physician in London, Dr. Montague Murray.

Prior to his death -- and he was the last survivor of a group of 13 individuals -- he had been employed for a period of about 10 years in the carding room of a textile mill in England. The group had died of what we now call asbestosis, but at the time it was unrecognized. Perhaps in some cases the deaths were thought to be of tuberculosis, but in this particular case it was unequivocal that the death occurred from the fibrosis that was in the lung of the individual.

An autopsy was performed and a report provided to a compensation hearing in 1907. This is one of the first documented cases of asbestos disease.

The British Compensation Board was reviewing the question as to whether workers exposed to asbestos should be eligible for compensation. At the time of the hearing, Dr. Murray stated that much had been done to eliminate the dust in the environment of these workers, and so the disease, as we have seen it here, was unlikely to occur in the future.

With that optimistic projection, the Compensation Board ruled that asbestos need not be included among compensable diseases in Great Britain.

In the slide one can see, in addition to the fibrotic tissue, rather than a thin membrane between the alveoli, there is scar tissue. That will prevent passage of oxygen from the alveoli into the bloodstream.

Additionally, one can see in the picture numerous golden bodies. These are protein coated asbestos fibers and were given the term asbestosis bodies sometime in 1920 when additional cases were seen.

If one had available at the time an x-ray of an individual with such disease, one would see diffuse interstitial fibrosis evident. The white filamentous lines are from scarring in the lung that, as I said, prevents the individual from actually taking advantage of the oxygen inhaled.

Along with the statement of Dr. Murray that I mentioned, in future years similar optimistic statements were provided at the time that controls were implemented, with the thought that they would be adequate. Unfortunately, while we were wishing away the disease, it continued.

In addition to scarring of the interior of the lung, another diagnostic feature of asbestos disease is scarring of the pleura, the lining of the lung or the lining of the chest.

This (slide being shown) is an autopsy in which, on the chest wall, one sees placques of thick -- in this case, calcified material, that here do not give rise to any clinical problems, but they can, evident in x-rays, and are usually associated with asbestos exposure.

In addition to such pleural thickening or pleural placques on the wall of the chest, one can have thickening of the lining of the lung itself, the visceral pleura, and one can see obscuring of the outline of the lung in this individual.

At death, his autopsy showed his lung to be encased in a one-inch-thick membrane, a one-inch-thick layer of scar tissue, instead of a very thin membrane.

In addition, the lung itself was scarred, but individuals in such circumstances not only have difficulty in passing oxygen from the air sacs into the bloodstream, but they have difficulty simply expanding and contracting their lungs, and their death is one literally of suffocation.

This disease, asbestosis, was, as I have said, first identified before the turn of the century. In the period from 1910 to 1920, other cases were seen and it is known, of course, that insurance companies in the 1918 period, at the time in the United States, were reluctant to insure asbestos workers because of the evidence of disease that was being seen.

In 1928 and 1929, a study was undertaken in the textile mills of Great Britain that revealed that approximately 80 percent of individuals who had been employed in such factories for 20 or more years had actually evidence of asbestosis. This led to the Factory Inspectorate of Great Britain promulgating regulations that, in essence, mandated that no dust be released into the work environment, with the proviso on that that unless conditions were such as it could not be prevented.

Unfortunately, as hindsight has recorded, in recent years these regulations were little more than pious aspirations.

In the United States, a study was undertaken by an insurance Company, Metropolitan, of the asbestos industry, and showed there too to be considerable disease and high dust concentrations present, and the study was then undertaken by the United States Public Health Service in 1938 of four asbestos textile mills, which showed high concentrations and asbestos disease present in individuals who were employed over a long period of time.

In that 1938 study of Gleason of the Public Health Service, there were approximately 160 individuals who had been fired by the four companies prior to the Public Health Service going in, because of feared asbestos disease present in them, and the Public Health Service was unable to examine all of these individuals, and so they recognized that, with the ones they did see, the short time of exposure or time from onset of exposure would limit the validity of their findings, and so they were proposed as tentative. They did state, however, that if the dust concentrations would remain below a value of 5,000,000 particles per cubic foot, it would be unlikely that asbestos disease would be seen.

This so-called level, it was first stated as tentative and then it was provided as guidance only because, in the United States, there were no mandated regulations requiring compliance with such levels. In fact, that level, the 5,000,000 particles per cubic foot, was the TLV for the ACGIH, and remained there until 1968, and it was a chief force of law, at least by 1960, for the industries that fell within the bounds indicated by the study.

It was not replaced until May of 1969, when a value of 2,000,000 particles per cubic foot was established, and later, in 1971, by a fiber standard of five fibers per millimeter.

As time progressed, so too did the awareness -- so too did the spectrum of asbestos disease. In 1935, even prior to the study looking toward asbestosis in asbestos employment -- there were two papers published describing lung cancer in asbestos workers, one in the United States and one in England, in which three individual cases were reviewed.

Today, we would not think much of a case of lung cancer. It's that common. In 1935, it was a very rare disease and the finding of one rare disease, cancer, with another of asbestosis was thought worthy of comment in the medical literature and, indeed, the authors of the paper suggested there might be a casual relationship.

Cancer was rare in 1935 because our smoking habits in the United States were minimal until World War I. Thereafter, an increasing number of men began smoking, but the effects of that habit were yet to take their toll.

There is a long time between the beginning of exposure to cigarette smoke and the onset of cancer. Most people who begin at age 15 or 20 will not develop malignancy until age 50 or thereafter.

So, in 1935, it was indeed a rare disease and there were few asbestos workers in 1935, so these two rarities led to that suggestion. It was not until 1947 that, in fact, a definitive study established unequivocally that lung cancer was associated with asbestos exposure, and it came from Great Britain, when an analysis of autopsies performed as a result of the 1931 Factory Inspectorate regulations showed that 13 percent of individuals who died with asbestosis had lung cancer and this was about four times what would have been expected in Great Britain at that time.

So, therefore, it was clear that asbestos was not only a material that could produce lung scarring, but it could also produce malignancy, but neither in the United States nor in Great Britain, nor in any other country was any regulatory action taken that would take account of this new finding.

In 1953, another malignancy was identified in the asbestos worker. Here, a cancer of the lining of the lung, Mesothelioma.

It is a tumor that is inoperable. It is incapable of being treated by chemotherapy. Here (slide being shown) you see it at autopsy with the white cancerous tissue completely engulfing the lung from apex to base. It is rapidly growing and an individual is usually deceased within one year of diagnosis.

Additionally, one can develop cancer of the lining of the abdomen, peritoneal Mesothelioma carcinoma. It too is inoperable and not capable of treatment by chemotherapy.

You can see (slide shown) the reason for the inoperability. The cancerous tissue is the white nodular material extending throughout the abdominal cavity. It is external in the gastrointestinal tract, so one does not see it early. It does not obstruct bowel function and so it is widespread by the time it is usually diagnosed.

There is perhaps some hope in the future that there may be some mechanisms that can treat individuals with this disease, but at this time we can offer them little hope.

Here (slide shown) is a picture of an asbestos insulation worker who is applying asbestos cement to a pipe in a boiler room of some building. He spends most of his time or did spend most of his time working with asbestos materials, but also applied other insulating substances, including tuberous glass, cork and cloth materials. In general, he is working with wet materials and the air concentrations that he experiences actually are little different from those of the fiber standard proposed in 1971.

I will comment later a bit about some later analysis of what disease can be expected with our current fiber standard of two fibers per millimeter.

In 1962, Dr. Irving Selikoff of the Mount Sinai School of Medicine undertook a study of men employed in the New York and New Jersey area. (Slide shown).

Firstly, about 1200 of them came for examination and the findings there showed that asbestosis was widespread among those employed for 20 or more years in the trade.

There, 20 to 29, 72 percent have abnormal x-rays, and for those 40 or more years' employment, 94 percent had abnormal x-rays, and for the ones employed for such long periods of time, more often than not, the degree of abnormality was severe.

For example, the 40-plus group had 35 out of 121 with minimal asbestosis. There were 79 with more severe grades of lung scarring. However, for those employed for less than 20 years, most had normal x-rays and, when abnormal, the degree of abnormality was relatively minimal.

In addition to scarring of the interior of the lung, pleural fibrosis, pleural thickening was also seen. Here too was little evidence of disease prior to 20 years from first exposure. Most people had normal x-rays. Thereafter, the percentage with abnormalities increased considerably.

At the same time, a mortality study was undertaken of the members of these two Locals of the Asbestos Workers Union, and in 1962, 623 men were identified who had begun employment 20 years earlier. Their mortality experience was followed over that period of time and it was found that, instead of about 195 deaths expected, 253 were observed. There are 60 men who died who should not have. The causes of death were largely found in cancer. Thirty-two expected, ninety-five observed. There were 42 lung cancers versus 6 expected.

Additionally, there were seven Mesotheliomas, three of the pleura and four of the peritoneum and gastrointestinal cancer was elevated three times. So, even in the small group of workers, 632, within a 20-year period of time of observation, clear manifestations of severe asbestosis disease were seen. This led to the undertaking by Selikoff of a much larger study of the entire membership of the Asbestos Workers Union in the United States, in which 17,800 individuals were seen.

The main features of this larger study are that the mortality experience predicted from the first one were fulfilled across the United States. It wasn't that there were conditions unique to the New York City area. It wasn't that the work practices or the materials there were different. Every Local in the United States pretty much had the same experience.

There were 1660 deaths expected; 2,271 occurred, 40 percent more than expected.

Lung cancer accounted for one in every five deaths seen. Mesothelioma accounted for seven percent of the deaths. Gastrointestinal cancer for ten percent and asbestosis, the disease wished away seven decades earlier, accounted for seven percent.

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If one takes into account the probabilities of these deaths in the general population, one can say that 40 percent or at least 40 percent of the deaths of these workers can be attributed to their occupational exposure to asbestos fibers.

That study, in essence, vastly broadened the spectrum of deaths to be seen with asbestos exposure.

Until that time, it was largely thought to be confined to the manufacturing industry. There were case reports and some studies made of the use of asbestos materials, but the extent of disease that was seen clearly expanded the amount of disease that would be seen overall from the use of this material.

In terms of when the disease comes, all of the malignancies in asbestosis usually were not apparent in considerable numbers until after 20 or 25 years from first exposure.

This (graph shown) shows the development of asbestosis from the time of first employment in the industry. Most deaths occurred 30 years or after in the group of insulators across the United States. Mesothelioma also does not generally appear until 30 years from first exposure. Both pleural and peritoneal Mesothelioma arise rapidly after that point in time. Lung cancer, however, arises somewhat earlier. After about 25 years, the increase is apparent.

Actually, the risk of developing lung cancer, the relative risk from the asbestos exposure is manifest earlier, but because there are few cases expected, that relative risk, which would multiply the risk of death in the absence of asbestos exposure is so little, when it is multiplied it is still virtually a trivial amount of risk. Only when one ages and has the risk of an older person for lung cancer does the multiplicative effect of the asbestos exposure become manifest in a significant number of cases.

If one looks at all asbestos cancers, with the exception of Mesothelioma, one can see the development of the relative risks of death compared to that which would be expected in the absence of asbestos exposure. That is, the general population would have a relative risk of one in this concept.

Asbestos that one inhales in the earlier years adds to the risk and, as one continues exposure to asbestos, one increases the relative risk compared to that of the general population. This increasing risk rises with increasing exposure pretty much in a linear scale, and the fact that it goes through the relative risk of one, either at zero exposure to very close to the indicator of the asbestos exposure, is to increase the relative risk very rapidly, but it may not lead to disease because the relative risk in early years -- early age, is a very low one that is multiplied, but as that risk -- as the risk in the absence of exposure rises with age, then the asbestos cancers will be seen.

There is a fall-off after about 40 years, and some of this is due to the fact that individuals who have been smoking cigarettes have been removed from the population under study, either because of death of lung cancer or death of cardiovascular disease.

The study that was undertaken in 1967, from which these data were taken by Selikoff allowed information to be obtained prior to the observation of the deaths from each of the members of the Union at that time and smoking habits were obtained.

Here (slide shown) is an insulation worker from a picture taken in the late 1960's. Occasionally, they wore aspirators during the work.

The consequences of cigarette smoking without asbestos exposure are severe. With the huge cancer risk rising according to the amount that you smoke, to a factor of about 15 for those that smoke between 20 and 30 a day to nearly 20 for those that smoke 40 or more a day, so you are multiplying the risk in the absence of cigarette smoking by an enormous amount due to that habit. If one now superimposes upon that additional assault of asbestos exposure, the consequences are considerable.

To evaluate that, comparisons were made between asbestos insulation workers who did smoke and who did not smoke with the population that was under observation at the same time in the study of the American Cancer Society, in which individuals in the general population had been enrolled.

For that study, individuals were selected who had, in essence, blue collar jobs. They were exposed at work to dust fumes, chemicals, et cetera. They were not farmers. They were white, as were the asbestos workers, had a high school education, were alive on January 1, 1967, and their smoking habits were known.

Looking now at the mortality of that group not exposed to asbestos, but who did have similar types of jobs, the risk of death per year from lung cancer in the nonsmokers was 11 per hundred thousand persons.

If one now looks at the individuals who worked with asbestos and do not smoke cigarettes, their risk is 58 per hundred thousand. It's about five times greater than that of a nonsmoker in the general population.

If you compare that with the cigarette smoker in the general population, the risk of the added asbestos exposure is less than that of the added cigarette smoking. There, cigarette smokers have a likelihood of 122 deaths per hundred thousand per year, about 11 times that of a nonsmoker. That 11 times reflects the smoking habits of this group under observation.

However, when you now compare asbestos workers who smoke cigarettes with their counterparts in other categoris, the risk is enormous. Six hundred deaths per hundred thousand per year. It is 53 times that of a nonsmoker who does not work with asbestos. It is five times that of a smoker who does not work with asbestos.

What is happening is that the two factors, the effects of the two factors multiply together and they are not additive. They are multiplicative, to give rise to a risk that is extraordinary, and this multiple factor interaction is extremely important, not only for asbestosis, but for other carcinogens.

It would appear, in fact, that the effect of asbestos exposure is to multiply whatever the risk might be in the absence of asbestos exposure, and it will multiply that risk that would have developed from past exposures to cigarettes or carcinogens in the general population, but it also multiplies whatever that risk will be in the future.

So, as one ages and the risk of developing lung cancer, in the absence of asbestos exposure rises, so does the risk from the added asbestos exposure. It will multiply that which will occur in years to come, providing a very high risk of death in later years. This can come about in part because of the fibers that one inhales remaining in the lungs, and they are there to do their damage when other materials that can be inhaled are ingested or otherwise contribute to or other factors that can contribute to lung cancer undertake their action.

In essence, asbestos is synergistic with that which has taken place in the past and will take place in the future.

One good feature of this is, if one undertakes remedial action to try to reduce that risk, it has a beneficial effect. With cessation of smoking in the general population, it's seen that the risk of lung cancer will decrease. So does it with asbestos workers. If you stop smoking, the risk of dying of lung cancer goes to one half or one third what it would be if an asbestos worker continued smoking.

Looking briefly now at one other aspect of asbestos exposure, seen in another group studied by Selikoff, factory workers producing asbestos insulation from 1941 until 1945 -- they did so in a group of plants in Paterson. Their overall mortality experience was little different from that of the asbestos insulation workers. Lung cancer, Mesothelioma, gastrointestinal cancer were all dominant in their patterns of death. The particular feature of this study is that it was possible to observe the effects of short-term exposures to asbestos because many people worked in the plant only a month or two prior to going to the service or until they got a better job. It was an undesirable place to work, being dusty as it was, so the dose-response relationship could be obtained by comparing the mortality for different causes in individuals that worked for different periods of time.

Here (slide shown) it shows the length of time worked and the risk of death of lung cancer compared to that which would be expected in the general population. This line is the expected deaths for those that were employed two or more years. There were about seven times as many deaths from lung cancer as expected for those at one year. That fell to five times expected. For six to eleven months, three times, but even for periods as short as one month or less, there is still an illustrated risk of death from lung cancer.

The effect of short intense exposures, if excessive, will produce disease, but after many years following that exposure. This is again because the individuals were mostly young when employed and their disease experience would be ahead of them.

However, there was even a group that was employed at older ages and it was found, because they already had a high risk of lung cancer, the effect of that exposure late in life was to produce many lung cancers relatively early, within 10 years. It was about a five-fold increased risk of death of lung cancer in the group that was employed there.

The principal is often seen in clinical observations. This is an x-ray (slide shown) of an individual that had a routine examination in 1951, with a slight possibility of there being some fibrosis in his lung field, but that could be due to other than asbestos exposure and little was thought of it.

In 1956, when he came back for examination, there was clearly some evidence here now of peritoneal fibrosis. He was seen by Selikoff, who questioned him carefully about possible asbestos exposure.

He said, "No. I worked here and there. All of the jobs were ones without asbestos fibers being present."

His wife then spoke up and said, "Don't you remember? In 1935 you worked for six weeks at an asbestos plant when you were laid off at such-and-such a place."

That was his exposure. He was employed in a factory for six weeks in 1935, and 21 years later there was evidence that was seen of that exposure.

Another decade later, the evidence is very clear. The person is totally short of breath and can barely walk to his mailbox to get his mail daily, is incapacitated, as anyone might be, from such exposure. Six weeks.

The spectrum of asbestos disease expanded from that of the factory boundary or the user of asbestos material to the environment, in 1960, when 47 cases of Mesothelioma were identified in the Cape Province of South Africa. Of these, half were individuals who worked with asbestos, but the remaining half were individuals who simply lived in the mining area. Their exposures were to the fibers that were dispersed from the mining activities across the fairly barren areas of North Africa.

To appreciate the finding of 47 cases in this one relatively rural area of South Africa, at Mount Sinai Hospital, which has 1200 beds, there was a classic paper written in 1931 on pleural Mesothelioma. The chest service was interested in the disease, but in the next 30 years, only three additional cases came through Mount Sinai, and that was a hospital with 400 autopsies annually. It is generally extremely rare in the general population. Perhaps 1 in 10,000 deaths might account for it.

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The evidence of nonoccupational disease was confirmed in 1967 when cases in the London hospital were reviewed by Neuhaus and Thompson. Seventy-six were found that were confirmed Mesotheliomas. Of the 76, 31 were from a factory -- otherwise, occupationally exposed -- 9 were individuals who simply lived with an asbestos worker, 11 were individuals who lived within one-half mile of an asbestos factory and the concept seen here is clear. Even the dust that is brought home contaminates the home environment.

That effect is also seen in the x-rays of household contacts of the asbestos workers in the Paterson plant. Of the 626 who were examined clinically, 36 percent had an abnormal x-ray. Most of the abnormalities were pleural in nature and thus were not generally in any way affecting their health directly. They were not short of breath but they were a clinical manifestation of asbestos exposure, and the consequences of that is that individuals with such exposure are higher risks for asbestos disease.

This has been borne out by the finding of four cases of Mesothelioma among such family contacts, all of whom died 30 years after the employment period of the worker in the plant. In fact, four deaths occurred among a hundred and eighty that were of the individuals thirty years from onset. Even in family contacts, 1 or 2 percent of deaths may be from Mesothelioma, and our primary suggests that lung cancer will be detected in these family contacts.

In comparison, there have been 14 cases of Mesothelioma in the workers in that plant because of heavier exposure, the higher risk associated with that employment. Their deaths began after 20 years from first employment.

One poignant case of family contact is in the daughter of a shipyard insulation worker in Quincy. He died of lung cancer from his asbestos exposure. His wife died of Mesothelioma and shortly after, his daughter, who had noticed pains in her chest similar to that of her mother, had a diagnosed case. This (slide shown) is the x-rays of the daughter in 1974, which is completely normal, and in 1978, her Mesothelioma was evident. So, the spread from the work place, on the clothes that were then shaken and washed by the mother while the child was nearby, took a very grim toll in that family.

The awareness of the expanding disease was further indicated in 1968 by a study of Harris in Great Britain, which showed that deaths in shipyard workers of Mesothelioma were occurring fairly frequently. He identified five at that period of time in noninsulation workers. A boilermaker, a fitter, a shipwright, a welder and a laborer.

Additionally, in other than insulation workers, asbestosis was identified. One can see (slide shown) the concept here, where you have an insulation worker who is now using a respirator and the pipe fitter in the background in this slide is not wearing the respirator, and is, in fact, probably unaware of any risk that he is facing from the dust cloud that will drift towards him from the insulation worker's work.

When that is done in the hold of a ship with many people trying to finish the work necessary during repair or during construction, the exposures were widespread and recent data from Harris has identified 55 Mesotheliomas in one dockyard in Britain, only two of which had been individuals who directly used asbestos in their work. The remaining were in people employed in shipbuilding, but their exposure was indirect while they were working near someone who was using the asbestos.

The greater number comes about because of the much greater percentage of individuals employed in these nonasbestos trades. Approximately two tenths of one percent of the work force of a shipyard are insulation workers. The other 99.8 are in other trades, and while at lower risk, that greater number gives rise to a greater finding of disease among them.

We have examined the effects in the United States shipyard. In fact, in three United States shipyards.

Here (slide shown) are some data that were taken from a yard in Baltimore, Maryland, in which 86 percent of the individuals examined, most of whom were 30 or more years from first employment in the yard, but 86 percent had abnormal x-rays. Fortunately, there was somewhat less severity than that of insulation workers, but the percentage with such abnormalities was considerable.

In this examination of 280 individuals, we found 5 that had previously undiagnosed lung cancer as well as those that had lung cancer and lungs removed from it.

So, the manifestation of exposure from shipyard work in the United States is severe and the consequences of that, in terms of malignant disease in the future will be great as well.

You will clearly see many cases from that exposure in the past. At this time, we have 250 yards in the United States, most of them employed with repair contracts, where there is asbestos already in place, that has been put there over the past decades, will have to be removed at different times, and even though at this time new ship construction uses material that does not contain asbestos, we have to deal with that which is there from past work.

Another industry in which there has been considerable exposure to asbestos, particularly in the period of time from 1958 through 1972, is the construction industry in large metropolitan areas. For those of you that would have seen it, (slide shown) you can recognize the spraying of asbestos material on steel work of high-rise buildings. This is in the Wall Street area, done without any attempt to contain it to the jobsite.

Though tarps are seen at this particular site, (slide shown) the sidewalk was to the right of that picture and most of it is probably staying on the jobsite, but very little of it is actually going into the steel work and one has a tremendous overspray while this activity is taking place.

Here (slide shown) you see it in this case in the World Trade Center, being applied to the supporting structure of the floor above. That overspray leads to exposure to cab drivers on the site, to bricklayers, steel workers, to electricians, and to sheet metal workers.

Incidentally, we have just two weeks ago examined sheet metal workers employed in New York City. Of 42 men examined, who had 30 years of activity in the trade, 75 percent had abnormal x-rays. In fact, one lung cancer was picked up among these 42.

So, the repair of buildings with the asbestos fireproofing material in place, the activities that these men have engaged in in past years, installing new materials, with buildings in which asbestos fibers have been sprayed, as well as using some asbestos themselves in earlier years, to wrap ducts -- as a trade, that will be a high risk for periods to come.

Here (slide shown) you see the consequences of repair of such buildings. In this case, they were putting electrical fixtures in the World Trade Center. At this time, the World Trade Center is anticipating a program of installing sprinklers, with the increasing concern of fires that have taken place nationwide, and when those sprinklers are installed, it will require that material in this area to be disturbed.

It will then expose the individuals doing it, but it will also be carried throughout the building directly, because in most construction, the space between the hung ceilings, which would be under these, and the floor above, forms part of a return air system, and all air from that space would enter the duct, going to the fan room to be recirculated through the building, additionally causing considerable further exposure.

One grim sort of problem, again, from past use of asbestos, is that asbestos that is placed in schools -- when one begins one's exposure earlier, with the long life expectancy of children, having a longer period of time over which asbestos disease can develop. Here (slide shown) is one severe example in New Jersey.

We investigated its use in New Jersey and found that about 10 percent of the schools in the state had asbestos in pupil-use areas, and of that that was in place, two thirds of the asbestos had some damage, about 20 percent of the schools having severe damage, although this is the worst that we saw in any circumstances.

In those cases where damage was seen, air levels of about 10 to 100 times background were measured in circumstances where no disruptions was occurring. When disruption occurred, you would have levels that would be comparable to those of the work place.

At the present time, there is about 25,000,000 tons of asbestos in place in buildings and ships across the United States. 1,000,000 tons of that asbestos is in friable form, either fireproofing or as thermal insulation. In years to come, the maintenance of that material in place will provide a continuing problem that we will have to face.

With regard to the disposal of it, we have the Love Canal. Here (slide shown) is an asbestos dump outside of Abner, Pennsylvania that snakes for 20 blocks through town. It was once used as a disposal site for the Milk of Magnesia Company, which used blue bottles that have relic value. The kids mine that area to try to mine the bottles for that value.

Here (slide shown) are painters. The painters are sanding the spackle material which contained asbestos in past years. That is also a risk for asbestosis.

We are now looking at what might be the potential for such disease in the future, from past exposures that have occurred.

Numerous groups have been examined at Mount Sinai, and the prevalence of x-ray abnormalities has been tabulated in different work activities. Using this as a guideline for the relative risk, and from estimates of the population in these different trades, some very tentative and very preliminary data have been developed on both the risk at present and what that risk might be.

In terms of the population risk, these data show the number of workers that have been estimated to have been exposed to asbestos in the years 1940 through 1980, and in 1940, in trades such as manufacturing, where there were 33,000 individuals employed, in insulation work we have 18,000, so you have relatively small population. It is expanded by others in other trades. There is shipyard construction, railroad repair, roundhouse people who are exposed while the asbestos material of the steam engines was worked on, utility engineers, maintenance people, chemical refining, auto mechanics, merchant marine. These are the major work activities having asbestos exposure.

In 1940, all told, about 1,700,000 men were employed in these trades. This was considering that only 20 percent of other than plumbers and painters in the construction trade would be exposed to asbestos on a significant basis. The number expanded considerably in World War II. There were four and a half million people employed in shipbuilding in the United States. This added considerably to those exposed to asbestos. With the other trades employed in the period 1940 through '49, the 1.7 million that had exposure in 1940 was joined by another 6,600,000, and thereafter about one and a half million individuals -- new individuals obtained asbestos exposure in one of these industries, so that from 1940 through 1979, approximately 13,000,000 employees would have had an asbestos exposure. About 10,000,000 of those are alive today. That's between 9.5 million and 10 million.

If one assigns a relative risk of asbestos disease, using the patterns of disease seen in insulation workers, but with a differing extent of disease -- that is, for insulation workers and manufacturers the full manifestation of the disease, as I described it earlier, with 40 percent of the deaths being related to that occupational exposure, it would be reduced in quantity by the lower factors.

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In construction we initially estimated that 20 percent of construction workers would have 10 percent of the risk -- and we find that this is an underestimate and our estimates of the construction contribution to asbestos disease in the future will be considerably higher. For railroad repair, utilities and other activities listed here, for example, the lowest exposed group was estimated to be that of garage mechanics, where they would have exposure to perhaps one tenth of a fiber, two tenths of a fiber and one twentieth the risk of an insulation worker with 30 years employment in the industry. That is, a 30-year garage mechanic would have one twentieth of the risk of an asbestos cancer as a 30-year insulation worker.

If one now looks at the effect of such calculations here (slide shown) for shipyard Mesotheliomas, you can see what some of the results will look like. They are depicted in terms of the number of deaths per year of Mesothelioma, going from 400 to 800 to 1200 annually.

The graph shows the effect of prewar employment, wartime employment, postwar employment.

Of the prewar group, there were 150 thus employed in 1940, and there is a rise and now they are falling off as most of them are deceased. The wartime group rises fairly rapidly, but the rise does not begin until 1970. It will not peak until about 1990 when it will begin to fall off.

Those employed after World War II have hardly begun to contribute to the disease experience that we are now seeing.

The sum of these is shown in the upper graph and the cross-hatched area here are those deaths that have occurred since 1940 to the present, through 1980. In other words, that's over the 41-year period of time.

The magnitude of these graphs are uncertain because they are based upon uncertain estimates of risk and fairly good estimates of the population, but the risk estimates are uncertain due to the lack of definitive air concentrations of asbestos, due to the uncertainty of the relationship of x-ray manifestations to later malignant disease and thus the magnitude up and down can be off by a factor perhaps of 2.

But what is not uncertain is the time course. We have very good indications of when asbestos disease will develop after a given exposure and the fact that from 1940 to 1980, we have seen only one quarter of the Mesotheliomas that will occur to the year 2,000 from past asbestos exposures indicates the dimensions of the problem and even at the year 2,000, you have only reached the peak. It will continue thereafter for another 20 years at least. This is from past exposures. Anything that takes place in the future will only add to this.

The lung cancers that have had a shorter time course, largely because of the fall-off in time after 40 years or after age 60, in that graph that I showed you earlier -- that was taken into account and one sees that, in fact, the peak of lung cancer from wartime shipyard exposure has occurred. That from postwar is still rising.

This has been done for all of the different activities I showed earlier. These data (slide shown) indicate the Mesotheliomas that might be expected in the different five-year periods from now to the year 2000.

Roughly, we project that about 2,000 deaths are occurring now from Mesothelioma from occupational exposures. This is more than the number of Mesotheliomas identified on death certificates, but it is an undiagnosed disease in individuals with no known -- individuals for whom the certifying doctor is unaware of an asbestos exposure.

Perhaps 25 percent are correctly certified and for those with known exposure, it rises to 50 percent. But, with full review of the pathological material, the numbers of cases increases considerably. This number of 2,000 currently being seen is anticipated to rise to at least 5,000 or more by the year 2000.

Of these estimates, one that is actually high is that of auto mechanics. If you look at the ratio of individuals that are dying in that trade, compared to others, it is less than would be estimated here, so that our findings, based upon x-ray estimates, is overestimated.

On the other hand, the construction activities have been underestimated. There were considerably more people dying in the construction industry than these figures would indicate. That does not bode well for the future as to what the construction Mesothelioma will be in the years to come.

The exposure there was in the period of time -- the major exposure there was in the period of time from 1958 through 1972, when asbestos fireproofing material was used, and that mortality experience is still ahead of us by a considerable number of years.

Here is something on the graph from 1940 of the Mesotheliomas expected on these calculations. You can see here in 1980, here just barely approaching the steeply rising period, considering all asbestos cancer, Mesothelioma lung cancer associated with asbestos, cancer of the kidney, which is elevated two times in construction workers, and assigning it proportionately to the different trades, one estimates that between eight and nine thousand deaths are occurring at this period of time from asbestos exposure. It will rise to perhaps 12,500 per annum by the turn of the century.

In addressing what is the disease experience to come, the important experience is that of cancer. Even in heavily exposed workers, in insulation and factory workers, three quarters of the occupationally-related deaths are from cancer.

If you look at the deaths in insulation workers, lung cancer and Mesothelioma, for example, account for about 674 deaths, whereas asbestosis accounts for only 162.

In these other trades, asbestosis will be even proportionally less. In many of them, it will not be a significant source of deaths, but the malignancies which will in essence be related to the asbestos exposure proportionally to the amount of fibers an individual inhaled can contribute at even very low doses.

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Asbestosis, on the other hand, has a dose-response relationship in which a threshold exists, and you need a certain amount before you have any significant risk of disease.

That is not the case with asbestos.

Our knowledge to date indicates that any dose-reponse relationship that would apply to that fiber does not have a level below which no risk obtains. All data that we have to date indicates linearity is the best relationship and that we must act as if there would be no threshold.

Looking at the problem that we face in 1980, we have certainly to be concerned with exposures that have taken place in the past two decades. Those in the wartime period were only a small portion of the exposures that will produce disease in the future.

Currently, our two-fiber standard is likely. If an individual were exposed to that concentration over a 40-year working lifetime, double the risk of lung cancer and increase all mortality by 10 percent -- mortality from all causes by 10 percent.

Some workers today are ill-protected by our regulatory process. In fact, asbestos is yet to be regulated as a carcinogen by the Occupational and Health Safety Administration. The two-fiber standard is based upon the attempt to protect against asbestosis.

As I showed earlier, that disease is the least of the problem of an asbestos exposed worker.

Dust from work activities spreading through the work place, fugitive dust is a continuing problem, as is the maintenance and repair of the 1,000,000 tons of friable asbestos in place. Family contact disease. The need for controls over all work with asbestos fibers is evident.

We have little to offer in the way of therapy or early diagnosis. Mesothelioma is at this point a death warrant.

With lung cancer, with early detection, you can save a few lives, 10 percent, perhaps, but it too is fatal most of the time.

There is no surveillance mechanism in place for those individuals at high risk, and there is little research on what might be done with individuals at high risk to reduce the future risk of disease.

Power plants, shipyards, construction industry -- these are areas where there is clearly the need to maintain vigilance to prevent future exposure so we don't have this experience continuing well into the middle of the next century.

This is the grim story of asbestos. One can see that it started with an identification of disease eight decades ago and we are still faced with major problems, with many people continuing to be exposed and much disease from that exposure which has taken place.

At the present time, there are about 230 chemicals that have been identified by the international agency for research on cancer that are carcinogenic in animals, and for which human exposures are known.

We have occupational standards in the United States for about 20 carcinogens. For the others, there is little regulation and in many cases, there is little control.

The experience with asbestos is being repeated with other chemicals. Fortunately, in some cases, action is taken much more rapidly.

With vinyl chloride, the history was condensed from that of eight decades to about four decades. Some disease was seen with vinyl chlorides in the 1940's. Some abnormalities of a nonmalignant nature were seen. When cancer was found, controls rapidly came into place.

That sometimes occurs with other chemicals, but not with all of them. The lessons we have to learn are that when there is the possibility of malignant disease, action must be taken because if we wait until the large number of individuals have been exposed, the potential for disease that will occur in those will plague us for decades to come.

In the case of the insurance company, as well as the individuals exposed, that effect will be, in some cases, fairly severe, as it certainly is in the case of absestos.

Thank you!