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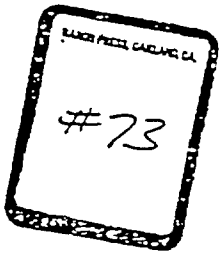

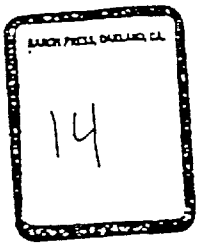

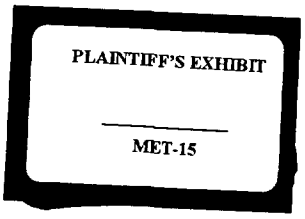

SEVENTH SARANAC SYMPOSIUM

THE SARANAC LABORATORY of the
Edward L. Trudeau Foundation
Saranac Lake, New York

Session, Wednesday,
September 24, 1952

PNEUMOCONIOSIS AND PULMONARY CANCER

Chairman: C. P. Rhoads, M. D.

Philosophy of Biostatistics as Applied to Environmental Pulmonary Cancer

Morton L. Levin, M. D.

Discussion

General Review

W. C. Hueper, M. D.

Discussion

Asbestos Miners

Paul Cartier, M. D.

Discussion

Asbestos Weavers

Kenneth M. Lynch, M. D.

Discussion, led by D. R. A. Merewether, M. D.

BY DOCTOR VORWALD:

Ladies and gentlemen, it's past time to begin. We're behind schedule by twenty minutes. We hope that we will proceed in making up this time during the course of the day. I will admit it's a very tight schedule, but with the leadership of our chairmen, I am sure that we will accomplish our objective for today.

Before we begin formally, there are just, again, a few announcements which I must make. I call your attention to the banquet tickets for tomorrow and also the

BY DOCTOR RHOADS:

The next paper on the Symposium concerns the paper already discussed by Doctor Hueper. If we could have a little quiet, it would be very helpful for those who are presenting papers. Doctor Hueper has asked to comment on Doctor Drinker's remarks. I think we must defer this until we can get the papers under way.

I will, therefore, introduce the paper on asbestos mining by Doctor Cartier. Doctor Cartier.

BY DOCTOR CARTIER:

Members of this Symposium: Not being a statistician, neither an epidemiologist, I don't think I should have accepted to present this paper, but I think, to excuse myself, I should say that this statistics and most of the papers I am presenting have been reviewed by your statistician in Montreal and Doctor Phillips, official statistician for National Cancer Institute of Canada in Toronto, so I would like that those two experts take the responsibility of the statements I might advance.

So I was invited to present this paper on the pulmonary cancer in the asbestos mining industry, not on account of any special qualification, only because I happen to be in charge of a clinic which has, as a primary function, to supervise the primary condition of four thousand asbestos miners, such a group of entrants offering an

outstanding metallurgical study of cancer of the lung in relation to asbestos fibers or any other related fibers.

In the origin of mines, six different companies are doing asbestos mining operations, so for more than eighty years, and since 1945, these companies have organized the Thetford Industrial Clinic which has, as a primary aim, to fulfill a program of industrial hygiene, mainly medical and with dust control provisions.

In 1950, the concept of an inhalation of asbestos fibers and pulmonary cancer was mentioned by many investigators and it was at that moment that the Medical Advisor of the Quebec Asbestos Mining Association, saw advantages for the employees and the employers, to recommend a company investigation composed of an epidemiological and experimental study.

This report is part of this study.

The Thetford Industrial Clinic has been in operation only since 1946, and we have medical records on five thousand fifty-two employees, but this survey is based only on three thousand nine hundred fifty-seven workers having worked in the industry from two to sixty years. About one thousand employees have been rejected from this survey because they have not worked long enough, or because they have worked in different industrial trades before.

Before presenting the first table, I think it is

worthwhile to say that the labor turn-over in the asbestos industry is one of the lowest in all the industry in Canada, meaning that the stable population is working in our mine and meaning, also, that in many aspects, it is easier to study and more representative.

The first slide please. So as I mentioned, this Table Number 1 shows the age group distribution of the group study and I don't think it needs any comments except to say that the average age of our employees is thirty-five, about two years older than the average for the general industrial population, and this table will show also that 1,577 men are included in the age group from forty to - and over, in the group where the incidence of cancer is more general.

Second -- next table, please. This table indicates the number of years spent in the asbestos mining industry by the total number of employees surveyed. Of course, this table is not as significant as would be a table indicating the specific exposure of those employees, but after many attempts it has seemed impossible to - to add together the different years spent in different concentration of fibers, to which part of the employees have been exposed, and I think as a remark too, it is worthwhile to mention that two thousand, two hundred have spent more than ten years in the asbestos industry.

Next table, please. The following table shows a classification of various exposures in the asbestos mining industry. Realize that this classification could be discussed for many hours, and present many quarrels, but I think nevertheless that we need, for many purposes, we need a job classification, even for the exposure aspect or for research, so after we were stationed with our engineer, we took the average of all the dust survey made in the mining industry and we decided just to draw this table, and this table has also, I don't know if it is objective advantage, but has the advantage of correlating with our case of asbestosis.

I want to state that all the cases of asbestosis have belonged - have worked in shops, under that rule, I'm sorry, in the lower group, and our men having worked even from two to forty-five years in that kind of exposure, has never developed an asbestosis which was found by pathologists or epidemiologists or by experiments, to be of any sequence, any medical sequence.

This table, as you may see, presents million particles per cubic foot and the percentage of fiber count. This is very important, because from experience to experience, it seems that the fiber is the only pathological agent, rock dust not being - not being reproduced in any concensus, pulmonary fibrosis. I think, only this night

need some further explanation, because you see that is not clear. Even this might seem a little less concentrated, but just the same we put in this whole group, because on the ground, dry work and the grizzly men are working longer, they are working in more constant concentration of fibers, and in the third place, because we have found a few exceptional cases of asbestosis in that group. So, please remember the categories, 0, 1, 2, 3, 4 and 5, because in the coming tables, they might help you to understand them.

The following tables intend to indicate indidence or prevalence of pulmonary cancer in different groups of asbestos workers in comparison to different control groups. The task of selecting significant control group has been, in this case, as everywhere, very difficult. We would have wished to be able to find a group in the province of Quebec, a group in any other comparative - comparable industrial group, but it was impossible for the following reason, that in no other industrial cities in Province Quebec, so large a proportion of the adult population is followed medically so closely, because I think I should mention to you that about thirty-three - about thirty percent of the adult population in Thetford are working in the mines, being the only industry, so we can't have a very close supervision of the function of the - of the condition of the lungs.

We tried, with the mass survey, to detect a con-

parable survey group, but I don't think it was or is possible, because in the Province of Quebec, very few adults over fifty years of age are taking advantage of the mass survey. As a matter of fact, the mass survey made in Thetford mines in 1950 by the Provincial Department of Health, did not detect a single case of pulmonary cancer, either in the generic operation or in fourteen miners who have been X-rayed, so having not succeeded in selecting a good control group for the reason just mentioned, we have decided to make comparative study of incidence of the pulmonary cancer in different groups of asbestos workers, which can be studied with the same methods and which, at the same time, would present sufficient characteristics to be significant.

The next table, please. This table indicates the prevalence of pulmonary cancer according to degree of length, to degree and length of exposure and by age. This table shows the prevalence of pulmonary cancer in the group with severe exposure, that's this group, and this is more or less a control group.

This, we have six cases of pulmonary - of primary pulmonary cancer and four cases, in fact, in the group exposed and this, of course, the number being smaller, it gave us a higher incidence, but if we also take that, we have to admit that this difference in incidence is not, has

no statistical value, because it is not more or equal to twice the secondary condition.

Next, please. This table was made at the suggestion of Doctor Pratt, who was interested to know the comparative incidence in group of employees, of employees who have been exposed to a significant degree of exposure, Category 3, 4 and 5, given as less - as one year, and as a control group, we take the group of employees with any kind of exposure, but of the Categories 1, - 0, 1 and 2.

Doctor Pratt had in mind, in suggesting that table, that the factor exposure to severe concentration of asbestos for any length of time might be as significant as the factor asbestosis itself, meaning that if there is a possible causal relationship, the inhalation of sufficient dosage of asbestos fibers might be as important as the factor asbestosis itself and at the same time, I think we have the two extremes.

In the previous slide, we have men with severe exposure, the incidence of cancer, pulmonary cancer in men with severe exposure, and in this - in this table, we have men in the group 2 with very light or very little exposure but with sufficient dosage of - of dust.

Next table, please. This table indicates the prevalence of pulmonary cancer in a series of fifty-three autopsied asbestos workers. This analysis, although not as

epidemiologist at the same time told me that less than ten percent are post-mortem cases, so this might be not comparable to a large extent, but I think if there was any significance, we should expect to have a bigger variation in the percentages.

Next, table, please. Instead of comparing the annual prevalence or incidence of pulmonary cancer in the population of Thetford Mines with the incidence in other control groups, Doctor Phillips from the National Cancer Institute of Canada has suggested to work this number, this table, which is based on the fact that Doctor Denning has found in a random population of 46,833, an annual incidence of seven cases for each hundred thousand of population, given a year expectancy of seventy.

On that basis, Thetford Mines, which is average population of 15,000 for the last ten years, should have ten cases between - twenty-five cases of pulmonary cancer, and the actual prevalence for ten years, this ten years, the actual prevalence is nine cases.

In Montreal, with the ten years expectancy of six, six ninety or six ninety-three cases, it has, as you see, eight hundred fifty-six and I think it is worthwhile to mention that in Montreal, the rate since '45, in '45 the rate per hundred thousand of population was only .5, 5.9, and in 1950, it has reached 12.9.

important as that of Doctor Merewether of Great Britain, is based on quite a similar basis and I would think that this group is less selective, because that is no section at all. That's all the cases we meant to autopsy after - from fifteen years and over in the industry. Again here, the difference is not as big as it looks, because after using - using the standard there, we came to a difference of about only .5 between the two groups, the group with asbestosis and group with - without asbestosis.

I can not answer why there is less cases of cancer in the asbestotic group, but I think that if we could have autopsy on every employee who happens to die, we might get either a different picture of maybe an indirect explanation.

Next table, please. This table was made for the purpose of knowing if the ratio between the number of cancer deaths outside and the pulmonary cancer deaths was somewhat different from the ratio observed in a few other control groups. First, I think it should be mentioned that ninety percent of the cases for the City of Montreal and a hundred percent of the cases for the City of Thetford Mines, are autopsied, are post mortem cases, so that is why I say it is difficult to compare. I don't know in which proportion for the Province or City of Quebec, but for the Province of Quebec, the statistician and the

(No response).

Now, if those of you who are in the back, could you come forward so that we can really get a picture. There are a lot of seats up forward and it will only take a few minutes.

I might say that the photographer will print these pictures and you may buy one from him if you so wish; on the bulletin board outside will be a paper where you might indicate whether you want one or a dozen.

(Photograph was taken, after which the meeting was adjourned. Session reconvened at 2:37 P. M.).

PNEUMOCONIOSIS AND PULMONARY CANCER (Continued) 2:30 to 5:30 P.M.

Chromate Workers

Anthony J. Lanza, M. D.

Discussion

Experimental Pulmonary Cancer - General Review

G. Burroughs Mider, M. D.

Discussion

Pulmonary Cancer in Experimental Exposures to Chromate

Anna Baetjer, Sc.D.

Discussion

Pulmonary Cancer in Experimental Exposures to Beryllium

Arthur J. Vorwald, M. D.

Discussion.

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question of an etiological relationship between cancer of the lung and asbestos, but also between cancer of the lung and other local illness.

In 1948, I made a note of the deaths from asbestosis, asbestosis with tuberculosis and either of these with also cancer of the lung, recorded in the United Kingdom from 1924 to 1947. I placed alongside them for comparison, the corresponding data we have from silicosis and cancer of the lung. These were factual data which speak for themselves insofar as they go, but I attempted to make deductions since I felt the asbestosis deaths were too few for the purpose. I have now brought these figures up to date.

The corresponding figures for silicosis deaths amount to several thousands. They were, I think, sufficiently large to show that there is no etiological relationship between silicosis and cancer of the lung and in this I'm fortified by the data produced by the South African experts. I will not weary you, therefore, with the additions in the last three and a quarter years to our silicosis figures.

Briefly, therefore, our latest figures are recorded deaths from asbestosis, asbestosis with tuberculosis, or either complicated with cancer of the lung, with cancer, are 306. I am excluding ten of these where there is also cancer of sites other than the lungs. Our net figures are,

therefore, 296 deaths and of these forty-eight or 16.2 percent were associated with cancer of the lung. This shows an increase from a 13.2 percent disclosed by our earlier figures. This means that, as more deaths from asbestosis come to hand, the cumulative percentage of deaths with complicating cancer of the lung is rising rather than falling.

Now, where do we go to from here? Are these figures sufficient to indicate a causal relationship between the retention of asbestos dust in the lungs and subsequent cancer of the lung? The small numbers certainly dictate caution. Nevertheless, they represent the great majority of the deaths from asbestosis which have occurred in the United Kingdom during the past quarter of a century.

Nowadays, because of the greatly increased awareness of workers, doctors and others in the neighborhood of asbestos plants, of the disease, because of the duty of Coroners to investigate with autopsy and to report to my department, deaths suspected to be due to occupational disease, whatever it may be, the compensation benefits accruing to cases of pneumoconiosis, the system of factory inspection, our periodical check-up of the death certificates provided by the Registrar General, and for other reasons, it is likely that very few deaths from asbestosis escape notice.

Therefore, with confidence, I think we can say that the figures point to the necessity for the collection of similar data from other communities with an asbestosis hazard, so that by means of statistical examination of the global figures so obtained, we can settle the question of whether cancer of the lung is an additional risk of asbestos exposures.

Now, I should mention here that the figures in United Kingdom, that those figures include all of them, because they come to me, so that we must not add up excess figures and - the X figures and Y figures and Z figures, and think that they're all additional cases of asbestosis, with carcinoma of the lung. One can add up, of course, different countries, but one must be very careful adding up or duplicating the same cases in the same countries.

There is another point that was brought up this morning, that the population risk of asbestos is small relatively to other industries and it fluctuates. A war brings a great increase of people, because obviously, there is a great demand for high class asbestos insulation for use in war ships and other types of work, and then it drops off again, so that one could never really get a population, for instance, to which one could relate a particular case of asbestosis, assuming that asbestos is a factor in this matter.

Now, another thing is the reverse which I think has got to be brought in mind, into mind, that when one is considering a hazard in an industry and one wants, as the statisticians always do want, something like a world population before they give us anything very satisfactory about the matter, that you - you say that, for all purposes, the population of an industry is say two hundred thousand, your very risk may be lost in the mass of the population.

That occurs, for instance, in coal carbon trade, where I tried a number of years ago, a relatively small portion of people exposed to tar or tarry vapors, and they're lost in the whole population of the trade, but when you limit them to the people who are exposed to tar and tarry vapors, you find there is six times the risk of cutaneous cancer. In other words, the risk was lost in the overall numbers assumed to be at risk.

And, it is something like that in the asbestos trade. A lot of people don't have much exposure to asbestos at all. Now, as far as the rate in asbestos, I haven't got into that yet, but following a remark made this morning, I will try and do so.

Then Doctor Lynch did say, what is the degree of asbestosis. Now, all these people have been autopsied and all of them died primarily of asbestosis, whether they had tubercle or cancer later.

Now, I won't weary you with the statistical approaches. Besides that, I'm very frightened of statisticians. They're going to die if I find an error in this. Not quite as bad as a psychiatrist, of course. I'm looking for the day when we have a statistical psychiatrist. Well, just another page of this, sir, then we'll be ready to throw me out.

Of the 296 deaths we are considering, 172 occurred in males and 126 in females. Eighty-two or 27.7 percent, half males and half females, were associated with pulmonary tuberculosis. The mean age of death was 48.2 years, with a range of 24 to 73 years for the cases of asbestosis. 39.3 with a range of 17 to 66 years, for the cases of asbestosis for or with tuberculosis and 53.4 years with the range of 32 to 77 for the cases of asbestosis and cancer of the lung.

The mean duration of exposure was 15.7 years with a range of one to forty-eight for deaths from asbestosis. Some took a Hell of a long time to die -- 11.1 with a range of 133 - no, I put the wrong one, I'm sorry, 11.1 years, with a range of 33 years with asbestosis with tuberculosis and 19 years with a range of 2 to 49, 2 to 42 years for asbestosis with cancer of the lung.

The mean duration of life between cessation of exposure and death was 6.5 years with a range of 1 to 32 for asbestosis, 417 years - that should be 4.7 years with

range of 1 to 21 for asbestosis with tuberculosis, and 5.8 years with a range of 1 to 26 for asbestosis and cancer of the lung.

You see the ranges are very wide indeed, which is of some interest. They say with tubercle, you can get tubercle any time. It can come on them at any time and kill them at any time. Now, there are indications, from our data, that our preventive regulations which came into full operations in 1932, twenty years ago, are having an effect and this may be the explanation of why the incidence of complicating cancer of the lung appears to be rising.

Today, we do not encounter cases of extreme massive fibrosis and gross bronchiectasis and even a sarcoma 'nutmeg' liver with death, and complicated with tuberculosis or cancer of the lung at an early age, within five to seven years from the commencement of exposure. Those cases don't seem to occur. The duration of exposure which results in death from asbestosis is lengthened, the age of death is increasing and the degree of fibrosis found at autopsy is less.

This means that cases of asbestosis are limited to the cancer occurring age period, and if - and I say if there is a relationship between asbestosis and cancer of the lung and if irritation, let us surmise from the asbestos fiber is a co-carcinogen with a long exposure period, then

we would expect an increased incidence of cancer of the lung over that found in the general population to become afterwards.

Regarding these cancer cases, the mean age of death, I said was 53.4 years, so I put this in for - since I found I'd be kicked off if I didn't. Now, the occupations involved are somewhat interesting. They're always different, as you know, because sometimes two occupations carried out in the same room with different dust exposures or with other different factors, but it is a little interesting to see that the majority of these forty-eight cases, that the more dusty the process, of course, it's most fallacious, but still we watch with care, for instance, weaving. Weaving is notoriously dusty, one case there with ten of these cancer lung cases, one case also associated with carding and spinning that the man had done, andone case mixing and sorting, disintegrating and mixing, either - well, eight pipe and boiler coverers, including mixing; seven, and mattress making, six and all the rest are below that, and all those are dusty jobs.

Well, what then is the etiological factor, if any here? And, I'd be most grateful for your views. I know that physical irritation as a direct carcinogenic agent has been rather debunked by the cancer experts, but I remember that some recent work by a United States expert,

That is the nature of the asbestos itself. Now, when I first used to go to Canada, I used to hear frequently that, up there, that the Canadian asbestos was less damaging than the kind they used in England, I believe, and I have put that comment down to what we might call the national or local patriotism, you know, like the rivalry between towns, so that you so frequently see, but the fact remains the same, that in this country, we do use the asbestos, mostly the asbestos that we get from Canada, and I believe, from what I hear from our English friends, that a great deal, if not the major part of the asbestos used in England, is Rhodesian asbestos, which is quite dissimilar in its construction and in its formation, its physical characteristics, to the kind that comes from Thetford and from asbestos in Canada.

Now, that may have nothing to do with it, and up until two or three years ago, I dismissed that. I thought that was just puerile, but since we have in the last few years, learned that different types of silica, for instance, produce entirely distinct pathological effect, I am beginning to wonder if we have not failed to pay sufficient attention to the type of asbestos which varies even, as I am informed, there is a difference between the asbestos that is mined in the town of Asbestos and the kind that is mined not far away in Thetford, and yet both of these, in turn,

time there, and have spent a lot of time reviewing films, and not long ago, spent several days with Doctor Kenneth Smith on asbestos, reading his films.

I find it difficult to believe that our cancer incidence among asbestos workers could be anything like as large as it seems to be in England, because while I'm perfectly free to admit that we may have missed cancer cases which we should have not, on the other hand, I don't think we could have missed all of them if they had occurred, into the same extent that apparently they do in England.

Now, that is simply an observation of mine. Of course, it is true that as soon as the business of the harmful effects of asbestos once took hold in the American industry, they did start to clean up their plants and, while I wouldn't say that all the asbestos plants in the country were marvels of industrial hygiene perfection, nevertheless great strides have been made, and particularly, for instance, in the plant in Doctor Kenneth Lynch's town in Charlotte, South Carolina, where they have done a very beautiful job, so that with the small number of people in the industry, it's obvious that we are never going to have the clinical experience with asbestosis that we have, for instance, with silicosis, because there is not going to be the material to work on.

Now, back of that, there is still one more question.

are quite different from the asbestos that come from Rhodesia, and possibly from other parts of the world with which I'm not acquainted.

And, having in mind the lesson we've learned in the silica dust, I think that is something perhaps that we should pay more attention to. Now, I simply raise that point, cause I think it may have a great deal more significance than we have been inclined to give it.

Now, I have summarized - I have summarized my remarks here very briefly, because the topic of chrome is going to be handled by Doctor Anna Baetjer, who has done the experimental work in chrome, and has a more intimate knowledge of it from that point of view than I do.

The available evidence is that chromate workers do have an incidence of cancer of the lungs in excess of what might be expected. Beyond this, we do not as yet know a great deal.

Interest in chrome as a possible carcinogenic agent, with particular respect to lung cancer, is comparatively recent. The officials of one of the largest chrome producing companies in this country supplied the impetus that started interest in this subject in the United States, their apprehensions to tangible form, in setting on foot the statistical survey conducted by Machle and Gregorius, and published in the Public Health Reports on August 27th, 1948.

There are some figures that might interest you concerning the duration of the exposure of these people until they got cancer. May I show one slide? This might interest you to show the distribution of these cases by length of exposure. If you just focus your attention, because we don't have much time, on this column and the range, you will see that the average age is fifty-two years, and the range was from thirty-one to seventy-two of these cases that have been reported in the literature.

The duration of exposure is the interesting thing here, and it varies from four to forty-seven years. These men have been exposed to chromium, before they developed their cancer. The interval between initial exposure and the diagnosis of cancer was approximately the same, because once it is - about seventeen, and the range is four to forty-seven.

Then between the end of exposure and the diagnosis of cancer is also interesting. It shows that in some cases, the cancer may develop many years after the end of the exposure. The interval between diagnosis and death is, as in all cases of lung cancer, an average of a very short period of time.

Many of these cases which we have had and which we have studied, have come to our dispensary claiming that their symptoms, their severe symptoms, didn't begin until

Amore who was formerly medical officer for the plant in Wales where these nasal sinus tumors had been observed, and I also visited Doctor Morgan who is the Medical Officer there at the present time.

They both stated that the men who has developed the nasal sinus tumors were not men who had been employed in the part of the plant where there might be exposure to nickel carbonel, and they were, for that reason, very reluctant to believe that the nickel carbonel was a factor in the nasal sinus tumors that had been observed.

They further pointed out that the tumors that had occurred were in men who have been exposed to the calciners, that is the ores with the - that since 1924, when the calciners were redesigned, they have not seen cancer of the nasal sinus in men whose employment in the industry has taken place only subsequent to 1924, so that it would seem that there is an instance which fulfills the stipulations that were raised this morning as to whether an experiment of nature might be performed which would have bearing on the question of an occupational hazard in the way of a respiratory tract carcinoma.

BY DOCTOR RHOADS:

Doctor Morewether, would you comment on these remarks?

BY DOCTOR MOREWETHER:

an opportunity to visit him and learn something of the material that he had assembled. He had seventeen cases in which there had been co-existent carcinoma and asbestosis in the lungs. In his series, there was no relation that could be detected between the degree of asbestosis and the presence or absence of cancer, or the degree of asbestosis and fight of cancer.

Now, his series came from a plant that used the Rhodesian blue asbestos which, as Doctor Lanza has pointed out, has certain characteristics that are different from the Canadian asbestos. It's a more brittle fiber and, therefore, gives rise to more dust. However, it was my understanding that some of the cases described in Great Britain, had had exposure to the Canadian white asbestos.

I wonder if any of our colleagues from overseas who are in the room, might care to comment on that?

I would like also, to make one further point in connection with a matter that both Doctor Doran and Doctor Rhoads brought out, and that is the experiment of nature, where one may vary circumstances and see if that has anything to do with a phenomenon that has been observed. The question of exposure to nickel, which was brought up this morning, is something that I have been asked about by several individuals over the lunch hour.

I recently had an opportunity to visit with Doctor

I couldn't comment on some of them, but I think I can partially answer some of these, sir, and I think Doctor Knox can answer conclusively one of them.

First of all, I think Doctor Lanza is misinformed about the proportions of asbestos used and where they are used in England. The original cases of asbestosis, fifty years ago, were all Canadian asbestos. The earliest asbestos work in England was either seventy-eight or eighty-two and there may have been some crystalline fiber then, but very quickly the asbestos trade concentrated on the white Canadian crystalline.

Later on, the Rhodesian asbestos and the Rhodesian - the South African blue, and the third one which is also an iron silica, the anacite, came in. Now, of all of these, the anacite is definitely the most brittle. It has short fibers, it's brown and it's got fibers as long as that (indicating) whereas the best Canadian spinning fibers have only got fibers as long as that (indicating) and the best blue is about that.

Well, there is no doubt about the dustiness of the anacite. That is the brown long fibered stuff, to such an extent that it's very little used today, so it's at the period where some of these cases are concerned, or where the cases of asbestosis occurred - some of my old friend Glynn's cases occurred - there was a good deal of blue and

a good deal of anacite used.

Now, I think Doctor Knox will be able to tell us, in his plant, which is the biggest in the country, what about the types of asbestos they use in that particular factory, and the - whether they have had any carcinoma of the lung.

Now, about the nickel cancer, it is perfectly correct that none of us think that nickel carbon has anything to do with it as such for the very simple reason that - well, one reason is that nickel carbon is so toxic that we should build a factory in order to get the - in order to get the little cancer, and of course, it might act in that proportion, then I should imagine a lot more people would have been effected.

Doctor Amore or Doctor Morgan and myself feel that the - that the re-building of the old calciners was the crucial change in the matter, though there was some operation in the constitution of the materials which are shipped from Port Home in Canada. The difference, as I know, because I saw it before and afterwards, between the old and extremely dusty calciners and the modern build, is enormous. Therefore, there may be some hope in the fact that perhaps a lot of big dosage is necessary to produce some of these cancers.

BY DOCTOR RHOADS: