

MULE SPINNERS' CANCER: THE TIME NECESSARY FOR ITS PRODUCTION.

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(With 2 Graphs.)

IN view of the number of cases of epidermal cancer, especially cancer of the scrotum, which have occurred amongst cotton mule spinners within recent years, constituting this the foremost occupational cancer in our country, it may be opportune to investigate the exact duration of employment in the mule rooms that would seem to be necessary before the disease manifests itself. How long must the individuals be exposed to the action of the cancer-inducing influence before the cancerous response is elicited? The Departmental Committee¹ on Mule Spinners' Cancer having found that the "influence" or agent in this case is mineral oil, which Leitch has proved experimentally to have cancer-producing properties, how long does it take to act?

Some of the cases of mule spinners' cancer which we have collected occurred in the last century, and the duration of employment in most instances is on record. We know from the Report of the Departmental Committee on the subject that a mineral oil was first introduced as a lubricant about 1850, and certainly not before 1848. Before that the spindles were lubricated with oils of animal or vegetable origin, chiefly sperm oil. Now the first case of which we have been able to find any record, definitely diagnosed as epithelioma of the scrotum in a mule spinner, occurred in 1887. This man had been a spinner for 45 years and consequently he could not have been exposed to the action of mineral oil for more than 37 to 39 years at the most. In his case the duration of employment would not coincide with the duration of exposure to oil. It is impossible now to determine whether this particular mineral oil had carcinogenic properties or not², for the supply was exhausted in 1862. The spinner again may not have been exposed to this oil, for it was by no means universal in the cotton mills. We know, however, that after 1862

¹ *Report of the Departmental Committee appointed to consider Evidence as to the Occurrence of Epitheliomatous Ulceration among Mule Spinners.* H.M. Stationery Office, 1926. Price 1s. net.

² An examination of the Register of the Parish of Bathgate, which is the earliest centre of the Scottish shale oil industry, for the period 1860-1880 revealed 3 deaths from cancer which are of interest: (1) 23. VIII. 1870, male, 39, chemical works labourer, epithelial cancer in the groin. Haemorrhage (2 years). (2) 17. II. 1875, male, 46, oil works labourer, cancer of stomach (6 months). (3) 2. IX. 1878, male, 59, oil works labourer, epithelial cancer of scrotum and glands of groin (12 months).

Bell, Joseph (1876-1877), *Edinburgh Med. Journ.* 22, 135, described two cases of paraffin epithelioma of the scrotum in labourers in oil works.

mineral oils, since proved to be carcinogenic, were gradually introduced into the industry, though we cannot discover at what rates or in what quantities they became a component part of all spindle oils.

In 1872 these mineral oils were well established. Thus the spinner mentioned would have been subject to the action of a *proved* carcinogenic mineral oil for anything between 15 and 25 years, with a possibility of having been in contact with a *probable* carcinogenic oil for 14 years before that. This case illustrates some of the difficulties encountered in attempting to ascertain the necessary duration of exposure. If the change from animal and vegetable oils as lubricants had been sudden and universal, then we could have answered the question more readily, and we should have reasonably large figures at our disposal from which to make our calculations. We must therefore analyse only the more recent cases of spinners, and most of them have been exposed to the action of mineral oils throughout the whole of their employed life.

From the beginning of the year 1920 up till February 9th, 1928, I have had the records of 300 cases of mule spinners' cancer of the scrotum for analysis.

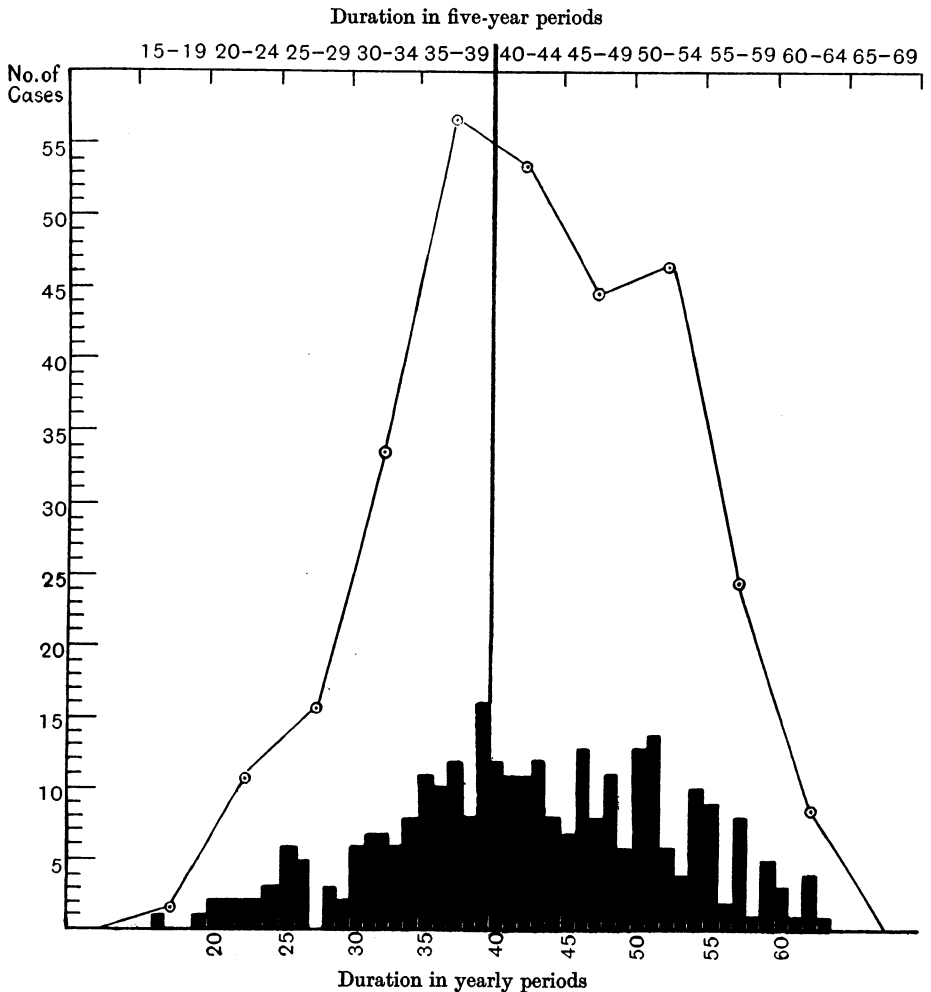
Graph I shows the number of years actually spent in active work in the mule spinning room before the disease was recognised. Of the 300, 286 had been in employment as spinners right up to the time when the cancer was diagnosed, whilst 14 had retired from the industry from 1 to 12 years before the disease manifested itself. This, I think, gives us for the first time an indication, in a reasonably large number of cases, of the actual duration of contact with a carcinogenic agent necessary in man to bring about a neoplastic reaction.

It will be seen that 16 years is the shortest period of contact in this series, and 63 years the longest. The maximum number of cases occurs after 39 years of contact.

If we take five-yearly periods, we find that the number of cases rapidly increases from 2 (or 0.6 per cent.) at 15–19 years of contact to a maximum of 56 (or 18.6 per cent.) at 35–39 years of contact, falling slightly to 54 (or 18 per cent.) at 40–44 years of contact, then to 45 (or 15 per cent.) at 45–49 years of contact, rising slightly to 47 (or 15.6 per cent.) at 50–54 years of contact, then falling rapidly to 25 (or 8.3 per cent.) at 55–59 years of contact, and then to 9 (or 3 per cent.) at 60–64 years of contact when they cease altogether.

It may be of interest to compare Graph I with Graph II showing the time that has elapsed between the commencement of the exposure in the mule room, and the onset of the disease in the same 300 persons. In the case of many the duration will naturally be the same as in Graph I, but where employment has been interrupted there will be a difference. Thus, if a man has been a mule spinner for 40 years and then has been retired for 10 years, he would be represented in Graph I by 40 years, and in Graph II by 50 years. Similarly for a man who had been a spinner for 30 years, a soldier for 4 years, out of work for 2 years, and a spinner again for 6 years, the duration would be represented

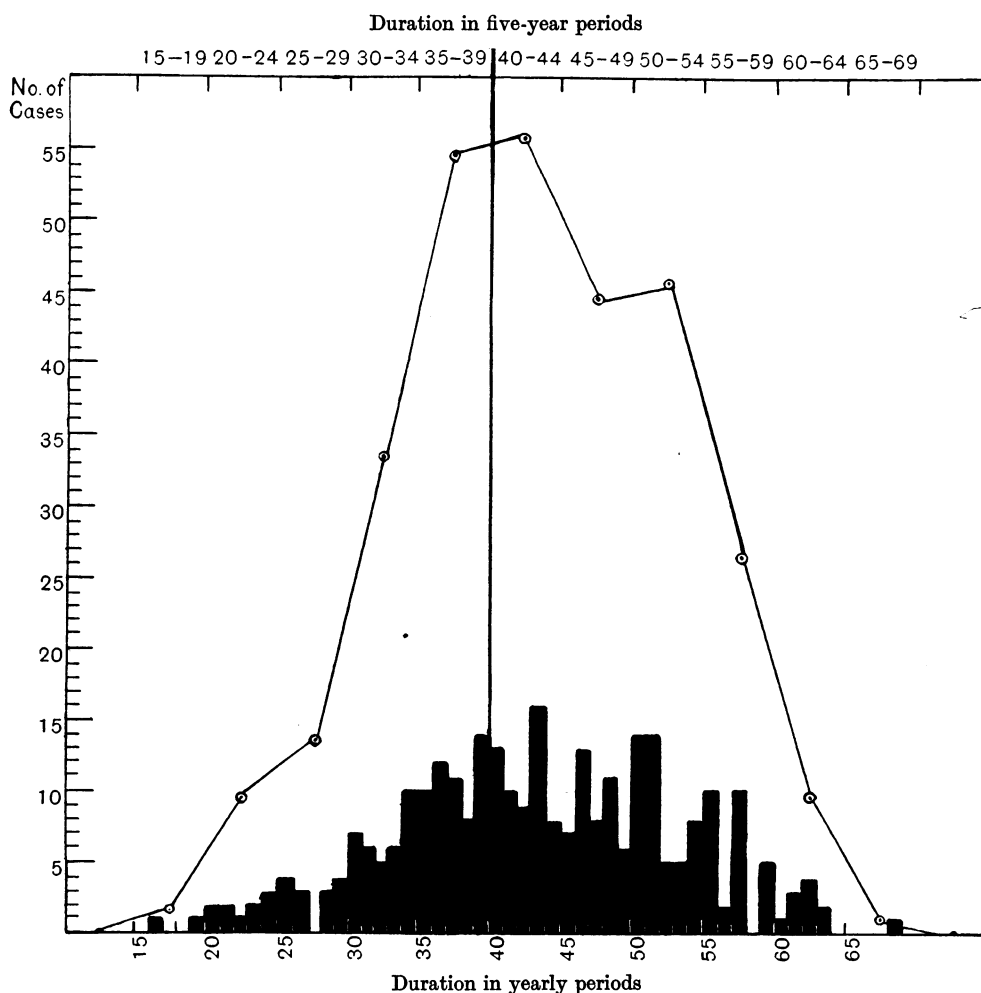
in Graph I by 36 years and in Graph II by 42 years. In fact, Graph II represents an index of when we should actually expect the disease to manifest itself in a certain number of spinners who started work at a certain date, and having spent some 40 years in employment left the industry. For instance,



Graph I. Showing duration in years of employment in cotton mule spinning up to date of recognition of the disease in 300 cotton mule spinners, including 14 who had retired before recognition, any time in the army or in other intermediate odd employment, or in retirement, being excluded.

2 of the 11 who had been employed for 42 years had retired before the disease had manifested itself, and consequently they appear in Graph II at a later period than in Graph I. The difference between the two graphs stands out in comparing the periods of maximum incidence; approximately the same number of cases occurs in the 35-39 years period in Graph I as in the 40-44 years period in Graph II. It is probable that the second graph gives us the

true indication of the relation between the carcinogenic agent and the resulting cancer, for Leitch has shown experimentally that if animals be subjected to a cancer-producing substance for a certain length of time and the treatment stopped before tumour formation has occurred, tumours will appear later just as if the agent had been in operation the whole time.



Graph II. Showing duration in years between commencement of employment in the mule room and recognition of the disease in 300 cotton mule spinners, including 14 who had retired for periods varying from 1 to 12 years.

CONCLUSIONS.

The largest number of cases occur after a period of contact of 35-39 years (18.6 per cent.), though as much as 63 years, or possibly even more, may sometimes be necessary. It is not essential that the exposure to the carcino-

genic agent should be continuous; and the disease may declare itself long after the patient has retired from the industry.

I should like to express my thanks to the various representatives of employers and employed, general medical practitioners, Certifying Factory Surgeons and my colleagues the District Inspectors in the Factory Department of the Home Office, without whose energetic assistance these details could not have been so accurately obtained, to Mr T. H. Lea for the arrangement and execution of the graphs, and to Dr Archibald Leitch, Director of the Cancer Hospital Research Institute, for his valuable and constructive criticism.

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