

CANCER OF THE SCROTUM IN THE BLACKBURN REGISTRATION DISTRICT, 1837-1929

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INTRODUCTION

THE following report describes the result of an effort to trace and investigate all the cases of cancer of the skin of the scrotum which have occurred in the inhabitants of the Blackburn Registration District during the period 1837-1929. Our enquiries have been directed in particular to the ascertainment of the various occupations followed by the patients affected, with a view to the consideration of carcinogenic agents operating in these occupations.

The year 1837 was that in which registration of deaths and their causation was put on an organized basis. Our search for cases was completed in 1930, but unavoidable delay occurred in tracing the occupational history of all the patients. This delay of over 5 years in publication has, however, enabled us to discuss the after-history for a minimum period of 5 years of those patients who were treated in hospital.

The Blackburn Registration District is largely industrial, although its outlying parts are agricultural. It includes Blackburn County Borough, Darwen Borough, Blackburn Rural District, and the urban districts of Great Harwood, Church, Rishton, Clayton-le-Moors and Oswaldtwistle. In it there were in 1921, according to the census, 75,100 occupied males over 12 years of age.

The most important source of employment is the cotton trade, of which, in this district, cotton weaving is the largest section for both males and females, although more females are so employed than males. Apart from cotton finishing, bleaching, and dyeing, other occupations in the area include engineering, paper manufacture, chemical manufacture, coal mining and agriculture.

The number of men occupied in 1921 in each of the more important industries of the district is shown in Table I. In relation to some of the occupations accurate details are not obtainable for the small subdistricts.

It is unfortunately impossible to show the population at risk in each occupation over the long period we have chosen, or to discuss the age distribution of the workers in the various groups over such a period, owing to the changes liable to occur from time to time in various industries. While the total

number of industrial workers has increased the number of agricultural workers has probably remained stationary.

Table I. *Blackburn Registration District. Census 1921. Occupied males over 12 years of age*

Agricultural workers	...	...	...	...	...	2,178
Coal and shale miners	...	...	...	...	...	2,534
Brick, pottery, earthenware makers	...	...	...	...	...	530
Workers in chemical processes	...	...	...	...	...	254
Metal workers (not electro-plate)	...	...	...	...	...	7,504
Including Foundry workers	...	...	...	(at least)	...	1,523
Fitters, millwrights	...	...	...	(at least)	...	820
Machine tool workers	...	...	...	(at least)	...	851
Electricians, electrical engineers	...	...	...	...	...	174
Workers in skins and leather (not boots, etc.)	...	...	...	...	...	127
Textile workers	...	...	...	...	...	22,479
Including Cotton weavers	...	...	...	...	...	10,917
Cotton-weaving foremen	...	...	...	(at least)	...	994
Cotton spinners (ring, mule, flyer, cap)	...	...	...	...	...	1,502
Cotton-spinning foremen	...	...	...	(at least)	...	53
Drawers in, twistors	...	...	...	(at least)	...	882
Card-room workers	...	...	...	(at least)	...	172
Sizers	...	...	...	(at least)	...	480
Dye mixers and dyers	...	...	...	...	...	189
Tailors	...	...	...	...	(at least)	342
Boot and shoe makers, repairers, etc.	...	...	...	...	(at least)	240
Workers in wood and furniture	...	...	...	...	...	2,551
Makers of paper (pulp, straw, etc.)	...	...	...	...	(at least)	1,474
Builders and bricklayers (stone and slate, etc.)	...	...	...	...	(at least)	2,070
Painters and decorators (house, ship, etc.)	...	...	...	...	(at least)	586
Gas stokers	...	...	...	...	(at least)	58
Railway workers	...	...	...	...	(at least)	994
Drivers, coachmen, etc. (horse)	...	...	...	...	(at least)	1,050
Salesmen, shop assistants	...	...	...	...	(at least)	1,528
Professional classes	...	...	...	...	...	1,226
Clerks, etc.	...	...	...	...	...	2,521
General labourers	...	...	...	...	(at least)	2,649
Labourers	...	...	...	...	(at least)	1,351
Stationary enginemen, etc.	...	...	...	...	...	1,011
Chimney sweeps	...	...	...	...	(at least)	13

For our purpose, the in-patient and out-patient registers of the Blackburn Royal Infirmary, which is the voluntary hospital of the district, have been searched, since its commencement in 1865, and all cases of suspected cancer of the scrotum extracted. In addition, some cases were traced from the records of the Blackburn Queen's Park (Poor Law) Hospital. Opportunity arose previously for one of us to search the in-patient registers of the Manchester Royal Infirmary from their inception in 1853, and so it has been possible to obtain the particulars of the small number of patients who were admitted to this infirmary from the Blackburn area.

Similarly, the death registers in Blackburn from their inception in 1837 were searched systematically and the details of those who died from the disease extracted; naturally it was found that many of those whose names were obtained from the hospital records were also amongst those taken from the death registers, but duplication of such was avoided by a carding system. We have accepted the diagnoses made in hospital and believe that they are

accurate. In some instances the findings of microscopic section and examination of the growth were available.

A questionnaire designed to elicit further information regarding other occupations followed by the patient was sent to each patient or a relative, and subsequent enquiries were made in all cases.

We originally collected the names of 157 patients, but this number was eventually reduced to 132, as twenty-five were excluded, eleven¹ because they resided and worked outside the chosen district although they were treated at the Blackburn Infirmary, and fourteen because either the lesion was primarily testicular in two,² or although on the scrotum, apparently never became malignant in two,³ or was tubercular in one,⁴ or was venereal in one,⁵ or because it was probably an extension of the disease from an adjacent site in four,⁶ or because the information available was insufficient for us to classify them as primarily cases of scrotal epithelioma in four,⁷ though in one or two of these we were tempted to do so. Thus 132 represents the minimum number

¹ One rougher-out at an Accrington foundry in 1898, one weaver, of Clitheroe, in 1918, one corporation labourer of Accrington in 1918, and eight cotton-mule spinners (in Accrington, one in 1926, and one in 1928; in Bolton, one in 1928; in Clitheroe, one in 1924, and one in 1925; in Haslingden, one in 1911; in Whittle-le-Woods, near Chorley, one in 1889 which was the earliest certain case of scrotal cancer in a spinner admitted to the Blackburn Royal Infirmary; and in Withnell, one in 1918).

² (1) Cotton-mule spinner, aged 34. Sarcoma testis. Died 12. xii. 96, as a labourer, of cancer of testicle and bowel. (2) A. W., aged 49. Creeler 3 years, cotton weaver 25 years, corporation gas-works labourer 9 years. Testicular tumour (? sarcoma) excised 24. iii. 06. Carcinoma of inner canthus of left eye 5½ years later, alive 20½ years later.

³ (1) J. W., aged 70, labourer. 24. iv. 28, cotton-mule spinner 23 years, cotton-mill labourer 37 years ? papilloma of scrotum; 16. x. 29 ? papilloma scrotum, hypertrophied prostate. Died 31. x. 29 as labourer at a cotton-waste works of myocardial degeneration, enlarged prostate (operation), senility. (2) C. K., aged 64, cotton-mule spinner. On 17. i. 27 he attended hospital as an out-patient for observation of ? epithelioma of scrotum. No operation was found necessary and he was alive and apparently well 5 years later. Subsequent investigation revealed the interesting fact that he died in hospital after operation for cancer of the sigmoid on 6. iii. 33.

⁴ J. C., of Church, aged 55, chemical labourer. "Tubercular nodules over scrotum", 4. ix. 22.

⁵ A. B., aged 43, bricklayer. "Penis and scrotum (syphilitic)."

⁶ (1) H. E., aged 34, labourer. 15. viii. 77, gangrene of scrotum and stricture of urethra. 4. xi. 97, epithelioma of scrotum, aged 54. 22. xi. 97, malignant disease of perinaeum. Died 12. vi. 98, aged 54, as a general labourer, of cancer of the scrotum. (2) J. F., aged 53, cabman. 29. viii. 99, epithelioma of penis. 26. iii. 1900, epithelioma of scrotum as a groom, aged 54. Died 22. xi. 1900, as a cab driver, of fungating epithelioma of the groin. (3) W. R., aged 65, collier. 30. x. 17, epithelioma of scrotum, urethral fistula, perineal abscess, fungating malignant prostate. Died 24. i. 18, as labourer at a coal yard, of malignant prostate. (4) W. K., aged 67, farm labourer and general labourer 44 years, retired 7 years. 27. xi. 22, epithelioma of scrotum as an out-door labourer. 18. xii. 22, epithelioma of penis as a labourer. Alive 9 years later, penis removed but scrotum and testicles intact. Died 7. ix. 34, as a retired labourer for a property builder, of myocardial degeneration and chronic bronchitis.

⁷ (1) J. G., aged 33, cotton-mule spinner. 5. v. 96, malignant recurrent disease of testis and groin glands. Died on 1. vii. 96 of "carcinoma". (2) R. G., aged 54, labourer. 6. vii. 81, epithelioma of testis and penis, removal of testis. 24. ii. 82, epithelioma of testis as an oiler. Died 12. ix. 82, as a cotton piecer, of cancer of penis 2 years. (3) J. P., aged 30, cotton-mule spinner. Phagedena of scrotum and penis. Died 31. i. 76, aged 57, as an operative cotton spinner. (Not sufficient evidence as to cause of death. (Coroner.)) (4) G. R., aged 52. Cotton weaver as a boy, coal carter 30-35 years, in army 3 years, coal-yard labourer 6 years. Died 23. viii. 21, as a labourer at a coal yard, of carcinoma of penis and scrotum.

of persons affected by epithelioma of the scrotum in the district during the period concerned. Probably a few cases may have been missed, such as some of those in men who were not treated in hospital and are still alive or have died from another disease, or have died from the disease in a locality outside the district. Statutory notification of epitheliomatous ulceration of the skin has only afforded us limited assistance in this respect, as first it only came into force in 1920, and secondly it only relates to those cases which are attributable to pitch, tar, paraffin, bitumen, mineral oil or products thereof, and then only when occurring in a factory or workshop.

OCCUPATIONAL HISTORY

The result of the investigation into the occupational history of the 132 patients is given in Table II.

Insufficient or no details were obtainable in eight cases, while in twenty-four (18.2 per cent.) the patients were found to have followed for considerable periods occupations other than those described in the records, although in a few cases the exact duration of each occupation was not elicited.

Cotton-Mule Spinners

The term "cotton spinning" has reference to spinning on a mule, a ring frame or, in the past, a throstle frame. While the operatives in the mule room are practically all males,¹ those in the ring room are females, with the exception of the overlookers, oilers, mechanics and jobbers.

The operative at the mule commences as a creeler or little piecer, working his way up to mule minder² after he has reached the age of 18 years, and occasionally to overlooker later, but all these workers are usually described as cotton-mule spinners. Some minders, who are no longer found suitable as such, have again to revert, near the end of working life, to the status of piecer, and it is in minders and such older piecers and not in the younger that the disease is liable to occur.

Since training as a cotton spinner usually commences immediately after leaving school, it is reasonable to assume that men described as cotton spinners have not previously followed, for any length of time, any other occupation than spinning and, in the main, our investigation confirmed this generalization. There are, however, in our series a few exceptions: for instance, two patients had been spinners for 37 and 46 years respectively with an interval of under a year of cotton-mill labouring, while three³ had previously been otherwise

¹ There are still a few female piecers at the mules in certain districts.

² Sometimes described as self-actor minder.

³ (1) C. P. (a retired spinner), aged 71. A hand-loom silk weaver in Coventry for 8 years, a cotton-mule spinner for 54 years, and retired for 3 years in 1917. He died of senile decay in 1929, aged 83, 11½ years after the removal of the growth. (2) W. S. (an ex-spinner), aged 62 in 1919. In a biscuit factory as a boy, a foundry worker for 13 years, a cotton-mule spinner for 30 years, and then a cotton-mill labourer (hoist man) for 4 years. He died of angina pectoris and acute nephritis 8 months after recognition of the growth. (3) J. E. B., aged 50. A railway labourer for 18 years (including 14 as a platelayer), a labourer on the tramways for 6 years, and a spinner for 6 years regularly and for 9 years irregularly.

Table II

Occupation as described in Hospital or Death Register	Occupation shown after investigation										Complete information not available																
	Cotton-mule spinner	Mule spinner (retired)	Ex-mule spinner	Ex-cotton stripper and grinder	Ex-cotton weaver	Mechanic (cotton mill)	Papermaker's machinist	Newspaper-printer's machinist (retired)	Gas-works stoker	Tar distiller (retired)	Ex-fat distiller	Chimney sweep	Coal miner (retired)	Ex-plate-layer (railway)	Road maker	Earthenware moulder	Builder and stonemason	Fruit-market porter	Night soilsman, ex- farmer	Outdoor labourer, ex-spinner	Cotton weaver	Fireman, ex-weaver	Chimney sweep	Blacksmith's striker, ex ?	Pavior, ex-coal heaver	Total	
(1) Cotton-mule spinner	84	3	1											1													
(2) Cotton-mule spinner (retired)		2	1																								
(3) Under spinning master in the mule room			1																								
(4) Willow tenter (cotton mill)			1																								
(5) Labourer (cotton mill)			1																								
(6) Bobbin carrier (cotton mill)			2																								
(7) Hoistman (cotton mill)			1																								
(8) Driller (iron foundry)			1																								
(9) Polisher (iron foundry)			1																								
(10) Labourer (iron foundry)			2																								
(11) Grocer (retired)			1																								
(12) Caretaker of a chapel			1																								
(13) Dealer in glass and china (formerly cotton spinner)			1																								
(14) Labourer (Corporation lamp dept.)			1																								
(15) Street sweeper (Corporation)			1																								
(16) Night watchman (Corporation) (previously stripper and grinder)			1																								
(17) Cotton weaver					1																						
(18) Labourer (water-paint works)					1																						
(19) Salesman (fruit and fish)					1																						
(20) Engineer (electrical)						1																					
(21) Paper worker							1																				
(22) Machinist (letterpress printer)								1																			
(23) Corporation gas-works stoker									1																		
(24) Labourer (Corporation sewage works) and ice- cream vendor										1																	
(25) Labourer (chemical works) (pitch and tar boiler)											1																
(26) Chimney sweep			1																								
(27) Labourer (railway)												1															
(28) Coal miner																											
(29) Labourer (Corporation tramways)															1												
(30) Earthenware moulder and chimney-pot maker																1											
(31) Stonemason																											
(32) Fruiterer's assistant																											
(33) Night soilsman (Corporation)																											
(34) Labourer (outdoor)																											
(35) Fireman and night watchman (factory)																											
(36) Blacksmith (iron foundry)																											
(37) Pavior's labourer (Corporation) (trammer and gauger)																											
Total	84	5	16	1	3	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	132

employed for periods varying from 8 to 24 years; one of these we have not classified as a "spinner" but as an "ex-plate-layer" in order to preserve uniformity of classification.

(a) *Mule spinners: active* (84), *retired* (5).

While in four cases of spinners the scrotal cancer was subsequent to a previous primary growth on the face (2) and on the forearm (2), and although some other occupations are shown later to provide cases of a primary cancer on one cutaneous site with a subsequent primary cancer on another cutaneous site, spinners alone provide examples of a primary and of a subsequent primary cancer both being on the scrotum. Hence as six of the spinners who had suffered from a primary scrotal epithelioma developed at a later date, after periods varying from $3\frac{3}{4}$ to 21 years (average 8.75 years), a similar growth on some other part of the scrotum, the eighty-nine spinners affected account for ninety-five cases of the disease.

Of the five retired spinners three had ceased work for 3-5 years before the growth on the scrotum (which was a primary one) was recognized, and two had ceased work from $2\frac{1}{2}$ to 4 years before the growth on the scrotum (which was a second primary growth subsequent to a primary growth on face or forearm existing during working life) was recognized.

One was an active spinner when the primary growth on the scrotum was recognized, although he had ceased work for $2\frac{1}{2}$ years when the second primary growth appeared on the scrotum 21 years later.

(b) *Ex-mule spinners* (16).

It is not unusual to find amongst workers in various trades not connected with the textile industry some men whose former occupation was in a cotton mill, and this might especially be so in recent years during the depression of the cotton trade. It was stated in 1929 that approximately only 200 out of the normal membership of over 900 of the Blackburn Operative Spinners' Association were then employed in spinning, the rest either being unemployed or in other occupations.

It is known that many men for various reasons change their occupations and may do so more than once, such changes providing in fact a well-known difficulty in occupational statistics and, although working in a cotton mill is a very settled occupation, an experienced spinner may be selected to take charge in the mule room or in another department, while it is not unusual for the more aged spinners or those unable to continue spinning to act as labourers in the mule room or other part of the mill. Those so described¹ in our series of the

¹ (1) W. A., aged 70. Cotton-mule spinner 50 years, under spinning master in the cotton-mule spinning room and retired, 12 years. (2) W. S., aged 62. Worked at a biscuit factory as a boy, then at a foundry for 13 years, cotton-mule spinner 34 years, cotton-mill hoistman 4 years. (3) J. R. T., aged 58. Cotton-mule spinner 40 years, foundry labourer 3 years, bobbin carrier 7 years (had epithelioma of the right ear almost concurrently). (4) R. B., aged 61. Cotton-mule spinner 40 years, cotton-mill labourer (proved to be an oiler and greaser and labourer in yarn cellar) 11 years. (5) B. B., aged 68. Cotton-mule spinner 33 years, unemployed 3 years, bobbin carrier 24 years.

Blackburn District and suffering from cancer of the scrotum, all proved to have been formerly mule spinners for periods varying from 33 to 50 years, the subsequent occupation lasting from 4 to 27 years.

Similarly was it for four¹ of the five workers in an iron foundry (the fifth being a blacksmith), although one of these had spent a much longer period in his subsequent occupation than in spinning. One of the Corporation street sweepers,² the Corporation labourer in a gas-lamp department,³ the grocer,⁴ the caretaker,⁵ and the cotton-willow tenter⁶ all proved to be ex-spinners.

Investigation of a case in a man, described in the death register as a "Glass and china dealer's labourer, formerly a cotton spinner", showed that he had been a cotton spinner for 52 years and then assisted his son, who was a glass and china dealer, as a casual porter for 10 years.

While no doubt a chimney sweep who has contracted the disease may reasonably be supposed to have so contracted it from such employment alone, one of the chimney sweeps was actually found to have been a cotton-mule spinner for 29 years, and then a chimney sweep for 12 years prior to the appearance of the cancer of the scrotum in 1911 at the age of 54 years.⁷ He developed a cancer on the left ear⁸ 13 years later while still a chimney sweep, and died 8½ years later from an accidental cause.

We have included this man among the ex-spinners to preserve uniformity of classification, just as we have excluded from the spinners the spinner who was an ex-platelayer, although, for practical purposes, any claim for compensation under the Workmen's Compensation Act would be correctly based on the effect of the last employment which, in each of these cases, was capable of giving rise to the disease.

The interesting question now arises as to whether two occupations in each case played a part in the causation of the disease or whether the disease would

¹ (1) W. S., aged 64. Cotton-mule spinner 53 years, iron-foundry labourer 1 year. (2) C. H., aged 68. Cotton-mule spinner 42 years, polisher at iron foundry 18 years. He died at the age of 74 of "senile decay". (3) W. Y., aged 68. Cotton-mule spinner 15 years, labourer in cotton mill 11 years, iron driller 35 years. Alive 4½ years later. (4) W. W., aged 54. Cotton-mule spinner 38 years, odd jobs 2 years, labourer (proved to be a foundry labourer) 2 years.

² J. C., aged 43. Cotton-mule spinner 25 years, Corporation street sweeper ? 5 years.

³ C. T. P., aged 39. Cotton-mule spinner 15 years, gas-lamp lighter 9 years, Corporation labourer in automatic gas-lamp department 3 years.

⁴ K. C., aged 64. Cotton-mule spinner 34 years, grocer 22 years.

⁵ P. C., aged 58. Cotton-mule spinner 36 years, caretaker at Wesleyan Chapel 12 years.

⁶ R. P., aged 56. Cotton-mule spinner 34-36 years, cotton-willow tenter 10-12 years. This is an exceptional instance of a willowing machine being placed in an ordinary cotton mill to deal with flat strips for recarding.

⁷ We have a record of an analogous case of a cancer of the hand in a man, aged 31, who had been in contact with mineral oil when employed as a cotton-mule spinner for 7 years and, after 5 years' interval in the army, in contact with tar as a gas-retort stoker for 7½ years. [See "Some landmarks in the progress of industrial medicine", S. A. Henry, *Camb. Univ. Med. Soc. Mag.*, 12, No. 2, 1935.]

⁸ Lawrence described a similar case of a chimney sweep suffering from cancer of the left ear who had had a scrotal cancer removed 2 years previously, and attributed the occurrence of the growth on the ear to the sweep's habit of carrying bags of soot on his left shoulder. *Lancet*, ii, 265, 5018.

still have occurred in the absence of the prior or the final occupation and, if so, whether at the time it did occur or later. The length of employment in each occupation does not afford, on this occasion, any help in answering this question, as the length of time spent in either of the two occupations upon which each man was engaged was apparently sufficient to be capable of giving rise to the disease.

With regard to ex-spinners, we are not suggesting that none of the occupations subsequent to spinning, other than that of chimney sweeping, contributed to the causation of the disease, but it is reasonable to suggest that if any of them are capable of doing so, cases of scrotal cancer should be shown to occur in ring spinners, cotton-willow tenters, cotton-mill labourers including bobbin carriers, hoistmen, iron-foundry workers, drillers, polishers, labourers, street sweepers, labourers in lamp departments, glass and china dealers, grocers, caretakers, etc., who have always during working life been so employed. Even if the previous employment of the men here discussed had actually never been concerned with the mule room it would still be necessary to prove that such previous occupation was not one which was capable of causing cancer of the scrotum before it could be suggested that the final occupation was the cause of the growth.

Conversely, if the final occupation provides contact with a known carcinogenic agent for a substantial period, it would be impossible with our present knowledge to assert that it had not contributed to the causation of the disease.

In order to throw some light upon this question, a survey of approximately 1100¹ certificates of death attributed to cancer of the scrotum in England and Wales from 1911 to 1930 inclusive was made by us, and cases (other than those in our series) in which the occupations under consideration were given on the death certificate were investigated and are here discussed.

Overlookers. In addition to the Blackburn man, aged 70, who had been a cotton mule spinner for 50 years and an under spinning master in the mule room for 12 years (whom we have classified as an ex-spinner), one "cotton-spinning master", one "cotton-mill overlooker", and one "mill overlooker", all inhabitants of other towns than Blackburn, died of the disease between 1911 and 1930. The cotton-mill overlooker proved to have been a spindle fettle on a braiding machine and then an overlooker responsible for maintenance of braiding machines, at a braid (small-ware) factory, while the cotton-spinning master² and the mill overlooker³ were found to have been in the cotton-ring spinning room all their

¹ The total number is 1105. In 646 of these, the term epithelioma is used; in 273, carcinoma; in 173, cancer; in nine, sarcoma; in two, rodent ulcer; in one, malignant papilloma; and in one, teratoma. Random sampling suggests that the cases of sarcoma were primarily testicular in origin, or cases of epithelioma. Of the twenty included cases of cancer of scrotum and penis, the few which may have been primarily penile are probably more than balanced by those of the seventy-eight cases of cancer of penis and scrotum allocated to the penile list, which proved to be primarily scrotal.

² W. S., aged 59. Doffer in ring room and then under overlooker 29 years, overlooker 20 years.

³ G. B., aged 49, whose working life of 42 years consisted of throstle spinning as a youth, and when this form of spinning was replaced by ring spinning he worked his way up to overlooker in the ring room. After a short period out of work he was obliged to return to the ring room in the lower capacity of ring jobber for a short time before the disease manifested itself.

working lives of 42 and 49 years respectively. This suggests that cotton-ring spinning in which there is some contact with mineral oil is capable of causing the disease. Only one other man in connection with the ring room was found to have died of the disease during the period. He was described as a cotton-ring jobber, aged 50, but it is interesting to note that he proved to have worked in his early days as a scavenger and then as a big piecer in the mule room before he changed over to ring spinning, the last 9 years of his working life as a ring jobber consisting mainly of carrying cops and bobbins, oiling the spindles for 5 hours a week and helping to run the frames.

Willow tenters. Only one other case of death from the disease in a willeyer was found between 1911 and 1930. The man, who was described as a willeyer in a cloth mill, proved on investigation to have been employed at a leather tannery for 11 years, and then in the willeying department of a woollen mill for 35 years, handling wool treated with "black oil" which is recovered oil from the bleaching department and consists mainly of vegetable oil, though in some factories mineral oil is to be found in it during the recovery process.

Cotton-mill labourers. Cotton-mill labourers, all from Lancashire and Cheshire towns,¹ provide eleven deaths from the disease from 1911 to 1930. In only one of these was the occupation further defined on the death certificate as bobbin carrying, that of the other ten being described as "labouring" in a cotton mill, which, however, in one case was further defined as a cotton-spinning mill and in another as a cotton-waste mill. Investigation showed that such labouring consisted of bobbin carrying for 1-8 years (2), labouring in the mule room for 10 years (1), labouring in ring room and cotton-waste card room for 24 years (1), taking skips from repair shop to warehouse for 40 years (1), labouring for a cotton-mill engineer or mechanic for 3-14 years (2), helping to build a cotton mill as bricklayer's labourer (1), general labouring in the mill for 6 years (1), and undefined labouring in a cotton mill 3 months to 3 years (2). Of the eleven, seven had previously been cotton-mule spinners for a long period varying from 22 to 49 years, including one² who had also spent some 7 years as a stripper and grinder, while three³ had been cotton-mule spinners and one⁴ a throstle spinner for short periods varying from 4 to 8 years with a subsequent long period in some form of labour varying from 24 to 45 years, which in some cases, owing to the nature of the work, may well have contributed to the disease. Alternatively the period of delay or "lag" period now well recognized between ceasing the alleged causal occupation of spinning and recognition of the disease must have been very prolonged. In this connection the case of the man who was a throstle spinner for only 4-6 years and subsequently carried skips, which is an occupation in which one would imagine little or no mineral oil played a part, provides an interesting problem.

Mill hoist men. With regard to hoist men, only two additional cases of death from the disease were found between 1911 and 1930, one, aged 66, being described as a hoist man in a wire works, who proved to have been a seaman for 10 years, an oiler and greaser in a cotton mill for 34 years, off work for 6 years, and hoist man at a wire works in Salford for

¹ Bolton, Oldham and Stalybridge two each; Burnley, Hyde, Middleton, Salford and Stockport one each.

² R. C., aged 59. On a rope walk 2 years, cotton piecer and spinner 30 years, cotton stripper and grinder 7 years, cotton-mule spinner 4 years, unemployed 4 years, engineer's labourer at a cotton mill 3 years.

³ (1) E. B., aged 42. Cotton piecer as a boy ? 6-8 years, ring-room labourer and labourer in a cotton-waste card room 24-26 years. (2) B. H., aged 61. Cotton-mule spinner 4 years, railway stoker 14 years, engine tender 5 years, cotton-mill engineer 14 years, and steam and hot-water pipe fitter 12 years. (3) P. M., aged 64. Cotton-mule spinner 8 years, cooper 34 years, labourer in the mule room 10 years.

⁴ M. B., aged 56. Throstle spinner 4-6 years, cotton-mill labourer (taking skips from repair shop to warehouse) 40 years.

2 years (probable "lag" period of 8 years), and the other, aged 62, a hoist attendant at a locomotive works at Oldham (cancer of scrotum and penis) who has not been traced.

Foundry workers. (a) *Drillers.* Between 1911 and 1930 there were five men described as drillers certified as having died of the disease. Two, aged 59 and 63 respectively, had been in the iron trade during the whole of working life (but in one of these the diagnosis on the death certificate was not confirmed),¹ another was an ex-painter and decorator,² another an ex-spinner,³ while the occupation of the fifth, aged 67 (which was described as formerly that of an iron driller (hydraulic engineer)) at Halifax, was not further investigated.

(b) *Polishers.* Of the two polishers (both in Lancashire) who died of the disease between 1911 and 1930, one was an ex-spinner⁴ while the other, aged 66, had been a ring polisher at a textile machine works at Haslingden for 40 years, but his previous other occupation (if any) for over 12 years was not elicited.

(c) *Labourers.* Of the five men (four in Lancashire and one in Yorkshire) described as iron-foundry labourers who died of the disease between 1911 and 1930, two, aged 57 and 59 respectively, proved to have been foundry workers during the whole of working life, the former as a furnaceman and the latter as an iron turner, another was an ex-coal miner,⁵ another was an ex-mule spinner,⁶ while the occupation of the fifth, aged 39, was not fully investigated, though we were assured that he had never been a cotton spinner.

Grocers. Between 1911 and 1930 there were four other men described as grocers who died of the disease. One was an ex-tar distiller,⁷ but another, aged 58, of Prestwich, had been a grocer from 13 years of age. The third, aged 72, of Sunderland, could not be traced, while the occupation of the fourth, aged 65, of Skipton, described as a grocer's manager, was not investigated.

Caretakers. Between 1911 and 1930 only two other men described as caretakers (one of a Methodist Church, and the other of a Council School, who had been so employed for 2 and 6½ years respectively) died of the disease. Both were found to have been cotton-mule spinners previously for 53 and 21 years respectively, with an interval of 5 and 23 years respectively between mule spinning and caretaking.⁸ Hence there is no evidence to show that the occupation of caretaking is likely to contribute to the causation of scrotal cancer.

No other glass and china dealer or labourer in a lamp department was found to have died from the disease between 1911 and 1930. There was, however, one other Corporation road sweeper of Oldham⁹ who proved on investigation to be an ex-cotton-mule spinner.

¹ G. H., aged 63. Diagnosis on death certificate, "Carcinoma (scrotum and penis)". Previous diagnosis at hospital, "carcinoma of urethra for which penis and scrotum were removed".

² W. R. F., aged 50. House painter and decorator 23 years, metal driller in machine too department 14 years.

³ H. W., aged 32. Cotton-mule spinner 14½ years, in army 4 years (infantryman 1 year, Lewis gunner 3 years), iron driller at a textile machine works a few months.

⁴ T. R., aged 44. Cotton piecer 10 years, tapper driller at textile machinery works 24 years.

⁵ R. H., aged 63. Coal getter at a coal mine 30 years, iron-foundry labourer 22 years. Multiple carcinomata, one at root of penis, one on scrotum at junction with left thigh, and one on hand.

⁶ G. M., aged 70. Cotton operative mule spinner 22-24 years, sawyer on log frame in wood-working department of a textile machinery works 40 years.

⁷ H. W., aged 82. Tar distiller 28 years, road navvy 4 years, grocer 30 years.

⁸ (1) E. S., aged 68. Cotton-mule spinner 53 years, road sweeper 5 years, and caretaker at a Methodist Church 2 years. (2) R. W., aged 61. Cotton-mule spinner 21 years, greengrocer (with intervals of light cartage) 18 years, munitions labourer at an engineering works 5 years, and caretaker of Council Schools 6½ years.

⁹ A. W., aged 50. Cotton-mule spinner 39 years, Corporation scavenger 9 months.

Ex-card-room operative (1)

In our series there was only one case of the disease in cotton card-room operatives in a man described in the death register as "formerly a cotton stripper and grinder", aged 70. Investigation showed that he had followed this occupation for 42 years, and then became a stone cutter for 4 years, a wool willeyer for 3 years, and a Corporation night watchman for 9 years.

Between 1911 and 1930 there were eight other fatal cases of epithelioma of the scrotum in cotton card-room workers, described as card-room operative (1), carder (1), card-room jobber (1), and stripper and grinder (5).

Investigation showed that five of these had worked in the card room (one as a carder and four as strippers and grinders or card-room jobbers¹) during the whole of working life from 36 to 54 years, two² were ex-mule piecers for 4–10 years with longer subsequent employment as strippers and grinders, while one³ was an ex-joiner and ex-groom with subsequent much shorter employment in the card room.

There were, in addition, five fatal cases in workers employed in processes preparatory to carding, viz. labourer in cotton chamber (1), cotton mixer (1) (excluding one, aged 26, who was described as suffering from sarcoma of scrotum), cotton scutcher (1), and cotton blowing-room operative (2). These were investigated to see if the deceased had had any previous connection with other processes, and it was found that one had been in the blowing room all his working life of 41 years, another had only worked in the blowing room and card room, while three⁴ had previously been at the mules for 18–35 years, though the subsequent employment of one of these for mixing was longer than that for the previous one of spinning.

Night watchman. Between 1911 and 1930 there was only one fatal case of the disease in a night watchman who proved to be an ex-stoker in the coal-gas house of a chemical works which no longer manufactured gas.⁵

Cotton weaver (untraced) (1) and ex-cotton weavers (3)

The occupation of one, aged 51, of the two in our Blackburn series described as weavers, proved on investigation to have been cotton weaving 34 years, army service 2 years, lamp lighting 1 year and that of a mill caretaker 1 year; the occupation of the other, aged 78, could not be traced, but his age suggests that he also was no longer occupied in industry when the disease manifested

¹ One of these after 51 years' employment as a card-room jobber had retired for 6 years before the disease manifested itself.

² (1) W. S., aged 53. Cotton piecer 10 years, card-room cop carrier and then stripper and grinder 26 years, labourer at textile machinists wheeling loam for pattern makers 8 years. (2) H. B., aged 51. Cotton-mule piecer 4 years, in cotton chamber 2 years, stripper and grinder in card room 32 years.

³ J. H. H., aged 66. Joiner's labourer 28 years, groom 16 years, lap carrier and waste bagger in card room 5 years.

⁴ (1) G. H. B., aged 68. Cotton-mule spinner 18 years, unemployed 4 years, cotton mixer 24 years, cotton-mill labourer and waste bagger 2½ years. (2) J. W. S., aged 52. Cotton-mule spinner 34 years, blowing-room hand 7 years. (3) A. G., aged 48. Cotton spinner 35 years, cotton chamber man 8 months.

⁵ J. W. F., aged 75. At a tar chemical works over 40 years (including 15 years in the coal-gas house), night watchman at same factory, 12 years.

itself. A labourer at a water-paint works¹ and a fish and fruit salesman² were found to have been cotton weavers for the greater part of their working lives, but it is interesting to note that 57 years before, the latter had been in the mule room for 2 years. Reference is made later to a firebeater, also described as a weaver, who had been in his younger days a cotton weaver but, in the absence of information regarding the duration of each employment, we have not been able to classify his case definitely.

Four³ other operatives in the cotton-weaving shed in Burnley (2) and Preston (2) died from the disease between 1911 and 1930, one, aged 51, being described as formerly a cotton weaver, whose history could not be traced, another, aged 82, as a cotton weaver who proved to have been so employed for 50 years and retired 20 years (including 16 years in a home kept by sisters of a religious order), and two as loom sweepers, one⁴ of whom proved to be an ex-weaver and the other⁵ an ex-cotton spinner.

Painters. Although the disease was found to have caused death in eleven painters⁶ between 1911 and 1930, no record of this cause of death was found in a worker at a water-paint works or any other paint works.

Fish and fruit salesmen. Four other men who died of the disease between 1911 and 1930 were connected with the distribution and sale of fish, being described as "labourer on fish market" (1), "fish hawker" (1), "proprietor of a fish restaurant" (naval pensioner) (1), and "fish dock labourer" (1), the first two proving to be ex-sea fishermen,⁷ the third an examiner,⁸ while the history of the fourth (who was a Norwegian at Hull) could not be traced.

Two were described as "fruit salesmen", of whom one, aged 71, proved to have been at a tannery for 5-7 years, then a fruit salesman at Rotherhithe for 20 years, on odd jobs at a public-house for 22 years, and retired for 12 years; the other, of Leighton Buzzard, aged 74, was found to have started work at the age of 9 as an apprentice cooper for 2 or 3 years, after which he assisted his uncle as fruit salesman at Spitalfields market for 60 years, but we have not succeeded in confirming, or otherwise, the original diagnosis.

Cotton-mill mechanic and engineer (1)

One man, aged 40, described as an electrical engineer, proved to have been at a paper mill for a year and a half in boyhood, a shuttlemaker for 12 years,

¹ C. F., aged 47. Cotton weaver 30-32 years, labourer at water-paint works 4 years to recognition of cancer of the shoulder and 6 years to recognition of cancer of the scrotum.

² W. C., aged 70. Cotton-mule piecer 2 years, cotton weaver 42 years, fish and fruit salesman 15 years.

³ There was also one case of an Oldham man, aged 42, who had been a weaver of camel-hair belts for 20 years and previously a bobbin carrier for 5 years.

⁴ C. C., aged 65. Cotton weaver 34 years, loom sweeper and oiler 20 years.

⁵ J. O., aged 69. Cotton-mule spinner 47 years, loom sweeper and retired 10 years.

⁶ Described in the death register as artist painter (1), journeyman painter (2), house painter (6), painter and decorator (1) and retired house decorator (1). Cursory sampling of five of these showed that two were in the painting and decorating trade (in one case for the whole of his working life of 38-40 years and in the other for a time unknown), in two the cancer proved to be primarily penile, while one could not be traced.

⁷ (1) A. F., aged 70. Fish trawler 47 years, fish packer on wharf including mending and tarring of nets, 9 years. (2) W. K., aged 60. Sea fisherman 30 years, labourer on shore 10 years, fish hawker 8-10 years.

⁸ A. C., aged 43. In Royal Marines to age of 40, proprietor of a fish restaurant 3 years.

and an electrician and mechanic at cotton-spinning mills for 17 years. He is still alive 24 years later.

Between 1911 and 1930 there was one man, aged 58, described as a "mill mechanic" who died of the disease, and he proved to have been a cotton-mill mechanic for 45 years to the onset of the disease. Another described as an "oiler and bander" in a cotton mill and another as a "cotton-mule stringer" were so employed for 6 and 8 years respectively, but previously both had been cotton-mule spinners for 16½ and 48 years respectively. One, aged 54, described as an oiler in a doubling mill in Stockport and another described as a mechanic at a rubber works in Newport were not investigated. Reference is made later to a sewage-works engineer who proved to be an ex-fireman and cotton-mill engineer for 22 years.

As regards electricians who died from the disease during the same period, a man described as an "electrician", aged 55, proved to have been a wheelwright's apprentice for 6 years, a painter and waiter at a pleasure ground for 19 years, and a meter fixer for a Corporation electric department for 17 years; an "electrical engine driver" proved to have been a stationary engine tender at a colliery, chemical works, and iron foundry for 30 or 40 years; a railway telephone wireman,¹ a labourer at an electric works² and an electrical engineer's storekeeper³ all proved to be ex-spinners; while a labourer at an electricity generating station for 5 years, aged 48, had previously been in the army abroad for 22 years.

Papermaker's machinist (1)

A paper worker, aged 62, proved to have been at a paper works all his working life of 44 years, beginning at 18 years of age and eventually becoming a paper-machine attendant. He died of "cirrhosis of the liver" 6 months after recognition of the scrotal growth.

Only two other deaths from the disease in paper workers were found between 1911 and 1930. One of these, who was described as a "paper-works labourer", was found to have been a wire drawer for 19 years, a baker for 1 year, and for the last 32 years of his working life mainly a fireman and night watchman at cotton mills and dye works, though near the end of this period he became a bobbin carrier for a short period and finally a paper-works labourer for 6 months. The other aged 65, was an engine driver at a paper-pulp works for the last 10 years of his working life, and previously a labourer at the same works for 3 years, but his previous working life, which must have embraced 40 years, was not ascertainable.

Retired newspaper-printer's machinist (1)

One case of the disease was found in a man who proved to have been a newspaper-printer's machinist for 46 years and who had retired for 10 years before he died of the disease at the age of 69. He would come into contact with lamp black and mineral oil.

Between 1911 and 1930 a "printer's assistant", aged 68, a "lithographic printer", aged 72, and a "retired railway printer", aged 72, died of the disease. All had been minders

¹ E. H., aged 55. Cotton-mule spinner 13 years, railway telephone wireman 23 years, retired 5 years.

² J. S., aged 56. Cotton-mule spinner 41 years, labourer in steel department of an electric works 2 years.

³ J. K., aged 65. Cotton-mule spinner 47 years, packer at a bleach works 4 years, storekeeper at an electric works 4 years.

of printing machines, the first¹ for 55 years until the onset of the disease, and the other two² for 30–43 years until they retired 4 years prior to death.

Ex-coal-gas workers (2)

One man, aged 62, suffering from the disease, who was described in the hospital records as a “fireman”, and in the death register as a “stoker at a Corporation gas works”, was found to have been employed as a gas-works stoker for 34 years, having previously been in the army for 8 years, and a fire-beater at a laundry for 3 years.

Another, aged 57, although described in the hospital register as an “ice-cream vendor” and on the death certificate as a “labourer at a sewage works”, had, according to his wife’s statement, formerly been employed in a gas works for at least 34 years.

In addition to a gas inspector who proved to be an ex-worker³ in a jute mill, and a gas fitter who proved to be a builder’s whitesmith (pipe fitter, tinsmith and sheet-metal worker) for 40 years, thirty-seven “gas workers” died of the disease between 1911 and 1930 in England and Wales excluding Blackburn. Three of these worked for 10–28 years in factories in which the gas manufactured was for private consumption by the firm concerned, being either producer gas⁴ (in two cases) or shale-oil gas⁵ (in one case), though all had a previous occupation, one having been a cotton-mule spinner for 10 years, another a butcher for 16 years, and another a glass carrier for 20 years. The other thirty-four worked at gas works where coal gas was manufactured for public consumption, being described as manager (1), foreman (1), stoker (13), labourer (14), Corporation gas worker (1), tar worker (1), ammonia mixer (1), boiler attendant (1), and engine driver (1). The thirteen gas stokers,⁶ three of the labourers, the Corporation gas worker, the ammonia mixer, the boiler attendant, and the engine driver all proved to be stokers (two had retired for 9 and 20 years respectively), or ex-stokers, at gas works for 20–47 years, while the manager had previously been both a gas-works stoker and a cotton-mule spinner.⁷ Of the remaining eleven “labourers”, one was an ex-tar distiller at a chemical works (though for a short period),⁸ two were pipe cleaners, syphon

¹ R. B. B., aged 68. Butcher’s boy at first, machine-boy printer 1½ years, machine printer 5 years, compositor 10 years, assistant rotary and general printing machine minder 40 years, his duties including lubricating the machines, assisting in setting up the stereotype printing plates, cleaning of machines and printers’ ink rollers. General contact with ink and oil.

² (1) G. A. W., aged 72. At first a wine and spirit merchant’s assistant (duration unknown), lithographic printer 43 years, retired 4 years. (2) C. H., aged 72. Railway booking clerk more than 20 years, in ticket printing department of a railway works (eventually as manager) more than 30 years, retired 4 years.

³ J. C., aged 50. In a jute mill 6 years, in army 4 years, in a jute mill 17 years, in army 6 years inspector in Corporation Gas Department 2–4 years.

⁴ (1) H. W., aged 56. Butcher 16 years, gas maker at a steel works (first on old gas-producer plant and then retort stoker on Mond gas plant) 26 years. (2) J. R., aged 44. Glass carrier 20 years, gas maker at a glass works 10 years.

⁵ J. R. B., aged 52. Cotton-mule spinner 10 years, railway-carriage cleaner, and shale-oil gas maker at railway works 28 years.

⁶ One of these had been so employed for 40 years but only in the winter, being a bath stone dresser in the summer months.

⁷ A. G., aged 48. Cotton-mule spinner 9–10 years, gas-works stoker 6 years, a working manager (handling all parts of the work including mechanical repairs) 18 years.

⁸ W. H. W., aged 53. Machinist in engineer’s wood-working department 5 years, van driver for mineral water manufacturer 1 year, tar distiller 7 years, gas-works yard labourer for 25 years (on carburetted water gas plant 6 years, on purifying plant 6 years, and boiler fireman 13 years).

attendants, etc., in contact with coal tar for 16–22 years, one was a pipe cleaner and ex-cotton spinner,¹ one was a tar distiller at a gas works for 36–40 years, and one loaded the gas-works tar for 19 years for transmission to tar distillers elsewhere, as did also the “tar worker”. The occupation of five of the labourers and of the foreman was not traced sufficiently to classify exactly, though the latter had been employed at a gas works for 37 years, the major and latter part of which was said to have been spent in the coke department.

Sewage worker. The only person connected with a sewage works who died of the disease between 1911 and 1930 was a man aged 42, described as “an engineer at a sewage works”, who proved to have been in a dyehouse for 8 years and then a fireman and cotton-mill engineer for 22 years, subsequently working for 1 year at a sewage works as under engineer but only after operative treatment for the disease. Although in this case the disease was described as sarcoma of scrotum on the death certificate, investigation suggested that the tumour was almost certainly an epithelioma of scrotum and not a sarcoma of testis.

Tar distiller retired (1) and ex-tar distiller (1)

The pitch and tar boiler at a chemical works, aged 51 years, proved to have been so employed for 38 years, while a Corporation road sweeper, aged 64, had been a farm labourer from 10 years of age for 19 years, in a tar distillery for 30 years, unemployed for 3 years, and a Corporation street sweeper for 2 years.

Between 1911 and 1930 there were, in addition, twenty-one deaths from the disease in men associated with chemical works, being described as chemical manufacturer retired (1), chemical worker (1), chemical-works foremen (2) or labourer (7), tar distiller (4), labourer at tar works (4) (including one retired), tar maker (1), and process worker (1).

Coke-oven tar was apparently a prime factor in causation in one foreman (so for 1 year only) who was an exhaustor-man at a by-product coke-oven plant² for 22 years (though previously in a grain warehouse for many years).

Coal tar or pitch was a causal factor in fifteen, one described as a foreman having been a sheep-dip maker for 10 years dealing with tar oils, soda ash, sulphur and tobacco wash, ten (including one who had retired for 10 years) having been at tar distilleries for 19–50 years (on tar stills or pumps (6), pitch breakers, fillers or loaders (2),³ and on anthracene plant (2)), in addition to one who proved to be an ex-collier,⁴ one was at a gas works and subsequently at a tar distillery,⁵ one was a pitch getter at a gas works where tar was distilled, while one although at an alkali works, was a tar painter there for over 30 years.

¹ R. D. C., aged 54. Cotton-mule spinner 13 years, labourer in an engineering works 3 years and in a railway yard 6 months, pipe fitter and syphon attendant at gas works 22 years.

² During the same period there were six other coke-oven workers (described as foreman (1), tar main labourer (1), by-product worker (1), hydraulic main man (1), gas regulator (1) and coke burner (1)) who died of the disease. Investigation showed that all had worked on a coke-oven plant for periods ranging from 12 to 45 years, three at least having been on the hydraulic mains for 9–13 years (including one who had previously worked on Beehive ovens for 23 years). Two had previous occupations, one as a coal miner for 14 years and the other as a blacksmith and tramcar repairer for 16 years. There was also one described as a blast furnaceman who proved on enquiry to have worked for a firm of iron founders using blast furnaces but no coke ovens, his occupation being that of a dipper of cast-iron pipes into a tar solution.

³ One of these had also a secondary primary growth on the lip, the extension of which was the main cause of death.

⁴ J. W., aged 73. Pit pony driver 6 years, coal getter 47 years, tar labourer and pitch getter at a tar distillery 8 years, watchman 6 weeks.

⁵ J. M., aged 64. At a bacon shop in youth, at gas works 13 years, at a tar distillery (pumping creosote and anthracene oil) for 18 years.

The possibility of wood tar as a factor in causation has to be considered in two of the cases—the tar maker and the retired chemical manufacturer. The former, aged 37 at death, was at a sack works for 23 years on a machine for tarring sacking with Stockholm tar (or American pine tar when the Stockholm tar was not available), though the occasional use of coal-tar oil cannot be excluded; while the latter, aged 90, was at an electro-plating works for over 30 years, and then the founder and proprietor of a factory for 30–40 years where wood was distilled, the products including wood tar, naphtha and charcoal. We have found no evidence of contact with coal tar in this case (but the firm has ceased to exist), and if wood tar alone was a prime factor in causation the facts suggest that its action is slow, as the patient did not cease work till the age of 80, did not notice any manifestation of the disease until 7 years later when it was not regarded as serious until 6 weeks before death, hence there was no operation, and at the last he had a seizure and died in his sleep. It must be noted, however, that he was not a routine manual worker in his own factory, though it is stated that his clothes had a chemical odour.

In three, tar or tarry products appeared to have played little or no part, two,¹ who had only worked for 3 and 6 years in a synthetic dye works, proving to be an ex-cotton-mule spinner and an ex-fireman in a glasshouse respectively, the third being a maker of grease (containing mineral oil, lime and resin) at a tar and oil works for over 30 years.

Street sweeper. We have already stated previously that the only other road or street sweeper who died of the disease between 1911 and 1930 proved to be an ex-spinner.

Chimney sweeps (4)

In addition to the chimney sweep who had previously been a mule spinner and whom we have included tentatively for uniformity of classification in the list of ex-spinners, three others were so described. We failed to trace the occupation of two of these further, but that of the third was verified. He began as a “climbing boy” at 6 or 7 years of age, became at approximately 19 years of age a foreman of twenty-five other climbing boys taken from workhouses and died as a master sweep in 1879 at the age of 50. Another patient, described as a “railway worker” in the hospital notes, was stated by members of his family to have been a chimney sweep all his life, and was so described in the death register when he died 4 years later from bronchitis at the age of 67.

Between 1911 and 1930 there were eighty-two deaths from the disease in chimney sweeps varying in age from 35 to 84 (average 61.6) years and described as “master chimney sweep” (10) (including two as formerly so), “chimney sweep” (70) (including four as formerly so and two as retired), and “chimney cleaner” (2). No investigation was made of any of these cases, but one was stated to have an epithelioma of the hand in addition to the scrotal epithelioma. In many of the certificates the disease was described as “chimney-sweep’s cancer”.

Railway worker. In addition to three railway platelayers referred to later, one man, aged 69, described as formerly a railway-works labourer, died from the disease between 1911 and 1930, but unfortunately we were unable to obtain any further information regarding the correct diagnosis or occupation.

¹ (1) E. C., aged 45. Cotton-mule spinner 28 years, in azo department of synthetic dye works 3 years. (2) P. H., aged 55. Breaker in of horses in Ireland 3 years, fireman in a glasshouse 73 years, and labourer in synthetic dye works 6 years.

Coal miner (retired) (1)

One¹ case of the disease occurred in a coal miner, aged 58, employed as such for 50 years. He had retired for 1 year.

There were forty-three² fatal cases of scrotal epithelioma between 1911 and 1930 in colliery workers (in the counties of Durham (10), Lancashire (8),³ Yorkshire (7), Monmouthshire (5), Staffordshire (4), Northumberland (3), Denbighshire (2), Glamorganshire (2), Derbyshire (1), and Nottinghamshire (1)) varying in age from 36 to 84 (average 59.3) years, and described as hewer (8) and formerly so (3), coalminer (3), surfaceman (2), roadman (3), deputy (2), labourer (2), engine driver or winder (2), joiner (2) (not investigated), stoker or fireman (2), and platelayer (1) (to which three, reference is made later when discussing stokers and platelayers), power-house attendant (1), fitter (1), ropeman (1), haulage-man (1), rolleywayman (1), shifter (1), dayman (1), banksman (1), onsetter (1), stoneman (1), horsekeeper (1), clerk (1), and manager (1).

Sample investigation of twenty-four of these led to the exclusion of two—the colliery manager (who proved to have been previously a mining engineer and farmer in Staffordshire) and the horsekeeper (who proved to have been a colliery banksman in Yorkshire for 25–30 years, a grocer's carter for 5½ years and a colliery horsekeeper for 1 year)—because the disease was primarily penile. Five had been previously employed elsewhere than in a colliery (one at a Yorkshire brickyard,⁴ and four at a Lancashire cotton mill,⁵ though one of these was apparently so employed for only 2 years), while the remaining seventeen had always been employed in a colliery as hewer (for 40–50 years) (6), ex-hewer (19–50 years) (5),⁶ loader (for 40–55 years) (2), rolleywayman (29 years) (1), roadman (44 years) (1), engine winder (60 years, retired 12 years) (1), and labourer (sharpening picks and attending to hoist ropes for 29 years) (1). In some cases there was evidence of contact with oil (“axle” oil, “tub” oil, “rope” oil, “engine” oil, etc.), as, for instance, in the case of the latter labourer, it being stated that his clothes were “saturated” with oil, with tarry products in the case of the platelayer (laying rails for wagons and unloading creosoted sleepers), and with wood dust no doubt in the case of the joiners, but in other cases apparently there would only be contact with coal dust.

¹ We have omitted a case of a man described in the hospital records as a collier who, according to the hospital notes, had “epithelioma of the scrotum—urethral fistula—perineal abscess—fungating malignant prostate”. On his death certificate his occupation was described as that of a labourer at a coal yard, and it was stated that he died of malignant prostate, thus suggesting that the scrotal condition was not necessarily primary.

² A coal hewer of Glamorganshire, aged 26, who died of “sarcoma of scrotum” is excluded.

³ This figure includes four who had previously worked in a cotton-spinning mill.

⁴ W. H. W., aged 56. In a brickyard 29 years, colliery engine stoker 17 years.

⁵ (1) R. L., aged 50. Cotton spinner 33 years, Council roadman and lamplighter 6 years, colliery surfaceman 2 years. (2) R. B., aged 67. Cotton spinner 46 years, colliery carter 2 years, colliery fan engine tender 8 years. (3) J. H., aged 55. Worker in a cotton mill 2 years, ? occupation 17 years, colliery surfaceman (joiner, labourer, and oiler of head gear, pulleys, and ropes) 16 years. (4) J. H. K., aged 66. Doffer and in waste breaking room of cotton mill 20–25 years, colliery surfaceman 30–35 years.

⁶ (1) S. J., aged 53. Coal hewer about 20 years, datal man repairing roads underground 20 years. (2) H. H., aged 69. Coal hewer about 50 years, waste workman repairing airways a few years, retired 2 years. (3) J. S. R., aged 76. Coal hewer about 50 years, lampman 3 years, weigh clerk 6 years, in prison and workhouse 3 years. (4) A. P., aged 67. Coal hewer 40–45 years, general labourer in colliery rolling mills and blast furnaces (using coke) 10 years. (5) J. M., aged 60. Coal hewer 19 years, colliery platelayer 30 years (see later).

Railway platelayer (1)

One man, described as a cotton spinner, aged 50, proved to have been a railway labourer for 18 years (including 14 years as a platelayer), a labourer on the tramways for 6 years and a spinner for 6 years regularly and for 9 years very irregularly. He is still alive but unemployed, and complains that his chances of obtaining work are lessened by the fact that he is described on the books of the Labour Exchange as a spinner, whereas he considers that he is primarily a platelayer and as such he has been classified.

Of the four platelayers, aged 60–75 years (average just over 70), who died of the disease between 1911 and 1930, one (previously referred to) had been so employed at a colliery in Yorkshire for 30 years but had formerly been a coal hewer below ground for 19 years, while the other three (one retired) worked on the railway, investigation showing that one of these had been so employed and had handled creosoted sleepers¹ for the whole of his working life of over 50 years, the other two not being traced.

Roadmaker (1)

A Corporation tramways labourer, aged 46, proved on enquiry to have been an ice-cream vendor from 17 years of age for 5 years, an outdoor labourer for a firm of road contractors (sewering, etc.) for 14 years, in the army for 4 years, and a casual labourer on the tramways (on summer work only) for 6 years, during which latter time he was picking up setts and preparing them but not doing the subsequent tarring.

Between 1911 and 1930 there were fifteen fatal cases of the disease elsewhere than in Blackburn among men described as connected with road construction (twelve of whom were specifically designated as Corporation or Council employees as were eleven² others who did not work on road construction). Of these fifteen, four (a navy, two Council roadmen and a Corporation tramway general labourer) were not traced, one, aged 44 (described as a roadmaker), was a labourer for a cable company for telegraph construction and maintenance, moving and coiling tarred cables for 21 years, while the other ten, whose ages varied from 53 to 71 (average 60.9) years, had been employed for varying periods on roadmaking, either attending to the tar boiler or applying the tar to the surface by pouring it between the setts or, in one case, by spray, though four of these who had a previous occupation of soldier,³

¹ The possibility of trauma when dragging the metal rails along between the thighs may be noted.

² (1) J. G. S., aged 77. Gardener most of his life, Corporation park lodge keeper 2 years. (2) R. G., aged 38. Corporation gas-works labourer 20 years (13 as retort-pipe cleaner). (3) M. F., aged 62. Refuse collector 20 years, previous occupation not traced. (4) F. B., aged 59. Cotton-mule spinner 8 years, labourer 15 years, night watchman and "knocker up" 25 years, Corporation groundsman 3–4 years. (5) J. H. S., aged 55. Cotton-mule spinner 30 years to first operation, then Corporation tram conductor for 12½ years to second operation. (6) H. R. H., aged 54. Tram conductor and previously driver of horse tram. (7) M. S., aged 42. Woollen machinist 28 years, Corporation tram car cleaner 1½ years. (8) J. H., aged 76. Corporation yard man, not traced. (9) F. D., aged 68. Jobbing joiner 30 years, Corporation market sweeper 3 years, retired 3 years. (10) G. B., aged 81. Corporation carter, not traced. (11) A. W., aged 50. Cotton-mule spinner 30 years, Corporation scavenger 9 months.

³ H. H., aged 61. Regular soldier many years, tar boiler for Highways department of Corporation 30 years.

builder's labourer,¹ pitch loader at a tar distillery² or unknown,³ had been employed on roadmaking for only 6–20 (average 15) years as compared with the other six who had been so employed for 25–56 (average 40) years.

Stonemason and builder (1)

The stonemason who died of the disease at the age of 56 proved to have been a stonemason and builder for 40 years.

During the period 1911–30 there were, in addition, twenty-eight deaths from the disease in men employed (or formerly employed before retirement) in the building trade aged from 48 to 83 (average 62.1) years, and described as builder (7) (manager (1), foreman (1), labourer (4) or formerly so (1)), stonemason (3) (including two labourers), marble mason (3) (including polisher (1) and sawyer (1)), slate slab driller (1), plasterer (2) and formerly so (1), and bricklayer (11) (including two retired and four labourers).

Sampling of three of the builders (whose average age was over 65) showed that they had been employed as bricklayer's labourers for over 40 years, two having retired for 6 and over 20 years respectively.

The stonemason, aged 80, had been so employed in Wiltshire all his working life but had retired for 20 years. One of the mason's labourers, aged 51, had been so employed in Lancashire dealing with stone and mortar for 30 years, though he began his working life as an engineer's apprentice for 5 years, while the other, aged 70, had only been so employed for 4 years prior to becoming an inmate of a Poor Law Institution for 11½ years, and subsequent to occupation in a lard factory for 20–30 years, his occupation for the 20 years prior to this period being untraced.

The marble polisher had been a polisher of tombstones for 51 years, using a certain amount of mineral oil for the purpose.

A plasterer was found to have been so employed for 35 years, also doing a little painting but probably not tarring.

Earthenware moulder (1)

In the hospital records one man, aged 48, was described as an earthenware moulder and chimney-pot maker on one occasion and on another as a chimney sweep, but this latter description was evidently due to confusion with his occupation as chimney-pot maker, as investigation showed that he had never been employed as a chimney sweep having worked for about 35 years at a terra cotta pottery works where chimney pots and roofing tiles were manufactured in addition to bricks. In this work the wooden moulds were lubricated by brush with a creosote oil which constituted the so-called moulding oil, brick oil, or press oil commonly used in the trade. It must be noted that when first he presented himself at the out-patient department of the local hospital his disease was described as "epithelioma scroti", but as "ulcers scroti" when he was admitted for treatment. We have not been able to discover the date or nature of the operation which we were assured by his

¹ J. K., aged 71. Builder's labourer 30 years, Corporation pavior (with a little tar boiling and spraying) for 15 years.

² W. H. F., aged 64. Excavator ? years, pitch loader at a tar distillery 15 years, street pavior on tar boiler 6 years.

³ C. M., aged 70. Occupation ? years, Corporation tar boiler 19 years, Corporation road sweeper 1 year.

relatives was performed, but according to the register his stay in hospital was of short duration, and he did not eventually die of the disease but of spastic paraplegia of 2 years' duration, 9 years later.

During the period 1911–30 there were eight deaths from the disease in similar workers aged from 44 to 78 (average 60·7) years, one being a crucible-pot maker at a steel works for 38 years, another a sanitary-pipe fettler at a pottery works for 26 years but previously a gas worker,¹ while the remaining six were brick makers for 21–58 years (at a brick works (5) and at a colliery company (1)), all having been employed as brick pressers for the majority of their time in the trade, though one² had not been so employed for 10 years while another had previously been a cotton weaver for 12 years.³ In one case it was found that shale oil was a component of the press oil at one period of manufacture.

Market porter (1)

The fruiterer's assistant, aged 52, was found to have been a market porter in the fruit trade for the greater part of his life.

Between 1911 and 1930, in addition to the two fruit salesmen previously discussed, there were two cases in market porters and one in a Corporation market labourer. One of the former proved to have been a porter trucking fish at Smithfield Market for 20 years and previously a conjuror on the stage for 26 years. The other had been a fruit and vegetable porter for 2 years and previously a tallow-candle maker for over 30 years. The third man (retired for 3 years) had been a Corporation market sweeper for 3 years and previously always a jobbing joiner.

Occupation indefinite or insufficiently traced (5)

We have not felt justified in classifying the following cases owing to insufficient information as to the duration or precise nature of their occupations.

(1) *Ex-farmer, night soilsman (1)*

A foreman night soilsman for the Corporation, aged 66, had been a farm hand in his younger days and subsequently for at least 16 years a Corporation night soilsman in which occupation a certain amount of soot is encountered.

During the period 1911–30 there were twenty deaths from cancer of the scrotum (described as carcinoma (8), epithelioma (6), cancer (5) and sarcoma (1)) in men aged 41–88 (average 65·8) years, and described as farm manager (1), farmer (4), farm labourer (7) or formerly so (2), agricultural labourer (3), agricultural garthman (1), carter on a farm (1), and horseman on a farm (1).

Sample investigation of six of these showed that in one⁴ case the disease was primarily penile, one was a Corporation farmer for 48 years in charge of horses though in his youth he had been in the army in India and Egypt for 5 years, one was a coal carter and small

¹ W. G. P., aged 66. Labourer at iron works and gas works 28 years, fettler of sanitary pipes at a pottery works 26 years.

² W. C., aged 74. Brick presser 52 years, brick burner feeding brick kilns with small coal 10 years.

³ R. W., aged 78. Cotton weaver 12 years, brick presser 50 years.

⁴ A. B., aged 72. Farm labourer 60 years. Amputation of penis 21. xi. 16, died of cancer of scrotum 1. iii. 19.

farmer for 31 years with previous occupation in a woollen mill and a colliery,¹ while three had been employed all their working lives as farm labourers for 50–60 years, though one of these had retired for 10 years after an operation for cancer of the tongue.

Although the disease is rare in farmers it does occur, though a prime factor in causation is not obvious. The use of soot, especially by potato farmers, has been suggested.

Night soilsman. No other instance of a death from the disease in a night soilsman was found during the 20-year period.

(2) *Outdoor labourer, ? ex-cotton spinner* (1).

The niece of an outdoor labourer stated that he had been a spinner in the cotton-spinning room in his younger days and later an outdoor labourer, but we felt that the information regarding spinning was too unreliable to include him with the ex-spinners, and we had unfortunately no information as to his exact occupation as an outdoor labourer. He died in 1883 of the disease at the age of 59.

Between 1911 and 1930 there was only one man described as an "outdoor labourer", aged 71, of Bradford, who died from the disease. He was found to have worked for the first 16 years of his working life at a brickworks and as an outdoor carter, but subsequently he was a Corporation roadman (including attendance on the tar boiler) for 42 years.

(3) *Fireman, ex-cotton weaver* (1).

A fireman night watchman also described in hospital as a weaver, aged 69, who had been a firebeater at cotton mills, dye works, a corn mill and a cotton-waste shop, was stated to have been, in his younger days, a cotton weaver, but in the absence of further information, in regard to the duration of each occupation, we are not in a position to decide whether the weaving or the firebeating was the causal occupation or if both contributed. It is interesting to note that a short time previous to the recognition of the scrotal cancer he suffered from cancer of the lip.

Stokers or firemen. There were eight stokers or firemen not described as connected with gas manufacture or gas-works tar (in a colliery (2), tin-plate works (1), match works (1), abrasive works (1), cotton mill (1), textile machinists (1), and merchant service (1)) who died of the disease between 1911 and 1930. The first three were not traced, three² had previous interesting occupations in connection with textile factories or gas works, while two³ appeared to have been stokers or firemen all their working lives, totally or partly on board ship, in which occupation contact with mineral oil cannot be excluded. Hence we have no evidence in this series to suggest heat rays alone as a primary factor in causation of scrotal cancer.⁴

¹ W. H., aged 60. Tenter in a woollen mill 8 years, coal-tub hoist attendant at colliery 3 years, woollen weaver 4 years, coal carter and small farmer 31 years.

² (1) W. L. D., aged 55. Jobber at a cotton doubling mill 11 years, boiler stoker at cotton mill 29 years. (2) S. K., aged ?. Beltman and oiler at flax and cotton spinning mills in Ireland 18 years, in army 4 years, attendant at wood gas plant and oiler at match works 8 years. (3) E. A. J., aged 40. Bus driver ? years, carrier of coal and gas-works coke more than 10 years, in army 4 years, kiln fireman at carborundum works 3 years.

³ (1) E. R., aged ?. Coloured marine fireman in merchant service. (2) J. H. M., aged 71. Ship stoker 15 years, stoker at textile machinists 40 years, retired 2 years.

⁴ This must not suggest that heat rays are not a primary factor in causation of epithelioma of other parts of the skin, especially such as are exposed.

(4) *Blacksmith's striker* (1).

Investigation of the one blacksmith's striker, aged 65, was incomplete. He had been a blacksmith's striker in a foundry for 10 years and possibly in a blacksmith's shop all his working life, but his previous occupational history was not available.

During the period 1911–30 there were eleven deaths attributed to cancer of the scrotum in men connected with a blacksmith's shop, varying in age from 45 to 86 (average 65.2) years and described as blacksmith (3) (including one at a colliery), blacksmith's burnisher (1), blacksmith's striker (5) (including one at an engineering works and one at a railway carriage works), shoeing smith (1) and farrier (1). In four no investigation was made, in two the diagnosis was doubtful and probably the growth was testicular in origin, but the remaining five, aged from 58 to 79 (average 67) years, were employed, as blacksmith for 39 years (1), burnisher of harness and chains in blacksmith's shop for 50 years (1), blacksmith's striker for 34 and 46 years respectively (2), and ex-shoeing smith¹ for 43 years (1). One of these, aged 77, had been previously employed as a bricklayer and labourer at rolling mills for 29 years and had retired for 6 years, during which period he had spent his time in chopping and hawking firewood.

(5) *Pavior, ex-coal heaver* (1).

A Corporation pavior (rammer and gauger), aged 50, proved on enquiry to have been a labourer at a pottery works and then at a corn mill in his early youth, and subsequently a coal heaver emptying coal boats for a canal company for a long period before becoming a Corporation pavior. He died 1½ years after recognition of the disease from "cancer of the liver". As the duration of employment in neither of this man's last two occupations was ascertainable, it is difficult to decide whether he should be classified as a Corporation pavior in contact with tar or as an ex-coal heaver in contact with coal dust and the tar (usually wood tar) with which the material of coal sacks is impregnated.

During the period 1911–30 there were six deaths attributed to cancer of the scrotum in men employed in the distribution of coal to the public, varying in age from 44 to 83 (average 65.5) years and described as coal merchant's canvasser (formerly) (1), coal merchant (1), coal dealer (formerly) (1), coal carter (2), and coal trimmer (retired) at docks (1). In the case of the coal merchant's canvasser (who proved to have been previously an auxiliary postman and finally in the workhouse for 10 years) the disease was primarily penile.

RELATIVE INCIDENCE IN CERTAIN OCCUPATIONS

Table III, compiled from Tables I and II, gives some indication of the relative importance of different occupations in the causation of scrotal cancer among men in the Blackburn Registration District. It emphasizes once again the significance of chimney sweeping, cotton-mule spinning, gas stoking and tar distilling in chemical works in this connection.

¹ W. J. C., aged 79. Shoeing smith 43 years, smallholder and seller of produce 25 years.

Table III

Occupation as determined by enquiry	Number employed in Blackburn Registration District (Census 1921)	Cases of scrotal cancer traced in the district during the period 1837-1929	Number of cases traced per 1000 employed in 1921
Chimney sweep	13 (at least)	4	308.00
Cotton-mule spinner	1,502	111	74.00
Gas stoker	58	2	34.00
Worker in chemical processes	254	2	8.00
Card-room worker	172	1	5.80
Cotton weaver	10,917	4	0.40
Coal miner	2,534	1	0.40
Other textile worker	9,888	1*	0.10
Other	49,762	12	0.20

* This was a case of a cotton-mill mechanic; the number of such workers employed is not available, though it is certainly very small.

AGE OF PATIENT AT MANIFESTATION, DATE OF OCCURRENCE,
AND TYPE OF CUTANEOUS EPITHELIOMA

In Table IV the cases are grouped according to the occupation (as determined by our enquiry) followed by each patient,¹ the age of the patient at which the epithelioma was recognized, the date of its occurrence, and its type, whether first or subsequent primary cutaneous growth.

Age

In about 75 per cent. of the cases the patient was aged from 45 to 64 years at the time the cancer was recognized: thus it is not essentially a disease of old men. The youngest patient in the series was a spinner,² aged 31. The oldest man in the series was a cotton weaver aged 78, and the oldest cotton-mule spinner was 73 years of age.

Date of occurrence

The number of cases of scrotal cancer is shown to have greatly increased since 1910, this increase being general and not confined to cotton-mule spinners. Chimney sweeps, however, proved a notable exception.

The earliest case was in a chimney sweep in 1871. The first case in a weaver occurred in 1894, and the first in a spinner in 1898, though an ex-spinner (a glass and china dealer's assistant) died from the disease in 1893. The occurrence of a subsequent primary scrotal cancer following on a previous primary cutaneous cancer on the scrotum or elsewhere is naturally manifested only in the later decades.

¹ Since six of the spinners suffered from two primary scrotal cancers at different times the number of cases (138) exceeds the number of persons (132) by six.

² We were informed by this man's relatives that he had numerous cancers on the skin when he died.

Table IV

Occupation as determined after enquiry	Number of		Type of scrotal cancer							Age in years, in 10- and 5-year periods at time of recognition					Date of occurrence in decennial periods									
	Persons	Cases	Second primary to previous growth on							1870-79	1880-89	1890-99	1900-09	1910-19	1920-29									
			Primary	Scrotum	Face	Lip	Ear	Back	Forearm							25-34	35-44	45-54	55-59	60-64	65-69	70 and over		
Cotton-mule spinner	84	89	58	5	•	•	•	•	•	•	•	1	31	5	31	22	12	1	8	1	28	37	4	
Retired cotton-mule spinner	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Ex-cotton-mule spinner	15	15	14	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Chimney sweep, ex-cotton-mule spinner	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Ex-cotton stripper and grinder	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Cotton weaver (untraced)	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Ex-cotton weaver	3	3	2	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Engineer (cotton mill)	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Machinist (papermaker)	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Newspaper-printer's machinist (retired)	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Ex-stoker (gas works)	2	2	2	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Tar distiller	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Ex-tar distiller	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Chimney sweep (two untraced)	4	4	4	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Coal miner (retired)	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Ex-plate-layer (railway)	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Pavior (Corporation)	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Terra-cotta moulder	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Builder and stonemason	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Market porter	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Night soilman, ex-farmer	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Outdoor labourer ? ex-cotton-mule spinner	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Fireman, ex-weaver	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Blacksmith's striker	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Pavior, ex-coal heaver	1	1	1	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Total	132	138	125	6	2	1	1	1	2	1	9	44	35	22	17	10	2	2	5	17	48	64	•	•

Type of cutaneous epithelioma

The occurrence of more than one cutaneous cancer at the same or at different times, in the same patient, due to occupational factors, is now well recognized. There were eighteen such cases in our series.

(1) *In spinners and retired spinners* (14).

A. The primary growth being on the scrotum with a subsequent primary growth on the:

(a) *Scrotum* in five. The subsequent primary growths appeared $3\frac{1}{4}$, $5\frac{1}{2}$, $7\frac{1}{2}$, $9\frac{1}{2}$ and 21 years respectively after the first primary scrotal growth had been treated at hospital. The second of these men died $1\frac{1}{2}$ years later from cancer of the jaw (post-mortem examination and microscopic section showed this, but no extension of the scrotal cancer could be found); in the fifth case the patient had retired $2\frac{1}{2}$ years before the subsequent primary growth appeared. In the last two patients the second scrotal cancer was the cause of death.

(b) *Face* (rodent ulcer) in two. The subsequent primary growths were recognized after 8 and 16 years respectively, the former having been unemployed almost continuously for the last 5 years. The latter patient died, $26\frac{1}{2}$ years after the occurrence of his first growth, from cancer of the colon at the age of 78 years.

(c) *Lower limb* in one. The epithelioma on the left leg (over the head of the fibula) appeared $3\frac{1}{4}$ years after the primary scrotal cancer had been removed, the patient having retired from work after the first operation. He has also a small sore on the calf of the left leg which crusts over and is slowly increasing in size—clinically it suggests a rodent ulcer.

B. The primary growth being on the scrotum with subsequent primary growths on the:

(a) *Scrotum and face* in one. The second epithelioma of the scrotum was recognized $5\frac{1}{2}$ years after the first was successfully treated in 1918, and a third primary growth (basal celled cancer) affecting the right side of the nose and upper lip was observed 6 years later: this was treated and further treatment for cancer of the lip was necessary 3 years later, the growth being probably a recurrence. The patient died in 1933 from "secondary carcinoma of the liver following epithelioma of the scrotum" at the age of 78 years.

(b) *Nasal septum and face* in one. This man had an epithelioma of the scrotum in 1923, a rodent ulcer (site unstated) in 1925, a malignant ulcer of the septum of the nose in 1929, and an epithelioma of the right cheek below the external canthus in 1931, dying in 1934 from senility and myocardial degeneration at the age of 75.

C. The primary growth being on the face, with a subsequent primary growth on the scrotum in two.

In one case, the primary growth was a rodent ulcer on the nose, the subsequent primary growth which caused death appearing on the scrotum $2\frac{1}{2}$ years later, the patient not having worked during that period. In the other case, the primary growth was an epithelioma situated at the outer canthus of the left eye, the subsequent primary growth on the scrotum appearing 5 years later and being the cause of death after 1 year.

D. The primary growth being on the forearm with a subsequent primary growth on the scrotum in two.

The subsequent primary cancers appeared $1\frac{1}{4}$ and 23 years after the first primary growths. In the first man "warts" had been removed from the scrotum 15 years before the epithelioma of the scrotum was recognized. In the latter, who retired on developing scrotal cancer in 1924, a small skin tumour $\frac{1}{2} \times \frac{1}{2}$ in. has since developed on the left forearm, the original growth having been on the right forearm. In addition, he has small ulcers

(? malignant) on the cheek and wrist and many keratotic areas on the back of the hands. These are all probably either pre-cancerous or slightly malignant in nature.

(2) *In ex-spinners* (2).

A. The primary growth being on the scrotum, with a subsequent primary growth on the ear. The chimney sweep, who was previously a spinner, had a scrotal cancer in 1911 and a subsequent epithelioma on the left ear in 1924. He died in 1933 from accidental causes at the age of 73.

B. Cancer on the scrotum and on the ear at the same time. One of the bobbin carriers, who had previously been a spinner, suffered from cancer of the ear and of the left side of the scrotum simultaneously; the latter caused his death at the age of 59.

(3) *In ex-weavers* (2).

A. Cancer on the lip and the scrotum at the same time. The fireman, who had previously been a weaver, had cancer of the lip and cancer of the scrotum at approximately the same time at the age of 69.

B. The primary growth being on the shoulder with a subsequent primary growth on the scrotum. The labourer at a water-paint works, who had previously been a cotton weaver, had a cancer on the shoulder and 3½ years later had a primary growth on the scrotum which proved fatal 10 months afterwards, the patient being then 52 years of age.

Table V gives details of those patients in our Blackburn series, twenty in number, who suffered from more than one primary cancer. In four of them one of the cancers was not cutaneous in site or origin.

Table V

Occupation	Site of first primary cancer	Site of second primary cancer	Site of third primary cancer
Cotton-mule spinners (7)	Scrotum at age of 57	Scrotum in 3½ years	
	Scrotum at age of 40	Scrotum in 7½ years	
	Scrotum at age of 49	*Scrotum in 9½ years	
	Scrotum at age of 54	Face in 8 years	
	Scrotum at age of 64	Nasal septum in ? 2 years	Face in 6 more years
Cotton-mule spinners retired before appearance of second primary growth (6)	Face at age of 51	*Scrotum in 5 years	
	Forearm (skin) at age of 58	Scrotum in 1¼ years	
	Scrotum at age of 50	*Scrotum in 21 years	
	Scrotum at age of 54	Lower limb (skin) in 3¼ years	
	Scrotum at age of 49	*Larynx in 17 years	
Cotton-mule spinners retired before appearance of third primary growth (3)	Scrotum at age of 65	*Rectum in 8½ years	
	Forearm (skin) at age of 41	Scrotum in 23 years	
	Face at age of 61	*Scrotum in 2½ years	
	Scrotum at age of 63	Scrotum in 5½ years	†Face in 6¼ more years
Chimney sweep, ex-cotton-mule spinner (1)	Scrotum at age of 49	Scrotum in 5½ years	*Jaw in 1½ more years
	Scrotum at age of 51	Face in 16 years	*Colon in 10¼ more years
	Scrotum at age of 52	Ear in 13 years	
Bobbin carrier, ex-cotton-mule spinner (1)	Ear at age of 58	*Scrotum (almost concurrent) in ? 6 months	
Fireman, ex-cotton weaver (1)	Lip at age of 69	Scrotum (concurrent)	
Labourer at water-paint works, ex-cotton weaver (1)	Shoulder (skin) at age of 47	*Scrotum in 3½ years	

* Cause of death.

† Died from "cancer of the liver following epithelioma of the scrotum" 3 years later.

Of the four patients above mentioned who died from non-cutaneous cancer, three were treated for the fatal growth in hospital.

A spinner and a pavior's labourer (ex-coal heaver) died from "cancer of the liver", 7½ and 1½ years respectively after recognition of scrotal cancer, but it is probable that in them the cancer of the liver was secondary to that of the scrotum.

AFTER-HISTORY OF THE CASES

Of the 132 patients in the series, seventy-six (57·5 per cent.) died from scrotal cancer (in three cases a second primary growth), but in thirteen of these (twelve spinners and one chimney sweep), the site of the growth could not have been traced from the death registers; the causes of death there stated were: cancer of the testis (1), carcinoma or sarcoma of the groin or groin glands (6), sarcoma of thigh (1), cancer abdominale (1), and cancer (4), but our previous investigation (in hospital records, etc.) and in one instance the Registrar-General's inquiries showed that in all these cases the true or primary site of the cancer was the scrotum. Thus in only thirty-nine of the fifty-one deaths due to the disease in cotton-mule spinners was the cause of death so described in the death certificates, and one of the two deaths in chimney sweeps was simply recorded as due to "cancer".

Table VI shows the period of survival of the men after attending hospital for treatment of a first epithelioma of the scrotum.

Table VI

Period of survival after first scrotal cancer	Alive 1935			Died of the primary scrotal cancer			Died of other cancer				Died of other cause		
							C.M.S.						
	C.M.S.	Ex-C.M.S.	Others	C.M.S.	Ex-C.M.S.	Others	Second primary scrotal	Other cancer	Ex-C.M.S.	Others	C.M.S.	Ex-C.M.S.	Others
0-6 months	.	.	.	17	3	4	.	.	.	.	.	.	1
6 months-2 years	.	.	.	12	2	6	.	.	.	1*	.	1	2
2-5 years	.	.	.	4	.	.	.	.	.	.	3	.	2
5-10 years	12	1	.	1	.	.	.	.	3†	.	1	2	1
10-20 years	11	1	1	.	.	.	2	1	.	.	4	1	.
20-30 years	2	.	1	.	.	.	1	1	.	.	.	2	.
Total	25	2	2	34	5	10	3	5	.	1	8	6	6

* Cancer of the liver.
 † Includes one case cancer of liver.
 C.M.S. = cotton-mule spinner.

As we have no further details of one man, a chimney sweep, who attended hospital in 1883, and as twenty-four (fourteen cotton-mule spinners, three ex-cotton-mule spinners, and seven others) of the series had never attended a hospital or a nursing home, and had died of the disease, the number of men discussed in this table is 107. It is certain that many of the sufferers sought hospital attention much too late, and this may be taken as the explanation of the high percentage of deaths within a year of attendance at hospital. It is interesting to note that of the men in this series admitted to voluntary hospitals during the decades 1910-19 (thirty-five men) and 1920-29 (forty-seven men)

the percentage surviving less than 1 year approximated closely in the two groups (28.6 and 31.9 per cent.). It may be added that the percentage surviving more than 5 years was also very similar in the two groups (54.3 and 55.3 per cent.). In a limited sense this table gives some measure of the results of treatment, but details as to such treatment and the duration or state of the growth when first seen at hospital were not, in many instances, obtainable, and are not here considered.

Of those who attended hospital for treatment, five died within a month, and forty (37 per cent.) died within a year: on the other hand forty-nine (46 per cent.) survived 5 years or more, and twenty-eight of these survived 10 years or longer. The proportion surviving 10 years may ultimately prove higher. It is evident from our investigation that a patient may live 5 years or longer after treatment for scrotal epithelioma and yet die from a second primary scrotal cancer or from a cancer not cutaneous in site or origin. Cotton-mule spinners provided in our series three examples of the former circumstance and four of the latter. What the relationship of these non-cutaneous to the cutaneous cancers is we do not know, but it is very interesting to note that two of the four men concerned had each suffered from two previous primary cutaneous cancers caused by contact with a known carcinogenic irritant during the course of their occupation.

CONCLUSION

In considering the causation of cancer in general it has to be remembered that there are many types of tumour classified under the broad name of cancer, that such tumours manifest themselves on various sites, and that the number of factors in causation is unknown not only for cancer in general but even for one particular type of tumour on one particular site.

Much information has, however, been gained in recent years with regard to cancer of the skin, especially of one part of the skin, namely the scrotum, and the study of this comparatively rare form of the disease has revealed a relationship between its increased incidence and exposure to chemical irritants such as shale and certain other mineral oils, and coal tar and pitch. Nevertheless the most important, and unfortunately least understood, factor of susceptibility or, alternatively, resistance, must not be forgotten, for even in the presence of a known carcinogenic agent of high potency, only a percentage of the workers exposed to it contract the disease and, even then, not all at the same age or after the same duration of employment.

Although the main object of this paper is to contribute to the knowledge of one particular cause, namely chemical irritation, of a particular tumour on a particular site, it is suggested that it may also contribute to the study of the same or another type of tumour on a different site,¹ for we have evidence that

¹ The site of election of a cutaneous epithelioma in the patent fuel worker is on the head and neck, but in the worker on the presses in the paraffin shed of a shale-oil refinery it is on the upper limb.

not only may primary tumours on different sites be found to appear more or less concurrently in the same person, but that if a single primary tumour is successfully removed it may be followed at a later date by one or more subsequent primary tumours on other sites. The factors influencing the choice of site have not as yet been elucidated and require further research, though one suggestion has been made that localized mechanical irritation¹ is a subfactor which, although precipitating the onset of the disease, would not in itself have caused it in the absence of the more important factor of chemical irritation exercising its influence over a period of some duration, while another suggestion is that previously damaged tissue² tends to be selected by the chemical agent on which to manifest its carcinogenic properties.

The use to which results of study of occupation in relation to cancer is put depends on the object in view. It may be that the object is to ascertain whether or not a certain occupation plays such an important part in causation that legislative action is necessary in order to prevent future occurrence of the disease in that occupation and compensate those affected therein, but this is not our immediate object on this occasion. Rather is it to study the disease in groups of persons under similar conditions—for which reason we have selected the occupational³ aspect—with a view to finding out if there can be brought to light any agent which may eventually be proved by experiment to be causal, whether it be of such high potency that it causes a sufficiently large number of cases of the disease in an occupation to satisfy statistically as in the case of cotton-mule spinners and chimney sweeps, or with such a low potency and such conditions of use that it causes few cases of the disease even among those workers who have escaped death from other diseases and whose span of life is prolonged beyond the average.

When there is found an occupation in which only an odd worker contracts the disease, a very careful investigation must be made to see whether or not this apparent occurrence is the exception that proves the rule. It may be that the diagnosis or occupation given is incorrect, or that the actual work done by the man in question in that occupation is exceptional⁴ to the occupation and should be designated otherwise than it is, or that some outside non-occupational cause, though possibly similar⁵ to an occupational one, is at play.

If after careful investigation among workers in any particular occupation the disease cannot be traced, or, if traced, is shown to be capable of having

¹ We have a record of an epithelioma following upon a burn caused by a splash of hot tar, but the patient had been in previous contact with tar for many years.

² As in the case of burns, abrasions, and lesions caused by lupus or syphilis.

³ While later it may be possible to show the full number of occupations in which epithelioma of the scrotum actually occurs, we have limited ourselves in this paper to an attempt to show the occupations in which it has occurred in the Blackburn area.

⁴ As, for instance, in the case of the man described as a blast furnaceman who, as previously referred to, was found to have spent a substantial amount of time in tar dipping.

⁵ We have a record of a case of epithelioma of the hand in a man who made creosoted fire-lighters in his spare time at home.

been produced by a previous occupation,¹ this fact correlated with the absence of any known carcinogenic irritant in the current occupation is important. Even where a known carcinogenic agent is present such as coal tar or tarry products in the case of the tar distiller, tar and pitch boiler, coke-oven worker, road maker, railway platelayer, gas worker, chimney sweep and earthenware moulder, or of mineral oil in the case of the cotton-mule spinner, cotton-ring spinner, cotton card- and blowing-room worker, cotton weaver, mill mechanic, and paper machinist, much further information is required with reference to the comparative nature and composition of the product used, the amount of contact, the number of males employed, their age at manifestation of the disease or at death therefrom and the duration of employment in each occupation, in order to show why the number of those affected is so great in sweeps and mule spinners, for instance, as compared with the number affected in cotton weavers who form so large a part of the occupied male population of the Blackburn area.

The other occupations to which we have referred may be divided into two categories. In one category may be placed those occupations in which a comparatively small number of cases of the disease have been found to occur such as that of the coal miner, coal distributor, painter, farmer, builder, stonemason, firebeater or stoker (other than at tar or gas works), foundry worker and blacksmith. While in some of these it may still be shown later by others that a known cancer-producing agent may be present to a limited extent,² and although more than one such known agent exists in a large industry, such as coal mining,³ we would suggest that, in addition to our present line of investigation, experiments on animals might be made at least with dust of various forms of coal⁴ and stone and with wood tar.⁵

Others may in due course suggest or place under suspicion substances occurring in the industries we have mentioned, the importance of which has escaped our notice, in which case the suggestions can be followed up by those most competent to do so.

In the other category may be placed those occupations in which we imagine we have found isolated cases such as that of the fruit salesman and the grocer in

¹ As in the case of the glass and china dealer, street sweeper, night watchman, hoist man, sewage worker, and caretaker.

² As with soot in farming, rays in stoking, and oil in foundry work, bearing in mind also the possibility of the presence of radioactivity.

³ *E.g.* oil and tarry products.

⁴ It must not be forgotten that many known carcinogenic agents are derived from coal by heat.

⁵ The occurrence of the disease in brush makers would be confirmatory evidence in favour of wood tar being carcinogenic seeing that this material is used for implanting the bristles. Although there is no case of death from cancer of the scrotum in any such worker between 1911 and 1930, one case of death from cancer of the penis and six from cancer of head or neck (including three of rodent ulcer) occurred in brush makers varying in age from 53 to 77 (average 65.4) years, thus suggesting that the carcinogenic action, if any, is slow and that the site of election is on the "head and neck", a part of the body specially exposed to fume from the molten pitch owing to the nature of the process.

regard to which we have failed to obtain any further satisfactory information. It may still be that our inquiries into diagnosis and life history were not sufficiently intensive, in which case our findings will not be corroborated elsewhere. In these cases we admit defeat at present, but the explanation so frequently forthcoming that the facts may be accounted for by natural occurrence of the disease in the general population does not appeal to us as more than indicating the line of least resistance, and as being destructive criticism in the absence of any attempt to supply proof or constructive suggestions.

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