CUTANEOUS CANCER IN RELATION TO OCCUPATION

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by

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INTRODUCTION

THE SUBJECT WHICH I submit to you to-day concerns certain cancerous growths of the skin in relation to occupation, and I would wish you to consider this as a sequel to my former Hunterian lecture ten years ago which concerned only those on one site of the skin—namely, the scrotum.

The skin has many sites but, in order to simplify analysis, it is usual for these to be subdivided only into the head and neck, upper limb, lower limb, trunk, and external genital organs; though one or other subdivision of these main sites may prove to be of importance when considering incidence, or a site of election, in a particular group of workers. Hence, for example, the lower limb includes the foot, the leg, and the thigh, on which, for instance, occurs the " Kangri cancer " in Kashmir described by Dr. Neve. I have no record or photograph of a carcinoma during life on the sole of the foot, as might have been expected in bare footed workers on an oily floor, as in a cotton mule spinning room, but I call to mind a cotton mule spinner who, after treading on a nail, developed a sarcoma on this site.

The trunk includes the back, chest, and abdomen, on which occurs, for instance, the " Kairo " cancer in Japan described by Dr. Itoh in 1925.

Such junctional sites as the shoulder, hip, axilla, perineum and groin are usually included as part of the trunk, though the outer half of the axilla might be claimed by the upper limb.

The external genital organs in the male include the scrotum and the penis, with at its distal end, the prepuce, glans, and corona, which leads me to refer to other so-called marginal sites, where the epithelium of the skin joins another membrane, such as the nostril, eyelids, lips, external auditory meatus, urethral orifice, and the nipple and vulva in females. Such sites are a matter of practical rather than academic interest when an astute lawyer desires to contest the right of notification or benefit, unless the growth begins on the skin side of the marginal line.

DESCRIPTION OF INDUSTRIES OR OCCUPATIONS

Before going further let us consider some of the industries and occupations which concern our problem.

Coal passes to the gas works where it is carbonised at the high temperature of 1,250°C. on old horizontal retorts, and 1,000°C. on newer vertical retorts; or it is submitted to a low temperature coal carbonisation at 600°C. in the manufacture of such a product as Coalite.

Coke ovens, which are usually situated on plants at or near to collieries or to iron and steel works, manufacture coke at a temperature of 800°C.

in special cases, or at a 1,000°C. ordinarily, for use in blast furnaces, the residual coal tar being distilled on another part of the plant or forwarded in the crude state by land or water to various tar distilleries.

In coal tar distillation the workers come into contact with the liquid tar and its fumes, and with its various products such as creosote oil, anthracene oil, naphthalene, and the end product pitch, which is broken up on the pitch beds, formerly by hand and now by modern mechanical methods.

Roadmakers apply this tar or its liquified pitch from a boiler on to the road surface by spreading or spraying. But they may also use Trinidad Lake Asphalt or bitumen previously mixed in the factory.

Boatmakers and repairers also use coal tar for painting boats and barges ; while the barges themselves may carry the tar or pitch from one place to another.

Even the bootmaker of hand-made boots and shoes sometimes applies this product to the threads he uses, while presumably machine oil is the product with which the maker of machine-made footgear comes into contact.

Similarly coal tar is used for proofing nets and fabric, such as brattice cloth used in mines, though canvas bags such as are used for carting coal are usually proofed with a wood tar such as Polish pine tar which has a distinctive odour.

Proofing of sails however, is performed with a mineral oil product.

The worker comes into contact with a moulding oil, which formerly at any rate contained creosote oil, in the manufacture of bricks and of the cruder type of pottery known as the sanitary pipe.

The pitch from gas works is used in the manufacture of briquettes or patent fuel as a binder for coal dust, and is similarly used for the binding of cork dust in the making of cork stone abroad for use in the building trade.

A form of gas known as producer gas, used for helping factory production, gives rise to a coal tar ; while an oil tar is produced during the manufacture of an oil gas such as carburetted water gas or shale oil gas produced by the cracking of the oil.

Oil refineries may refine the mineral oils used as such in nature ; while the oil extracted in retorts from oil-bearing shales is similarly refined and eventually expressed from the final waxy base known as paraffin wax.

Heavy engineering is mainly associated with radiant energy such as in the extraction of the metal from the ore and moulding into ingots. The metal may subsequently be flattened out by a process of hot rolling, though there is also a process of cold rolling ; while casting of the metal is performed in a foundry.

While blast furnaces normally use coke, there are certain furnaces, almost exclusively around our northern border, which use a special form

of hard or slate coal, known as splint coal, found in the vicinity, which produces a limited amount of tar, the temperature at the bottom of the furnace being 340°C. and at the top 1,000°C., but so far I have been unable to trace a case of cutaneous carcinoma attributable to this form of tar, though Berenblum and Bonser claim to have produced the disease experimentally.

Mineral oils are used in trades where there is machinery, as, for instance, on the prime mover or engine which runs the factory, and by various machinists such as those in the engineering and textile trades.

Now, in the cotton trade, the cotton is first opened by undergoing a process of blowing and scutching, then passing to the card room where it is treated on the carding engine, which from time to time has to be cleaned and improved by men known as strippers and grinders.

After some further combing and drawing the cotton is spun on a machine known as a mule with moving carriage, the head spinner being assisted by youths known as big or little piecers, who, in the past, used to start work at the early age of eight years, or even earlier; or the cotton may be spun on a ring frame which is mainly operated by women, the overlookers and so-called ring-room jobbers being males.

Doubling the cotton is usually performed on a ring-doubling machine or on a twiner machine on which the spindles remain stationary and the creels revolve.

Other processes include winding, weaving, bleaching, dyeing and finishing.

Spinning of cotton waste is performed on a machine known as the condenser mule which helps to roll the cotton.

The chemical industry includes the dead or dying trade of making aceto-arsenite of copper, or emerald green, in colour works; other arsenic salts and the manufacture of sheep dip containing either a coal tar or an arsenical compound.

LEGAL REQUIREMENTS

No lecture on this subject is ever complete without reference to that great surgeon and pioneer of occupational cancer, Percival Pott, who was the first to point out, in 1775, the special incidence of the disease on the scrotum of chimney sweeps which he attributed to the soot encountered.

Let us pass quickly over that period of delay or "lag period" of 130 years until official recognition was forthcoming. This was for compensation as a scheduled disease under the Workmen's Compensation Act of 1906, if the disease was attributable to pitch, tar or tarry compounds; and later to bitumen, mineral oil or paraffin—added in 1914. This act has now been replaced by the National Insurance (Industrial Injuries) Act of 1946, in which the expression "Scheduled Disease" has been replaced by the term "Prescribed Disease" (prescribed in regulations made by the Minister) and the word "compensation" has given way to the word "benefit." The prescribed disease is termed

Epitheliomatous Cancer or Ulceration of the skin due, in any case, to tar, pitch, bitumen, mineral oil (including paraffin), soot or any compound, product or residue of any of these substances.

But it was not until 1919—by an order made under Section 29 of the Factory and Workshops Act, 1895, and now under Section 66 of the Factories Act of 1937—that cases of the disease became notifiable, from the 1st January, 1920, to the Chief Inspector of Factories, so that they could be studied, and preventive methods be devised and, in due course, adopted.

The term used differs somewhat from that under the National Insurance Act being *Epitheliomatous Ulceration due to tar, pitch, bitumen, mineral oil or paraffin, or any compound or residue of any of these substances*, and the obligation to notify is laid upon the employer who receives notice, and upon the patient's medical attendant.

It may strike you as curious that no site is referred to as in the prescribed disease, but it was intended, as shown in explanatory leaflets, to have reference to the skin, and the terminology does not exclude the so-called rodent ulcer which is an epithelioma, though of the basal-celled type.

I think the pathologists and radiologists are tending to discard the word epithelioma and to simplify the nomenclature by using the term " cutaneous carcinoma " which they divide into the squamous-celled and basal-celled varieties. This is of special interest when we remember that the term epithelioma in some other countries includes the non-malignant or pre-malignant tumour, which in this country is described officially as a new growth, " papillomatous or keratotic," which is subject to benefit under the National Insurance (Industrial Injuries) Act of 1946 ; but it is not subject to notification under the Factories Act, though there is a growing tendency on the part of some energetic medical men to notify voluntarily such cases, thus enabling the early stage of the disease to be studied and also treated satisfactorily, mainly by radiotherapy.

I may also point out that another form of cancer—namely sarcoma —is not included, as evidence as to its connection with occupation is lacking, except in the case of the American dial painters, who used a radioactive paint and, by ingesting it, contracted sarcoma of the bones which, if contracted in this country, would be subject to benefit under the prescribed disease No. 25 which is described as : *Inflammation, ulceration or malignant disease of the skin or subcutaneous tissues or of the bones, or leukæmia, or anæmia of the aplastic type, due to X-rays, ionising particles, radium or other radioactive substance ; or inflammation of the skin due to other forms of radiant energy.*

You may wonder why arsenic is omitted from the list of causal substances in both Acts, but is was considered that, when it was found that the disease might occur in the makers of colours, and of arsenical sheep dip, and was attributable to the salts of arsenic, it could come under the

heading of *Poisoning by Arsenic* which was one of the first notifiable diseases in 1895 and is No. 4 of the prescribed diseases under the National Insurance (Industrial Injuries) Act of 1946.

Wisely, I think, the terminology of the causal agents is wide, and embraces the liquid tar and its more solid derivative pitch, whether manufactured from wood or, in later years, from coal or, later still, from the shale oil or mineral oil during the so-called process of cracking by heat to form an oil gas.

Now, in chemistry, the term " paraffin " has reference to a series of compounds, with the common property of lack of affinity ; and in shale oil refining it is the trade term for the inert waxy base hydraulically expressed after refining, one of its uses being for making candles ; while the oil from which it is derived is termed paraffin oil, one distillate being used for lamp oil. Later the Americans gave to their lamp oil the more informative name of kerosene, derived from the Greek word Keros, or wax. But in due course, the term paraffin and kerosene came to be used rather indiscriminately, and the confusion reached its height when the medical profession prescribed a highly refined product under the name of liquid paraffin, which is, so far, thought to be harmless, if not always efficacious.

May I, therefore, venture to suggest that your serious consideration should be given to the improvement of the official wording by replacing the terms *Epitheliomatous Ulceration and Epitheliomatous Cancer* by *Carcinoma of the skin, squamous-celled or basal-celled,* unless you wish to include other than the cutaneous sites ?

Bearing in mind that notification is for the purpose of study with the view to prevention, you may care also to press for the introduction of notification of the " precancerous papilloma or keratotic new growth," as yet microscopically benign, unless, perchance, you hesitate to add to the labours of the Factory Department, and feel that it would be inappropriate in the present state of our finances.

Secondly, if you cannot allow the broader interpretation of poisoning suggested, you must see that arsenic and its salts are added to the list of other carcinogenic products in both Acts, as this would have the advantage of educating the employer and the medical profession as to their carcinogenic properties.

But, on the other hand, bear in mind that, if you accept the broader interpretation of poisoning, you leave a suitable opening for cases of cancer of sites other than the skin to be notified under this heading of poisoning as, for instance, cancer of the lung, cases of which have already been notified spasmodically and without prejudice, from arsenical sheep dip factories ; and possibly a similar opening is left for those cases of cancer of the interior of the nose occurring in the manufacture of nickel carbonyl, if, as some have suggested, they were caused by arsenical batches handled in the past, but now no longer so.

Thirdly, I hope you will agree with me that it would be wise to delete the word " paraffin " from the list of causal agents of the notifiable disease

and of the prescribed disease, and to replace it by the term " shale oil and its products," which would further satisfy the school of thought which considers that, when an oil has to be extracted from a shale, it should be referred to as shale oil to distinguish it from mineral oils found in nature as such.

NOTIFICATION OF THE DISEASE

Let me now show you some of the results of statutory notification for the last 30 years (Graph I), having first drawn your attention to the fact that, from 1911 up to the end of 1919, 182 cases of the disease were notified voluntarily, 170 being attributable to coal tar or pitch, and 12 to shale oil.

The annual figure has increased from 45 cases in 1920, to 245 in 1946, but has now fallen to 190.

The great rise from 1923 for the next four or five years is attributable to the discovery of the disease in those using a lubricating mineral oil, especially in the cotton trade in Lancashire, and, to a less extent, in Yorkshire, which, to my knowledge, had shale oil blended with it, especially in earlier days. The number of cases notified from this source reached the maximum in 1927, since when there appears to have been a gradual decline.

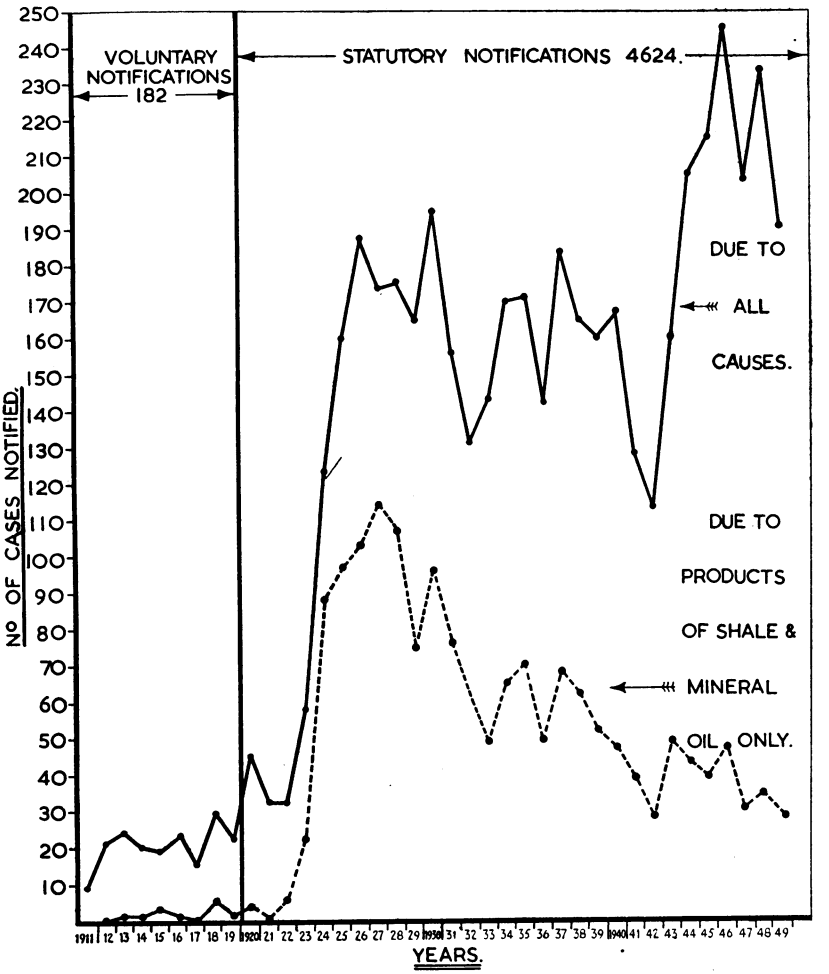
On the other hand, from about 1942, you will observe a sharp rise in the number of notifications which is attributable to cases due to coal pitch and coal tar. This, however, must not be taken at its face value, but can be explained, at least to a great extent, by the fact that, in certain large tar distilleries and gas works, the medical officers have been notifying an appreciable number of early cases, which receive immediate treatment by radiotherapy before any ulceration has occurred, and, in some cases, no microscopic examination was available to show that the tumour had not, as yet, reached the stage of malignancy, let alone ulceration.

I have made an analysis of the 4,632 cases of cutaneous carcinoma notified to the Chief Inspector of Factories from 1920 to the end of 1949 consisting of 4,624 notified under the heading of epitheliomatous ulceration (Table I), and eight under arsenical poisoning, but not included in Table I.

The total number suffering from a carcinoma includes 474 cases from coal gas works, 122 from coke ovens, 11 from low-temperature coal carbonisation, 10 from brick works, 3 from sanitary pipe works, and 2 colliery stationary engine drivers notified from a factory to which the colliery was attached; while there was one maker of furnace crucible pots in an iron works and even a maker of clay pigeons from a mixture of coal pitch and clay.

I must explain that the number of cases coming from such factories as gas works includes others on the plant than the makers of the product, such as blacksmiths, welders, carpenters, and joiners, coopers, electricians, bricklayers, plumbers, fitters, retort or boiler scurfers, boiler stokers, crane drivers, locomotive or lorry drivers, warehousemen, garage men, gate-keepers, clerks, analytical chemists, the familiar mess-room attendant, and the ambulance-room attendant, though such cases mainly exemplify

GRAPH SHOWING THE NUMBER OF CASES OF CUTANEOUS CARCINOMA IN MALES & FEMALES IN ENGLAND, WALES & SCOTLAND NOTIFIED ANNUALLY FROM 1911 – 1949 INCLUSIVE.



THE DOTTED PORTION OF THE GRAPH DENOTES THE NUMBER OF CASES CONTRIBUTED BY SHALE OIL & MINERAL OIL ONLY.

GRAPH I.

TABLE I.—SHOWING ANALYSIS OF CASES OF CUTANEOUS CARCINOMA IN ENGLAND, WALES AND SCOTLAND NOTIFIED FROM 1920 TO 1949

The raised letter R *with attached numeral denotes the number of Rodent Ulcers included in the larger number*

INDUSTRY	NUMBER OF		SITES									CAUSAL AGENTS				
				DESCRIPTION								PRODUCTS OF				
	Cases	Persons	Number	Lower Limb	Scrotum	Vulva	Penis	Clitoris	Trunk	Upper Limb	Head and Neck	Coal	Wood	Shale or Mineral Oil	Coal and Oil	Arsenic
COAL MINING (Maintenance)	2	2	2	—	1	—	—	—	—	—	1	—	—	2	—	—
COAL GAS	474	424	493	5	88	—	15	—	4	145	236R14	373	—	—	101	—
COAL CARBONISATION (L.T.) ..	11	8	11	—	10	—	—	—	—	—	1	10	—	—	1	—
COKE OVENS	122	111	138	1	48	—	2	—	5	23	59R3	119	—	—	3	—
BRICKS	10	10	10	—	7	—	—	—	—	3	—	9	—	—	1	—
SANITARY PIPES	3	3	3	—	2	—	—	—	—	1	—	3	—	—	—	—
POTTERY	2	2	3	—	1	—	—	—	—	1	1	2	—	—	—	—
GLASS (Optical Instruments)	67	30	72	—	6	—	—	—	—	44	21R1	67	—	—	—	—
CHEMICALS	2,108	1,227	2,244	25	321	—	14	—	24	529R1	1,331R6	1,841	—	62	197	8
METAL { Heavy Engineering	12	12	12	—	4	—	—	—	—	5	3	3	—	9	—	—
METAL { Light Engineering ..	47	46	47	1	30	—	1	—	—	7	8R2	—	—	47	—	—

TABLE I (continued)

INDUSTRY	NUMBER OF		SITES									CAUSAL AGENTS				
				DESCRIPTION								PRODUCTS OF				
	Cases	Persons	Number	Lower Limb	Scrotum	Vulva	Penis	Clitoris	Trunk	Upper Limb	Head and Neck	Coal	Wood	Shale or Mineral Oil	Coal and Oil	Arsenic
ELECTRICAL EQUIPMENT ..	67	60	73	—	18	—	—	—	—	28	27	61	—	1	5	—
TEXTILE AND TEXTILE GOODS..	1,555	1,490	1,595	106R3	931	3	27	1	32R1	282R6	213R66	35	2(?)	1,517	1	—
BREWING (Maintenance) ..	1	1	1	—	—	—	1	—	—	—	—	—	—	1	—	—
WOOD WORKING	19	19	21	—	7	—	—	—	—	9	5R1	14	—	2	3	—
BUILDING (Roadmen) ..	17	16	20	—	4	—	—	—	—	9	7	17	—	—	—	—
RAILWAY CARRIAGE BUILDING	4	4	4	—	3	—	—	—	—	—	1	1	—	3	—	—
BOAT AND BARGE BUILDING	3	3	3	—	1	—	—	—	—	2	—	3	—	—	—	—
BLINDS (Maintenance) ..	1	1	1	—	1	—	—	—	—	—	—	—	—	1	—	—
WATER TRANSPORT { Stevedores	59	38	60	—	34	—	—	—	—	1	25	59	—	—	—	—
WATER TRANSPORT { Boatmen	4	4	4	—	—	—	—	—	—	1	3	4	—	—	—	—
ROAD TRANSPORT CARTER (Tar)	1	1	1	—	1	—	—	—	—	—	—	1	—	—	—	—
STORAGE OF OILS	12	10	14	—	2	—	—	—	1	8	3R1	11	—	1	—	—
MAKING PRODUCER GAS ..	19	17	19	1	16	—	—	—	—	1	1	19	—	—	—	—
MAKING CARBURETTED WATER GAS	4	4	4	—	—	—	—	—	—	2	2	—	—	4	—	—
MAKING OIL GAS	8	8	8	—	4	—	—	—	—	3	1	—	—	8	—	—
TOTAL	4,632	3,530R10	4,863	139 R3	1,540	3	60	1	66 R1	1,104R7	1,950R94	2,652	2(?)	1,658	312	8
PERCENTAGE	—	—	100	2·8	31·6	—	1·3	—	1·4	22·7	40·0	—	—	—	—	—
	100	—	—	—	—	—	—	—	—	—	—	57·2	—	35·7	6·7	0·2

the existence of the recognised period of delay after a previous occupation associated with the causal agent.

Even as regards the two gas-works managers included, whom the Registrar General classifies under the high status of civil engineer, one had previously been a fitter and the other a cotton mule spinner.

Glass manufacture is only represented by makers of optical lenses who use coal pitch for embedding the lens. Similarly, there were 67 cases in the manufacture of electrical equipment, including makers of cables in contact with coal tar, and makers of special apparatus such as carbon brushes in contact with pitch dust which, in one case, was capable of reaching a clerk in the adjacent office.

Only 11 cases have been notified from the so-called heavy branch of the metal industry, but include a dipper of metal pipes into coal tar and a crane driver in contact, not only with radiant heat and mineral oil, but also with tarred wood often used as fuel.

You may well ask why it is that, in view of the amount of lubrication required, only 48 cases have been notified from lighter engineering, and even 14 of the men concerned had previously worked in textile trades which alone may have been responsible.

One of the reasons given is that much of the lubrication is performed under a spray of fluid consisting, at any rate in the past, mainly of soap suds ; but I venture to suggest that failure to notify such cases, as do occur in those in contact with a lubricating mineral oil, plays some part.

However, this problem is now occupying the attention of certain research workers officially sponsored, and it is to be hoped that, where they come across cases, they will educate the occupier of the factory and the medical men concerned to perform the statutory duty of notification, unless they prefer to do it themselves. Such a gracious act may even help the worker indirectly to obtain his so-called benefit.

While creosote oil accounts for 11 of the cases in men at warehouses or storage premises (the 12th being a mineral oil storeman at a match works), it is also responsible for 14 of the 19 cases in wood working, arising from proofing timber. One of the creosoters of wood and the one maker of fire-lighters had previously been cotton mule spinners ; two were maintenance men and only one was a cabinet makers' machinist.

Transport is represented by a contractor's tar carter ; four boatmen employed by works to carry the tarry products from place to place by canal, river or sea, and 59 cases in 38 stevedores loading pitch from special wharfs ; while roadmaking provides six cases in tar sprayers and 11 in tar boilers, employed in winter in gasworks or contractors' depots.

Building of ships or of vehicles provide three cases in repairers and painters of boats with tar ; four in repairers of vehicles as, for instance, at railway works, the worker being in contact with mineral oil or with coal tar in the case of a wheelwright who chipped tar off old vehicles ; while another was a maintenance engineer at a factory where blinds were manufactured.

I have classified in such a way as to indicate the industries in which cases have arisen, rather than under the heading of actual occupation, which is the classification used by the Registrar General for fatal cases. Hence, those whose duty it is to keep the factory running, or to keep the machinery in sound condition or healthy, are included in each industry, rather than in a combined maintenance class by themselves. I have, however, made an exception to this rule by collecting under a special heading 17 in contact with coal tar when making producer gas, and 12 in contact with oil tar, eight when making shale oil gas and four when making carburetted water gas.

The number of cases notified is more by 1,100 than the number of persons concerned, and fewer by some 230 than the number of classified sites on which the disease arose, for the reason that in many cases, a person may be notified at one time for a primary growth and later for one or more subsequent primary growths on a similar or different site; or a person may be notified for two or more growths appearing at the same time on different parts of the skin.

In just under 3 per cent. of the persons concerned was the carcinoma described as of the basal-celled type, or rodent ulcer; and as regards the sites, the disease occurred in 40 per cent. on the head and neck, under 32 per cent. on the scrotum, under 23 per cent. on the upper limb, under 3 per cent. on the lower limb, and in only 1·4 per cent. on the trunk and 1·3 per cent. on the penis.

Bearing in mind that the penis is a more common site for the disease than the scrotum, it suggests that possibly some causal agent which is absent from the official list, is more closely concerned. The main causal agents were coal tar or its products in over 57 per cent., shale or mineral oil in under 36 per cent., or contact with both at the same or separate times in under 7 per cent.; arsenic products only being responsible for eight cases.

Wood tar was only encountered by two men at rope works, one a rope maker who also lubricated his machine with a mineral oil, and the other a worker in the so-called "tar house" where wood tar only was said to have been used.

The chemical industries enumerated in Table II provide 45½ per cent. of all the cases notified, the head and neck being mainly affected in over 59 per cent., then the upper limb in 23½ per cent., the scrotum in over 14 per cent. and the lower limb in just over 1 per cent. The cases are mainly attributable to coal tar or its products such as in the three cases of makers of disinfectants, or in the five cases of purifiers of anthracene at a synthetic dye works, or in the 736 cases of patent fuel workers in contact with pitch dust, but in some cases associated in addition with mineral oil. The tar distilling industry, where both coal tar and pitch are encountered, heads the list with 128 cases, and, in addition to many subsidiary workers similar to those at gas-works, this number includes some stable men; and some men in end occupations such as time-keepers and even a lavatory attendant.

TABLE II.—SHOWING ANALYSIS OF CASES NOTIFIED FROM 1920 TO 1949 IN CHEMICAL INDUSTRIES

INDUSTRY	NUMBER OF		SITES							CAUSAL AGENTS			
				DESCRIPTION						PRODUCTS OF			
	Cases	Persons	Number	Lower Limb	Scrotum	Penis	Trunk	Upper Limb	Head and Neck	Coal	Shale & Mineral Oil	Coal and Oil	Arsenic
TAR DISTILLING	1,281	726	1,364	7	181	8	12	400	756[R3]	1,135	—	146	—
PATENT FUEL	736	421	781	10	118	5	6	85	557[R1]	687	—	49	—
SYNTHETIC DYES	5	5	5	—	—	—	—	2	3[R1]	5	—	—	—
SLAG WORKS	12	11	12	—	2	—	—	6	4	11	1	—	—
SHALE OIL REFINING	55	45	56	4	15	—	—	33[R1]	4	—	54	1	—
MINERAL OIL REFINING	2	2	2	—	—	—	—	1	1[R1]	—	2	—	—
OIL AND GREASE	2	2	2	—	2	—	—	—	—	—	1	1	—
LINSEED OIL (Cooper)	1	1	1	—	1	—	—	—	—	—	1	—	—
PAINTS (Bituminous)	1	1	2	—	1	—	—	—	1	—	1	—	—
VARNISHES	1	1	1	1	—	—	—	—	—	—	1	—	—
COLOURS	2	1	2	1	—	—	—	1	—	—	—	—	2
ARSENICALS	1	1	2	1	—	—	1	—	—	—	—	—	1
SHEEP DIP	5	4	10	1	—	1	5	1	2	—	—	—	5
DISINFECTANTS	3	3	3	—	1	—	—	—	2	3	—	—	—
MAINTENANCE (Tank Painter)	1	1	1	—	—	—	—	—	1	—	1	—	—
TOTAL	2,108	1,227[R7]	2,244	25	321	14	24	529[R1]	1,331[R6]	1,841	62	197	8
PERCENTAGE	— 100	— —	100 —	1·1 —	14·3 —	0·6 —	1·0 —	23·5 —	59·3 —	— 87·3	— 2·9	— 9·3	— 0·4

Now, although the Scottish shale oil industry has produced 55 cases, the refining of natural mineral oils has only afforded two cases, though a distillate of such oils was presumably responsible for one of the two cases in oil and grease makers, due to mixing such oil with lime and resin, for a varnish maker, and for a cooper at a linseed oil refinery who coopered old barrels which had contained mineral oil.

I must just refer to three persons who had worked in contact with mineral oil bitumen, a boiler of the material at a paint works making a so-called bitumastic paint a painter using it for painting tanks at a chemical works and a maker of road material from Trinidad Lake Asphalt at a slag works.

I am not convinced that such workers had not at some time or other come into contact with coal tar or mineral oil, though I was assured that the maker of road material had never done so ; but it may be that the exception proves the rule.

As regards bituminous paints it may not be amiss to bear in mind their use in brewery maintenance. Arsenic salts were responsible for five cases in four mixers of arsenical sheep dip, two in a mixer of emerald green at a colour works, and one in a furnaceman making sodium arsenite who eventually died of cancer of the lung, as did at least one of the sheep dip mixers.

Lastly, let us turn to the textile industries (Table III) which include the making up of textile goods, and which provide 33·5 per cent. of all cases of carcinoma notified.

The site mainly affected is the scrotum in over 58 per cent. The cotton industry alone has provided as many as 1,512, or 97 per cent. of all textile cases, all attributable to mineral lubricating oil.

Still more interesting is the fact that of these 1,512 cotton workers, 93 per cent. were contributed by one particular form of spinning—namely, cotton mule spinning—or even over 95 per cent. if we include the 30 ex-mule spinners who had passed into other processes in the cotton trade, let alone 21 others who had passed into other industries under which they have been classified.

In just over 5 per cent. of the persons coming from the textile trades, the disease was of the basal-celled type or rodent ulcer, for mule spinners alone the percentage being just under 5.

The manufacture of wool and worsted, jute, ropes and camel hair belting and the proofing of nets and brattice cloth, and sailmaking (in which case the maker was an ex-fisherman) have accounted for some 43, or 3 per cent., of the textile cases.

I have often wondered why the manufacture of jute and hemp has only produced one notified case of a jute spinner and oiler, for I remember paying a busman's holiday to Belfast, where a Gallup search of the hospital registers disclosed a case of an oiler and greaser in the linen trade. This did not surprise me, as in the early days of shale oil production, this oil was supplied to Northern Ireland, as shown in the list of testimonials

TABLE III.—SHOWING ANALYSIS OF CASES NOTIFIED FROM 1920 TO 1929 IN THE TEXTILE TRADES AND IN THE MAKING UP OF TEXTILE GOODS

INDUSTRY	PROCESSES	NUMBER OF		SITES									CAUSAL AGENTS			
					DESCRIPTION								PRODUCTS OF			
		Cases	Persons	Number	Lower Limb	Scrotum	Vulva	Penis	Clitoris	Trunk	Upper Limb	Head and Neck	Coal	Wood	Shale or Mineral Oil	Coal and Oil
COTTON ..	Preparatory ..	5	5	5	—	3	—	—	—	—	1	1	—	—	5	—
	Carding, Combing	32	32	35	2	12	1	—	—	1	13	6R1	—	—	32	—
	Ring Spinning ..	17	16	18	—	9	1	1	—	—	3	4R2	—	—	17	—
	Mule Spinning ..	1,407	1,349R67	1,437	102R3	879R2	—	23	—	27R1	233R6	173R55	—	—	1,407	—
	Doubling	7	7	7	—	1	—	—	—	—	3	3R1	—	—	7	—
	Winding	2	2	2	—	—	—	—	1	—	1	2	—	—	2	—
	Weaving	17	17	17	—	3	1	2	—	1	3	7R3	—	—	17	—
	Labouring ..	7	7	7	1	3	—	—	—	1	2	—	—	—	7	—
	Maintenance ..	13	13	15	—	5	—	1	—	1	4	4R1	4	—	9	—
	Printing, Dyeing ..	3	3	3	—	2	—	—	—	—	1	—	2	—	1	—
COTTON WASTE	Devilling, &c. ..	2	2	2	—	1	—	—	—	—	1	—	—	—	2	—
OTHER TEXTILES	Wool Carding ..	1	1	1	—	1	—	—	—	—	—	—	—	—	1	—
	Wool Spinning ..	2	2	2	—	—	—	—	—	—	—	2R1	—	—	2	—
	Wool, Other ..	3	3	3	—	1	—	—	—	1	—	1R1	—	—	3	—
	Camel Hair Belting	1	1	1	—	1	—	—	—	—	—	—	—	—	1	—
	Jute Spinning ..	1	1	1	—	1	—	—	—	—	—	—	—	—	1	—
	Rope Making ..	5	5	6	—	3	—	—	—	—	2	1	—	2(?)	3	—
	Net Repairing ..	18	17	21	1	5	—	—	—	—	8	7	18	—	—	—
TEXTILE GOODS	Sails (Ex-Fishing) ..	1	1	1	—	—	—	—	—	—	—	1	1	—	—	—
	Felt Proofing ..	5	5	5	—	1	—	—	—	—	2	2R1	4	—	—	1
	Brattice Cloth Proofing	6	5	6	—	—	—	—	—	—	5	1	6	—	—	—
TOTAL		1,555	1,490R78	1,595	106R3	931R2	3	27	1	32R1	282R6	213R66	35	2(?)	1,517	1
PERCENTAGE		—	—	100	6·6	58·3	—	1·7	—	2·0	17·6	13·3	—	—	—	—
		100	—	—	—	—	—	—	—	—	—	—	2·25	—	97·55	—

of Young's patent mineral oil issued by a firm of oil blenders in 1854, and addressed to cotton, silk, flax and worsted spinners.

THE DISEASE IN FEMALES

Here I must say a few words about the disease in females.

During the last war, many women took on work which had formerly been performed by men, and so we find women occupied as chimney sweeps, window cleaners, painters and even labourers in gas-works and tar distilleries, which latter industries have now for the first time provided four cases contributed by three women.

You will see from Table IV that only 28 cases have been notified, including two optical lens makers and a rope machinist.

Three-quarters of the number come from the cotton trade ; firstly from the machines which deal with the cotton after it has left the carding engine (which is manned by males) and prior to spinning, then ring spinning, winding, and weaving—mainly occupations for females except for the overlookers, and mill mechanics.

There are now even two cases in females from the mule spinning room, though such few women who work in this room are not granted the senior position of spinners, but only act as creelers behind the mule, or as piecers at the mule, and even as such only in one or two districts.

The exposed parts were mainly affected, the head and neck, in the pitch and tar workers, and more frequently on the upper limb in cotton workers, though the cotton trade supplied four cases of the disease on the external genital organs.

I once thought it might be possible to obtain some valuable information as to the occurrence of cutaneous carcinoma in women by extracting from Lancashire Registers of deaths some 826 cases of cancer in women, 175 (or over 21 per cent.) of these being cutaneous. But I found to my sorrow that, of these 175, well over 80 per cent. were merely described as housewives, or even only as daughters, wives or widows. The result was no more encouraging when, owing to the courtesy of the Registrar General, I perused the list of fatal cases of carcinoma of the vulva occurring in England and Wales during one year.

But, some years ago, at my suggestion, a young gynæcologist in Manchester, Dr. Gerrard, traced some 100 cases of carcinoma of the vulva out of 217 admitted to five Lancashire hospitals and, after full investigation as to occupation, he found that over 59 per cent. were, or had been, cotton operatives, although only 28 per cent. of the admissions of women related to the staple cotton industry. As a comparison he also traced 14 of the 33 cases he collected from a Yorkshire hospital. Unfortunately, he included, under the heading of " Housework only," any who had previous employment for less than 10 years.

The old practice of sweeping up the oily fluff, especially from under the loom, in a squatting position, caused, according to statements made to me by older female weavers, a noticeable dirty deposit between the

TABLE IV.—SHOWING NOTIFICATION OF CUTANEOUS CARCINOMA IN FEMALES FROM 1920 TO 1949

INDUSTRY OR OCCUPATION	No. of			Sites				Causal Agents	
	Cases	Persons	Sites	Lower Limb	External Genitals	Upper Limb	Head and Neck	Coal-tar or Pitch	Mineral Oil
Gas Works ..	1	1	1	—	—	—	1	1	—
Glass (Optical Lenses) ..	2	1	2	—	—	1	1	2	—
Tar Distilling	3	2	3	—	—	—	3	3	—
Cotton :									
Combing, Drawing	10	10	10	1	1	7	1	—	10
Ring Spinning ..	6	6	6	—	1	3	2	—	6
Mule Spinning ..	2	2	2	1	—	—	1	—	2
Winding	2	2	2	—	1	1	—	—	2
Weaving	1	1	1	—	1	—	—	—	1
Ropes :									
Machinist ..	1	1	2	—	—	1	1	—	1
TOTAL ..	28	26	29	2	4	13	10	6	22
PERCENTAGE	—	—	100	6·9	13·8	44·8	34·5	—	—
	100	—	—	—	—	—	—	21·5	78·5

upper part of the thighs which was prevented when bloomers or knickers replaced the old-fashioned open drawers.

In this connection it is of interest to call to mind the not uncommon practice in mills where oily textile waste is available of using it for lavatory toilet. Mr. Eric Stacey of Sheffield, a Fellow of this College and former Certifying Factory Surgeon, has also pointed out that in his home town there have been, in 10 years, 150 cases of carcinoma of the vulva, and he suggests that buffer girls working in the silver and cutlery industry may suffer unduly from this disease.

ANALYSIS OF FATAL CASES

There is another source of information available—namely, the certificates of death occurring in England and Wales; Scotland having a separate Register Office for this purpose.

But we must not overlook the fact that the site of the disease at death does not give a true picture of its extent, or the sites on which it may arise during life as, owing to the surgeon's skill and improved technique, those who previously would have died of a primary growth on one particular site now live, either never to have a recurrence, or to contract one or many more primary growths on different sites, until the last one proves fatal.

The official figure for the annual number of deaths from cancer of all sites of the body has risen from over 15½ thousand to well over 40 thousand in 1948, that is more than two and a half times as many as in 1911.

The official number of fatal cases of cancer (carcinoma and sarcoma) of the skin—namely, 29,025, for the same period is only about 3 per cent. of the number for all fatal cases of cancer, this number excluding cases of the lip other than rodent ulcers, and also 175 cases of cancer of the anus, which site was only transferred to the skin group in 1940 (Graph II).

The peak seems to have been reached round about 1930; since then there has been a decline.

But the number of cases from 1911 to 1945 which I have been able to analyse is 27,215, which exceeds the official figure of 26,930 for the same period by 285, owing to the inclusion by me of cases which had been allocated elsewhere by the Registrar General because the tumour was associated with some other disease which appeared to be the more immediate cause of death.

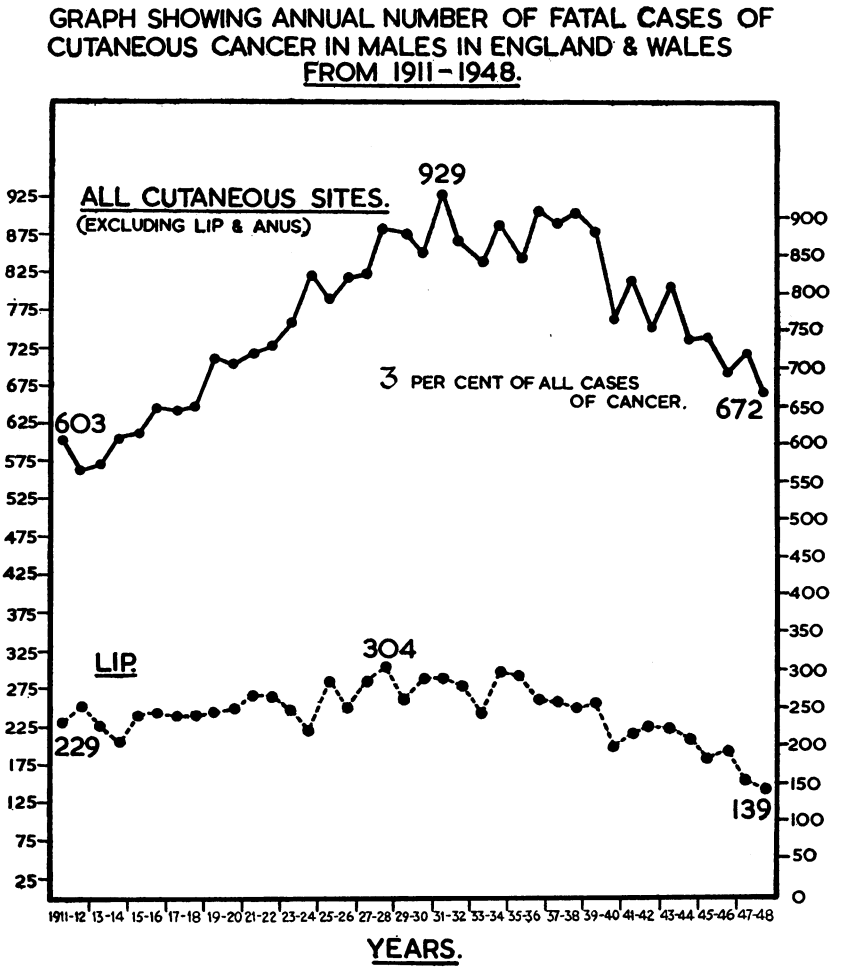
Just over 6 per cent. of my total number were described as sarcomata or melanomata, with which I do not propose to deal to-day, leaving 25,545, of which 23 per cent. were described as basal-celled carcinomata, or rodent ulcers.

Table V shows that the site of the disease at death was the head and neck in 55·1 per cent.; the penis in 20·6 per cent.; the scrotum in 7·9 per cent.; the upper limb in 6·1 per cent.; the trunk in 4·9 per cent.; and the lower limb in 4·4 per cent.; while in 1·0 per cent. the site was not specifically stated.

For the purpose of obtaining the rate per million of each population, at risk I have had to use the figures obtained at the 1931 census as being the best available date between 1911 and 1945; and I have classified the occupied and retired together, having, of course, added to the figure for each population, at risk, the separate official figure for such of that population as had retired.

TABLE V.—SHOWING ANALYSIS OF 25,545 *FATAL* CASES OF CUTANEOUS CARCINOMA IN ENGLAND AND WALES, 1911-1945

SITES	CARCINOMA		TOTAL	%	RATE per million
	SQUAMOUS	BASAL			
HEAD AND NECK ..	8,346	5,728	14,074	55.1	27·48
PENIS	5,264	2	5,266	20·6	10·28
SCROTUM	2,007	4	2,011	7·9	3·93
UPPER LIMB ..	1,489	73	1,562	6·1	3·05
TRUNK	1,196	64	1,260	4·9	2·46
LOWER LIMB ..	1,099	23	1,122	4·4	2·19
NOT STATED ..	248	2	250	1·0	0·49
TOTAL ..	19,649	5,896	25,545	100	49·88
PERCENTAGE	77%	23%	100%	—	—


GRAPH SHOWING ANNUAL NUMBER OF FATAL CASES OF CUTANEOUS CANCER IN MALES IN ENGLAND & WALES FROM 1911-1948.
ALL CUTANEOUS SITES.
(EXCLUDING LIP & ANUS)
929
603
672
3 PER CENT OF ALL CASES OF CANCER.
LIP.
304
229
139
925 875 825 775 725 675 625 575 525 475 425 375 325 275 225 175 125 75 25
900 850 800 750 700 650 600 550 500 450 400 350 300 250 200 150 100 50 0
1911-12 13-14 15-16 17-18 19-20 21-22 23-24 25-26 27-28 29-30 31-32 33-34 35-36 37-38 39-40 41-42 43-44 45-46 47-48
YEARS.

GRAPH II.

I must make it quite clear that only the crude rate has been calculated, by dividing the number of cases by 35 (representing the number of years dealt with), multiplied by a million, and divided by the number constituting the particular population at risk.

No attempt has been made to correct for age distribution or other elaborate statistical requirements but, in defence, I submit that the figures involved are so substantial as to minimise error and, at best, I am only attempting to give you a crude but, I hope, suggestive picture, in spite of the fact that the occurrence of two wars during the period in question must have some incalculable influence.

According to my calculations, under 50 per million of the general population died of cutaneous carcinoma, the disease on the head and neck being responsible for 27·48 per million, on the penis for 10·28, on the scrotum for 3·93, on the upper limb for 3·05, on the trunk for 2·46, and on the lower limb for 2·19 per million.

The Registrar General divides the population into 32 main Orders, which I have rearranged in Table VI to indicate the relative frequency.

You will observe that 12 of the Orders show an excess in incidence per million over that of the average for the general population, the list being headed by the fishermen; followed by those who treat non-metalliferous mine and quarry products such as makers of coal gas and coke; then textile workers; agricultural workers; others and undefined workers such as general labourers, watchmen, timekeepers, etc.; stationary engine drivers; builders, bricklayers, stone and slate workers, contractors; makers of bricks, pottery and glass; workers in precious metals and electro-plate; workers in skin and leather and leather-substitute goods; workers in mixed or undefined materials such as makers of musical instruments, vehicles, ships and boats; and makers of textile goods and articles of dress.

Then comes the figure for the incidence in the general population (occupied and retired) over 14 years of age, which however, is only the average rate for all, though it is normally used for comparison in default of some more satisfactory figure.

While it is not surprising to find the clerks last but one on the list, thereby being a temptation to use their figures of incidence as a basis for comparison with all other occupations, instead of the average incidence in the general population, it seems strange to find the incidence in electricians and electrical apparatus makers and fitters the lowest of all, since we know that pitch and tar are used with ill effects in some branches of the trade, though separate figures for the population at risk in such branches are not available. But, maybe the widespread use of electricity has not yet existed long enough to show a significant incidence.

But when these Orders are further subdivided, certain occupations are revealed for which the number of the population at risk is available and for which the calculated incidence is found to be very significant, either for cutaneous carcinoma in general or for the disease on one

TABLE VI.—SHOWING THE 32 ORDERS OF THE REGISTRAR GENERAL'S CLASSIFICATION OF OCCUPATIONS, AND THE INCIDENCE PER MILLION IN EACH POPULATION AT RISK

Order	Occupied and Retired	Number of certificates	Incidence per million
I	Fishermen	232	226·78
IV	Workers in the Treatment of Non-Metalliferous Mine and Quarry Products	132	149·82
XII	Textile Workers	1,185	105·79
II	Agricultural Occupations	3,907	92·99
XXXI	Other and Undefined Workers. (General labourers, Watchmen, Timekeepers, Fire Brigade, &c.	3,863	72·43
XXX	Stationary Engine Drivers, Dynamo and Motor Attendants	374	64·70
XVIII	Builders, Bricklayers, Stone and Slate Workers; Contractors	1,637	63·78
V	Makers of Bricks, Pottery and Glass	153	58·14
VIII	Workers in Precious Metals and Electro-Plate	47	54·10
XI	Workers in Skins and Leather, and Makers of Leather and Leather Substitute Goods (not Boots or Shoes)	94	53·54
XXI	Workers in Mixed or Undefined Materials (Musical Instruments, Vehicles, Ships and Boats, &c.)	126	50·98
XIII	Makers of Textile Goods and Articles of Dress	520	50·71
	GENERAL POPULATION	25,545	49·88
XXVII	Persons engaged in Personal Service (including Institutions)	845	49·52
XV	Workers in Wood and Furniture	920	49·51
XXIV	Persons employed in Public Administration and Defence	613	48·38
VI	Workers in Chemical Processes; Makers of Paints, Oils, &c.	68	46·70
III	Mining and Quarrying Occupations	1,605	45·06
XXII	Persons employed in Transport and Communication	2,614	45·03
XIX	Painters and Decorators	426	44·69
XIV	Makers of Foods, Drinks and Tobacco	263	41·82
VII	Metal Workers (not Electro-Plate or Precious Metals)	1,989	40·19
XXV	Professional Occupations	528	38·26
X	Makers of Watches, Clocks and Scientific Instruments	29	37·59
XX	Workers in other Materials (Rubber, Vulcanite, Bone, Ivory, Feathers, Brushes, &c.)	40	36·88
XXIII	Commercial, Finance, Insurance	1,786	32·97
XXIX	Warehousemen, Storekeepers and Packers	299	32·29
XXVI	Persons professionally engaged in Entertainments and Sport	99	29·85
XVII	Printers and Photographers	150	26·66
XVI	Makers of and Workers in Paper and Cardboard; Bookbinders, &c.	36	26·27
XXXII	Not Gainfully Occupied	376	18·44
XXVIII	Clerks and Draughtsmen; Typists	494	16·97
IX	Electrical Apparatus Makers and Fitters and Electricians	95	14·24

particular site, the best example being the chimney sweeper who is included in Order XVIII, which embraces all individuals in personal service.

The subdivisions (shown in Tables VII-XIV) are far from exhaustive as, rightly or wrongly, I have omitted any occupations providing less than five cases and, further, had it been possible to extend the lists, other occupations, providing five or more cases, would be forthcoming with a lower incidence than those presented, though higher than the average.

It must be appreciated that in some occupations there may be contact with more than one form of chemical agent, such as pitch and oil in maintenance men in patent fuel works, or with a chemical agent and radiant energy, as in the case of such outdoor workers as roadmakers, fishermen, seamen, and stevedores on a pitch wharf, in contact with the sun's rays and a tarry product; or such indoor workers as gasworks stokers in contact with tar and radiant energy from the furnace.

It is possible that the separate agents may both play a part on one or other site of the skin such as the exposed hand of the fisherman, or of the railway platelayer in contact with creosoted sleepers; or each agent may choose a separate site as in the case of fishermen, a covered site like the scrotum or penis being affected by tar from the nets, and the head and neck mainly by the sun's rays.

The outdoor workers in contact with the sun's rays predominate, with main incidence on exposed parts—the head and neck in proprietors and managers of livery stables, owners, agents and managers of coal mines, harbour, dock and canal officials, and gamekeepers (who are included among those in personal service); or on the head and neck and upper limb in the case of navigating officers and pilots, estate labourers, farm bailiffs and shepherds.

But other outdoor workers have, in addition, an incidence on some covered sites—the lower limb in gardeners and the lower limb and trunk in farmers, (both accredited with using some soot on the land) or the penis in stevedores and coal boat loaders, or the penis and scrotum in bargemen, boatmen and seamen, and, in addition, the lower limb in ship-builders, and the trunk in fishermen, all (except perhaps the coal boat loader) usually in some contact with tar or tarry products.

The fact that coachmen and drivers of horse-drawn passenger vehicles are affected on such covered parts as the penis, scrotum, trunk and lower limb, and grooms on the penis and upper limb, may conceivably be accounted for by the use of saddle and axle grease; and in this connection it may be of interest to note that saddle and harness makers have an incidence on the penis of more than twice that of the average, (and also on the lower limb, if four cases be allowed, making an incidence more than seven times the average). Nevertheless, the incalculable influence (in favour or against the validity of the figures) of the replacement of horse transport by mechanical transport since the beginning of this century must be borne in mind.

TABLE VII.—TOTAL CARCINOMATA

Occupation	No. of Cases	Incidence per mill.
GENERAL POPULATION	25,545	49·88
Chimney Sweeps ..	182	791·70
Drivers of Horse-drawn Passenger Vehicles	130	583·82
Puddlers	49	574·24
Textile Card, Comb, and Frame Tenters	29	470·67
Proprietors and Managers of Livery Stables	20	441·60
Textile Spinners and Piecers	637	314·36
Chemical Distillers ..	15	309·20
Skilled Makers of Coal Gas, Coke, etc. ..	114	237·39
Fishermen	232	226·78
Glass Teasers ..	6	216·16
Navigating Officers and Pilots	117	182·41
Barge and Boatmen ..	141	175·26
Estate Labourers ..	33	171·55
Coal Mine Owners, Agents and Managers	27	168·32
Gunsmiths	8	162·48
Glass Blowers and Finishers	23	162·21
Ship and Boat Builders	99	151·04
Bleachers', Dyers', Finishers' Labourers	26	147·09
Farm Bailiffs ..	55	146·19
Shepherds	56	140·94
Skilled Brewers ..	10	139·40
Coopers	42	136·12
File Cutters (Hand or Machine)	6	132·38
Stevedores	24	131·45
Harbour, Dock, Canal Officials	10	122·60
Farmers	1,109	121·14
Hat Plankers, Formers, and Stiffeners ..	26	119·29
Wheelwrights ..	47	119·24
Church, Chapel, and Cemetery Officials	24	118·03
Gamekeepers ..	49	117·11
Lock Keepers ..	14	116·72
Stonemasons ..	170	115·72
Seamen, Deck Hands	167	114·99
Coal Boat Loaders and Dischargers ..	34	113·97

TABLE VIII.—BASAL-CELLED CARCINOMATA ONLY

Occupation	No. of Cases	Incidence per mill.
GENERAL POPULATION	5,896	11·51
Puddlers	19	222·66
Proprietors of Livery Stables	8	176·64
Drivers of Horse-Drawn Passenger Vehicles	29	130·23
Navigating Officers and Pilots	43	67·04
Harbour, Dock, Canal Officials; Pier-masters	5	61·30
Fishermen	60	58·65
Chimney Sweeps ..	13	56·55
Glass Blowers and Finishers	8	56·42
Estate Labourers ..	10	51·98
Coal Mine Owners, Agents, and Managers	7	43·63
Coal Boat Loaders and Dischargers ..	13	43·58
Ship and Boat Builders	28	42·71
Church, Chapel, and Cemetery Officials	8	39·34
Stevedores	7	38·34
Shepherds	15	37·75
Occupied Abroad ..	16	37·66
Farm Bailiffs ..	14	37·21
Seamen, Deck Hands	54	37·18
Metal Miners (above ground)	5	36·67
Gamekeepers ..	14	33·46
Skilled Makers of Coal Gas, Coke, etc. ..	16	33·32
Farmers	300	32·91
Stonemasons ..	43	29·27
Coopers	9	29·17
Grain Millers ..	7	28·26
Gardeners	228	27·85
Potter's Ware Makers, Casters, Finishers ..	9	27·84
Textile Sizers, Slashers, Tapers	5	27·55
Hat Plankers, Formers, and Stiffeners ..	6	27·53
Painters (Employers and Managers) ..	13	27·40
Saddlers and Harness Makers	7	27·15
Coal Dealers ..	26	27·01

TABLE IX.—CARCINOMA OF HEAD AND NECK

Occupation	No. of Cases	Incidence per mill.
GENERAL POPULATION	14,074	27·48
Puddlers	39	457·04
Drivers of Horse-drawn Passenger Vehicles	66	296·40
Proprietors and Managers of Livery Stables	12	264·96
Glass Teazers and Founders	5	180·14
Card, Comb and Frame Tenters	8	146·07
Chimney Sweeps	33	143·55
Navigating Officers and Pilots	92	142·43
Fishermen	145	141·76
Owners, Agents and Managers of Coal Mines	18	112·21
Barge and Boatmen	89	110·63
Shepherds	43	108·22
Estate Labourers	20	103·97
Farm Bailiffs	38	101·00
Harbour, Dock, Canal Officials ; Piermasters	8	98·08
Ship and Boat Builders	64	97·64
Gamekeepers	39	93·21
Glass Blowers and Finishers	13	91·68
Skilled Makers of Coal Gas, Coke, etc.	41	85·38
Stevedores	15	82·16
Farmers	738	80·98
Metal Miners (above ground)	11	80·68
Seamen, Deck Hands	115	79·18
Church, Chapel and Cemetery Officials	16	78·68
Undertakers	10	78·51
Lock Keepers	9	75·03
Wheelwrights	29	73·57
Hat Formers, Plankers and Stiffeners	16	73·41
Coal Boat Loaders and Dischargers	21	70·39
Gardeners	540	65·93
Stonemasons	96	65·35
Glass Moulders and Pressers	6	64·61
Occupied Abroad	27	63·56
Civil Engineers	53	62·17
Coopers	19	61·58

TABLE X.—CARCINOMA OF UPPER LIMB

Occupation	No. of Cases	Incidence per mill.
GENERAL POPULATION	1,562	3·05
Drivers of Horse-drawn Passenger Vehicles	8	35·93
Skilled Makers of Coal Gas and Coke, etc.	15	31·24
Photographers	10	27·86
Estate Labourers	5	25·99
Fishermen	22	21·51
Farm Bailiffs	7	18·66
Barge and Boatmen	13	16·16
Navigating Officers and Pilots	10	15·59
Stonemasons	21	14·29
Platelayers	25	14·17
Shepherds	5	12·58
Farmers	106	11·63
Watchmen	13	11·10
Gardeners	90	10·90
Grooms, Horsekeepers	9	8·38
Railway Officials : Station Masters, etc.	6	8·07
General Labourers	160	6·83
Stone Miners and Quarriers	7	5·97
Textile Spinners and Piecers	12	5·92
Medical Profession	6	5·73
Seamen, Deck Hands	8	5·51
Iron and Steel Foundry Furnace Labourers	6	5·45
Stationary Engine Drivers	16	5·42
Coal Dealers	5	5·20
Navvies	31	4·92
Drivers of Horse-drawn Goods Vehicles	23	4·87
Dock Labourers	17	4·79
Signalmen	5	4·69
Bricklayers	18	4·13

TABLE XI.—CARCINOMA OF PENIS

Occupation	No. of Cases	Incidence per mill.
GENERAL POPULATION	5,266	10·28
Drivers of Horse-drawn Passenger Vehicles	36	161·68
Card, Comb and Frame Tenters	8	129·84
Puddlers	5	58·59
Chimney Sweeps	13	56·55
Wool Sorters	7	54·87
Glass Blowers and Finishers	7	49·37
Bleachers', Dyers', Finishers' Labourers	8	45·26
Maltsters and Skilled Brewers	8	42·49
Coopers, Hoop Makers, Benders	12	38·89
Coal Boat Loaders and Dischargers	11	36·87
Boiler Scalers	9	34·25
Potter's Ware Makers	10	30·93
Grooms, Horse-keepers	32	29·80
Mechanical Engineers' Labourers	18	29·75
Hat Formers, Plankers, Stiffeners	6	27·53
Ship and Boat Builders	18	27·46
Stevedores	5	27·39
Silver and White Metal Smiths	5	27·37
Barge and Boatmen	22	27·35
Skilled Makers of Coal Gas, Coke, etc.	13	27·07
Haulage Contractors	16	25·65
Wheelwrights	10	25·37
Innkeepers, Publicans	66	24·65
Railway Officials: Station Masters, etc.	18	24·21
Saddle and Harness Makers	6	23·27
Drivers of Horse-drawn Goods Vehicles	109	23·10
Smiths and Skilled Forgemen	89	23·05
Stonemasons	32	21·78
Curriers, Leather Dressers	6	21·09
Seamen, Deck Hands	29	19·97

TABLE XII.—CARCINOMA OF SCROTUM

Occupation	No. of Cases	Incidence per mill.
GENERAL POPULATION	2,011	3·93
Chimney Sweeps	125	543·75
Textile Spinners and Piecers	476	234·91
Chemical Distillers and Stillmen	9	185·50
Card, Comb and Frame Tenters	7	113·61
Skilled Makers of Coal Gas and Coke, etc.	35	72·08
Bleachers', Dyers', Finishers' Labourers	7	39·60
Breakers, Rag Grinders, Hecklers, Willowers	10	35·61
Drivers of Horse-drawn Passenger Vehicles	7	31·44
Strippers and Grinders, Card Room Jobbers	8	31·18
Fishermen	29	28·35
Engine and Machine Oilers and Greasers	5	17·62
Mechanical Engineers' Labourers	9	14·88
Chemical Processmen and Furnacemen	5	10·84
Watchmen	12	10·25
Barge and Boatmen	7	8·70
Ship and Boat Builders	5	7·62
Caretakers and Office Keepers	9	7·53
Stationary Engine Drivers	22	7·45
Iron and Steel Foundry Furnace Labourers	8	7·27
Grocers and Assistants	49	7·26
Metal Furnacemen and Assistants (not Puddlers or Shinglers)	5	6·94
Seamen, Deck Hands	10	6·89
General Labourers	145	6·19
Boiler Firemen and Stokers	11	6·03
Making and Repairing Roads in Coal Mines	13	5·24

TABLE XIII.—CARCINOMA OF TRUNK

Occupation	No. of Cases	Incidence per mill.
GENERAL POPULATION	1,260	2·46
Drivers of Horse-drawn Passenger Vehicles	6	26·94
Chimney Sweeps	6	26·10
Occupied Abroad	7	16·48
Skilled Makers of Coal Gas and Coke, etc.	7	14·58
Textile Spinners and Piecers	24	11·84
Fishermen	10	9·77
Legal Profession	6	7·98
Stonemasons	10	6·81
Wool and Hosiery Scourers, Calenders, Finishers	5	5·75
Stationary Engine Drivers	16	5·42
Navy and Marines	13	5·21
Clergymen	7	5·16
Foundry Metal Moulders	13	5·10
Caretakers	6	5·02
Drivers of Horse-drawn Goods Vehicles	23	4·87
Medical Profession	5	4·78
lasterers	5	4·14
Weavers	8	3·98
Boiler Firemen and Stokers	7	3·85
Farmers	35	3·84
Smiths and Skilled Forgemen	14	3·63
General Labourers	85	3·62
Tinsmiths, Sheet Metal Workers	5	3·53

TABLE XIV.—CARCINOMA OF LOWER LIMB

Occupation	No. of Cases	Incidence per mill.
GENERAL POPULATION	1,122	2·19
Drivers of Horse-drawn Passenger Vehicles	6	26·94
Ship Builders	6	9·15
Watchmen	10	8·54
Makers of Leather and Substitute Goods (not Boots)	6	7·73
Signalmen	7	6·57
Navy and Marines	12	4·81
Bootmakers and Re-pairers	11	4·78
Stationary Engine Drivers	14	4·74
Dock Labourers	16	4·51
Innkeepers, Publicans	12	4·48
Boiler Firemen and Stokers	8	4·39
Caretakers and Office Keepers	5	4·18
Drivers of Horse-drawn Goods Vehicles	19	4·02
Textile Spinners and Piecers	8	3·95
General Labourers	88	3·76
Farmers	33	3·62
Boiler Makers, Platers and their Labourers	6	3·47
Gardeners	27	3·29
Agricultural Labourers in Charge of Cattle	7	3·14
Builders' Labourers	10	3·01
Weavers	6	2·99

As to those occupied abroad (whether in or out of doors) in contact with more intensive sun rays than encountered in this country, the fact that, in addition to the head and neck, the trunk is significantly affected (including rodent ulcer on the chest in two cases and on the back in one) suggests that in hot climates this site may tend to be uncovered.

The indoor workers include those in contact with coal tar or its products, with a special incidence on the scrotum, such as chemical distillers, chimney sweeps (with also an incidence on the head and neck, penis, and trunk), coal gas workers (with also an incidence on head and neck, penis, trunk and upper limb); and those in contact with mineral oil, including textile strippers and grinders, willowers and rag-grinders, stationary engine drivers, engine and machine oilers, and mechanical engineers' labourers, all with a special incidence on the scrotum; textile

card tenters (with also an incidence on head and neck and penis) ; textile spinners and piecers (with also an incidence on upper limb, lower limb and trunk); bleachers, dyers and finishers' labourers (with also an incidence on the penis), though radiant heat may play a part ; wool sorters, and curriers and leather dressers, with an incidence on the penis, and makers of all leather, and leather substitute goods, with an incidence on the lower limb ; and signalmen with an incidence on the lower limb but also to a less extent on the upper limb.

The makers of hand-made boots and shoes (who are classified as makers up of textile goods and articles of dress), with an incidence on the lower limb, and, to a less extent, on the penis, may possibly be accounted for by the ball of soft pitch used, or formerly used, for applying to the threads, or by the boot blacking or other greasy dressing and, in this connection, it may be of interest to note the posture of the bootmaker pictured with the boot on his lap.

Much stress cannot be laid on any figures of incidence for what may be described usually as an end occupation such as that of caretaker, time-keeper, hotel or lodginghouse keeper, gatekeeper, lock keeper, commissionaire, watchman and even shopkeeper or those who have risen to a higher position in an industry, such as station-masters, owners, agents and managers of coal mines, and church, chapel and cemetery officials ; as sampling investigation of such may reveal a previous occupation in the same or separate industry with a recognised cause, though perhaps certain end occupations from their nature may assist in causation or in choosing the site. That the incidence is on the head and neck in church, chapel and cemetery officials (who include sextons, vergers, parish clerks and cemetery superintendents), would tend to suggest the influence of an outdoor life. Sample investigation showed that one was also a tax-collector and another had previously been a grave digger.

There are, of course, important groups of persons, including many which could not be included in these tables, with an incidence above the average for cutaneous carcinoma in general or for the disease on one or other particular site, especially if a covered one for which the cause remains obscure. This supplies an intriguing problem for further study and research, such as those in contact with one or other form of irritant dust, in which so far no particular carcinogen has been discovered, as for instance coal boat loaders, metal miners below ground, stone miners and quarriers, boiler scalers, with an incidence on the penis ; stonemasons, with an incidence on the penis and trunk ; plasterers with an incidence on the trunk ; and bricklayers with an incidence on the upper limb. But we should not lightly attribute these to mechanical irritation alone without further chemical research as we know that certain clays have an arsenical content ; that an abrasive dust—asbestos—has recently been held accountable for cancer of the lung ; though apparently no such accusation has been made against silica, while the ill effect of radioactive dust on the lungs of certain miners abroad is now well known.

But to-day I wish to draw your attention mainly to the indoor workers in contact with some form of radiant energy because, up to now, there has been a tendency to under-estimate the importance of this contact. I must, however, leave it to the radiologist to decide which form of radiant energy is responsible.

Hence reference must be made to the puddlers in the heavy metal industry, who stir the molten iron to make it malleable, glass blowers and finishers, coopers, wheelwrights, hat plankers, formers and stiffeners, all with a significant incidence on the penis and head and neck ; silver and white metal-smiths, with an incidence on the penis, smiths and skilled forgemen, also with an incidence on the penis and to a less extent on the trunk, foundry metal moulders, with an incidence on the trunk, as also with tinsmiths and sheet metal workers to a less extent, and boiler makers and their labourers with an incidence on the lower limb.

Radiant energy may also play a part in causation of the disease among the small class of gunsmiths, though some may have limited contact with a mineral oil, and, if a figure of less than five cases be accepted, they would show a significant incidence for four cases on the head and neck and for three cases on the penis, three and five times respectively greater than the average.

The scrotum is mainly affected in iron and steel foundry furnace labourers (with an incidence on the upper limb to a less extent), metal furnacemen and their assistants, other than puddlers and shinglers (with an incidence on the penis, and head and neck to a less extent), and boiler firemen and stokers (with an incidence also on the trunk and lower limb), though we know that some stokers may also have contact with oil and soot.

In this connection it may be of some interest to place on record that one worker in the heavy metal industry, with a carcinoma of the ear, who dipped pipes into coal tar for 16 years, and so was notified, had previously been a puddler.

Perhaps the makers of alcoholic drinks, especially skilled brewers, maltsters and cellarmen, each with an incidence on the penis, should be included amongst those who have contact with radiant heat, were it not that the sellers of these drinks—the publicans—have an incidence on the same site, though theirs, to some extent, is an end occupation.

The presence of the photographers and members of the medical profession in the list for the upper limb is accounted for by the action of X-rays, all the 10 photographers being radiographers and four of the six medical men being radiologists.

The presence of the medical and legal profession and that of the clergy cannot be accounted for satisfactorily in the table for the trunk, though investigation of one solicitor revealed that he had suffered from an X-ray burn in the sacral region due to treatment 21 years before, and it was also revealed that one medical man had been treated with X-rays for psoriasis on the same site many years previously, no reference being made to arsenical treatment.

In 1909 Mr. Cecil Rowntree in his Hunterian Lecture referred to nine American and 11 English cases of carcinoma due to X-rays, after four to 16 years of first contact, the earliest case in England being in 1904; and in 1922 he reported two further cases, making a total of 13 to that date in his English series.

Between 1911 and 1945 there were in my series of fatal cases of cutaneous carcinoma at least 31 attributable to X-rays; two in makers and testers of X-ray apparatus (on the upper limb in one and on both upper limb and chest in the other who came from America): six in those to whom the rays had been applied many years previously, either for diagnosis of an injury to the chest of a Naval Stoker, or treatment for psoriasis on the back of one medical man not otherwise associated with X-rays, or for lupus (on the face of an electrical crane driver and of a man who, after onset and treatment of the carcinoma, became a lamp assistant at a light clinic where there was no X-ray apparatus) or for an undescribed disease (on the back of a solicitor and on the neck of a man of independent means): and 23 in those who had manipulated the apparatus for treatment, four of whom were medical specialists, the remaining 19 being medical electricians or radiographers or ex-radiographers, such as a commissionaire (previously a qualified male nurse at a radium institute), an infirmary secretary, an army pensioner (previously a radiographer in the R.A.M.C.), and one who had become a man of independent means. In these 23 cases the disease was on the upper limb (17), on both upper limb and chest (1), on the chest alone (1), on the back (1), and on the face (3).

The case of an ex-sergeant in the New Zealand Forces who had worked for some years as radiographer at a military hospital was excluded from my series because the growth, originating in a pigmented mole on the right breast, was described as a melanotic sarcoma.

During the perusal and sampling investigation of the cases in my series I was struck by references to syphilis and, more frequently, to lupus and sometimes to its previous energetic treatment by radiotherapy; and also to psoriasis and its previous treatment by one or other form of radiotherapy or by a medicinal arsenical preparation, which was also used for the eczematous, the epileptic, the invalid from birth, the imbecile, and the man of leisure or of independent means. I have not so far been able to trace a case of psoriasis treated by a tar ointment or bath in which the patient has not also had arsenical treatment.

Lastly, no searcher after the truth should omit enquiries as to hobbies in addition to occupation, as in the case of a director of a railway who died of a carcinoma on the hand which, I was informed, he himself considered was due to manipulation of tarred ropes on his luxurious yacht.

CONCLUDING REMARKS

It has been suggested to me in some quarters that such information as I have given you to-day has, as its aim, prevention rather than cure. I confess that regulations, mechanical appliances to reduce the number of

workers at risk, suitable washing accommodation, and even locally applied exhaust ventilation, as at present installed in such places as patent fuel works, can only have a limited, though educational influence, so long as a carcinogen is still present in the material manipulated, and human nature is what it is. But as it is not practical politics to prohibit its use, I look forward to the day when the pure carcinogen of each offending material is isolated, as in the case of benzpyrene, and is subsequently extracted on a commercial scale from the material in question, but of course, with full safeguards for the extractor.

Nevertheless, in view of the well-known period of delay, or so called " lag period," many years will have to pass before all those have died who worked, even for a short period, on the material before it was made harmless, or before any shielding against any injurious forms of radiant energy was instituted ; and therefore the necessity for cure is still urgent, especially as we have not considered those carcinogens produced by the human body.

But the work of those now studying the changes which take place in the body cell to cause it to proliferate abnormally seems to strike at the very core of the problem, however interesting and helpful it may be to add one more piece to the unfinished picture puzzle by the study of occupations. Be that as it may, I shall continue to watch with interest any results which accrue from the lectureship, which I and my sister have ventured to present to this great College, in memory of my father, the late Joseph Henry, on " Surgery in Relation to Occupation." This subject seems to me not to have had the attention which it merits, its light, having been hidden under the bushel of the better advertised subject of Industrial Medicine or, as I prefer to call it, medicine as applied to industry or to occupation, which can best be learned by long practical experience rather than by examination and the receipt of a Diploma.

I sincerely trust that candidates will be forthcoming to put forward a thesis of work which is original and not a hashed-up dish of material culled from the lectures and publications of others, though this may have its value in the case of an M.B. thesis. Why should not all the medical officers in industries, especially in those which are now directly under the State, be encouraged to produce original material for such a lecture, after learning to spend their lives amidst the factory processes and workers, rather than in the works ambulance room, thereby being more likely to qualify themselves as specialists, a status to which some of them, I understand, desire rightly or wrongly, to lay claim.

Recently a firm of pharmaceutical chemists, advertising their wares, have reminded us of the lesson of the box of Pandora filled with plagues and distempers. Female curiosity induced her to raise the lid and out flew the causes of widespread suffering for mankind. But, fortunately, Hope lay at the bottom of the box.

At the moment, we are like the mountain goats in the midst of fires roaring with conflagration. But, one by one, these fires will be put out by

the energy and persistence of research workers that bring one gloriously to the fruits of enterprise.

Meanwhile, we may all have gained in spirit by our patient waiting.

I should like to express my thanks to many personal friends, including members of the Factory Department of the Ministry of Labour and National Service, Dr. Case of the Chester Beatty Institute, and Professor Smithers, for their practical advice and assistance, and to the staff of the General Register Office by whose courtesy much of the necessary data was made available.