LECTURES ON THE SANITATION OF INDUSTRIES AND OCCUPATIONS.

OCCUPATION AND MORTALITY.

By ARTHUR NEWSHOLME, M.D.Lond., M.R.C.P., D.P.H.

Medical Officer of Health, Brighton.

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THE lecture which I have the honour to give is introductory to a course of six lectures, to be given by various specialists, which, although they cannot, of course, cover the whole range of the sanitation of industries and occupations, will, it is hoped, give a practical insight into some of the more important problems connected with this subject.

The importance of the subject.—A moment's reflection will show the enormous influence of a man's occupation on his health. At least one-third of each working day is spent under the conditions implied in this occupation, and it may therefore be credited with this proportion of the total influence exerted by the circumstances of life on health. The influence exerted by occupation is however much greater than this. Conditions of overcrowding are more deleterious during active work than when lying quietly in bed. Overcrowding implies an atmosphere loaded with the products of respiration, which are when re-breathed a fertile source of disease. Dr. E. Smith found that if the air inspired lying down be represented by unity, the amount inspired when standing erect is 1.33; when on a treadmill, lifting 196 lbs. through 1920 ft. per hour, 4.40; and when walking four miles an hour, 5. Not only is more air inspired during active work, but there is a corresponding increase in the amount of carbonic acid eliminated by the lungs. Thus during rest 13.11 grains of CO_2 are expired per minute; on a treadmill, under the conditions named above, 57.68 grains per minute. If, as in ill-ventilated warehouses and shops, the carbonic acid resulting from respiration is not quickly got rid of, the substance of the muscles becomes loaded with carbonic acid and their activity diminished. For this reason, if for no other, it would be economical for large employers of labour to provide an abundant supply of fresh air for their workpeople.

Conditions of overcrowding in insanitary factories and workshops are aided by the effects of inhalation of dust and

irritating or offensive effluvia, or the absorption into the system of chemical poisons, or the effects of undue strain or over-exertion. These various considerations give to the industrial side of hygiene an importance which is secondary to no other.

Past Neglect of Industrial Hygiene.—Notwithstanding its importance it cannot be said that Industrial Hygiene is one of those “flat and flexible topics which have been beaten on by every hammer.” There are scattered papers in the medical journals, and in the reports of factory inspectors, and a few papers contributed to the Royal Statistical and other societies, and three or four books, of which the most recent and at the same time the most accurate and exhaustive is Dr. Arlidge’s *Diseases of Occupations*. These represent the whole literature of the subject in English. French and German hygienists have expended much more labour on the subject; they have published elaborate statistics which are very generally defective or fallacious in one particular or another; and under the different conditions holding good in this country but little use can be made of the data they have collected.

Legislation on Industrial Hygiene.—In saying that industrial hygiene has been much neglected in the past, the importance and value of factory and workshop legislation is not ignored.

A legislature, which, urged on by the pressure of public opinion, has passed the Factory and Workshop Acts, culminating with that of 1891, and has devised and arranged so many checks and curbs on unscrupulous masters and careless workmen; which has altogether prohibited the employment of women in certain industries, and curtailed their hours in others; which has raised the minimum age of employment of children in factories and workshops to eleven years, and insists on a previous medical examination of all children thus employed; which has by the Shop Hours’ Act of 1891 prohibited the employment of young persons under eighteen in shops for a longer period than seventy-four hours, including meal times, in any one week; and which has by the Alkali Works Regulation Acts, the Coal and Metalliferous Mines’ Regulation Acts, the Merchant Shipping Acts, the Canal Boats’ Acts, &c., regulated other industries in a more or less efficient manner, cannot be said to have adopted the policy of national selfishness, which is embodied in the theory of *laissez-faire*. The majority of these enactments are still administered by Government Inspectors. These inspectors have in the past done work of great importance to the health of the community. The principle is however being gradually accepted that this work should be delegated as far as possible to Local Authorities. In the case of bake-houses this has been already done with good results, and gradual extension of such

decentralisation is desirable. If this work is placed more fully in the hands of Local Authorities, the appointment of inspectors should be made compulsory on these Authorities, and districts should be so combined as to ensure the appointment of skilled inspectors, with reasonable fixity of tenure of an office, which like other sanitary work implies interference in the interest of workers with wealthy proprietors.

What is rather meant, when I state that industrial hygiene has been neglected in the past, is that the opportunities afforded for investigating and elucidating the influence of various industries on the health of the workers in them, have not been fully utilised; and as sound progress in the prevention of industrial diseases must rest on medical and hygienic study of these diseases, valuable time has been to that extent lost.

Much of this neglect of investigation into industrial diseases is owing to the difficulties inherent to such an enquiry. The pathological material connected with our large hospitals has been utilised to a certain extent. The medical enquirer has, however, in investigating the relative prevalence of any disease in a given occupation, been beset by overwhelming difficulties.

Statistics of Occupations.—Correct statistics of any occupation can only be obtained when the deaths in that occupation are stated in proportion to the total number of persons engaged in it. An initial requirement is therefore an accurate statement of the number engaged in each occupation.

Difficulties in Classifying Occupations.—Classification is by no means an easy task. The number of distinct industries in this country is enormous. Most of these industries are sub-divided with great minuteness, thus further complicating the task. Twenty-four orders of occupation are described by the Registrar-General, which comprise eighty sub-orders or genera. The orders are grouped into six classes; viz., professional, domestic, commercial, agricultural, industrial, and non-productive. The lines of demarcation between these classes must not be supposed to be very definite, though the classification is convenient.

The number engaged in each of these six classes at the census of 1891 was as follows:—

	Persons.	Males.	Females
Total aged 10 yrs. & upwards..	22,053,857	10,591,967	11,461,890
Professional Class	926,132	597,739	328,393
Domestic Class	1,900,328	140,773	1,759,555
Commercial Class	1,399,735	1,364,377	35,358
Agricultural & Fishing Class ..	1,336,945	1,284,919	52,026
Industrial Class	7,336,344	5,495,446	1,840,898
Unoccupied Class	9,154,373	1,708,713	7,445,660

Whatever classification of occupations is adopted errors must occur, largely owing to *ambiguity in the nomenclature of occupations*.

A drummer may mean either a musician or a blacksmith's hammerman; an engineer may be either a maker or a driver of engines; a collar-maker may be a seamstress or a harness-maker. In these instances the confusion is only between two occupations. But the same name may apply to a larger number of different trades. Cotton, silk, wool, and flax factories alike have spinners, weavers, &c., and unless some further specification is added to these occupations, confusion must arise. Similarly, merchants, miners, mechanics, artisans, and labourers, are frequently returned as such without further definition, thus rendering their classification under special headings impracticable.

One great source of difficulty is the occurrence in the same individual of *double occupations*. The same person may be a farmer and a miller, a plumber and a gas-fitter, or a clergyman and a schoolmaster. The general rules adopted in the census * are that a constructive or mechanical handicraft is invariably preferred to a mere shop-keeping occupation; and that of two occupations, the apparently more important one is to be selected; or failing any special indication, the occupation first named on the census return is to be taken.

Another great source of difficulty is in the *separation of classes*. It is often very difficult to separate between masters and men in any given trade or manufacture. A watchmaker or tailor may be either a master or journeyman, the health conditions in the latter case being probably much more unfavourable than in the former; and similarly in other cases.

The difficulties in classifying the occupation returns of the census, which have been briefly indicated, apply even more forcibly to death returns. It is evident, therefore, that it is only in certain clearly recognised and well-defined groups of occupations that accurate occupational death-rates can be deduced. We must be satisfied, to quote the golden rule laid down by Joshua Milne, that "the population enumerated is precisely that which produces the deaths registered," the great desideratum being "to determine the number of annual deaths at each age which takes place among the living at the same age." These rules have been so frequently neglected, that a large share of the occupational statistics which have been published are untrustworthy.

Erroneous Forms of Occupational Statistics.—(1) Much of

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* General Report of 1881 census of England and Wales, Vol. IV. pp. 27 & 28.

the earlier work on occupational statistics is invalidated by the acceptance of the *mean age at death* of men employed in different industries as a trustworthy indication of the relative salubrity of these industries. This is evidently fallacious. The mean age at death is governed by the mean age of the living, and it is as much affected by the ages at which people enter and leave any given occupation, and by the increase or decrease of employment, as by its salubrity or insalubrity. Mr. Ben Tillett in 1890 stated that the average age at death of workmen was 29—30 years, of the well-to-do classes 55—60 years. It is probably quite true that the prospects of life of the average workmen are less favourable than those of the average member of the well-to-do classes; but Mr. Tillett's statement, founded as it probably is on the experience of Trades' Union Societies composed largely of young men, by no means proves this.

In 1888 the Collective Investigation Committee of the British Medical Association reported, as the result of an elaborate inquiry, that of

122 Total Abstainers	the average age at death was	51·22 years.
1529 Habitually Temperate	" "	62·13 "
977 Careless Drinkers	" "	59·67 "
547 Free Drinkers	" "	57·59 "
603 Habitually Intemperate	" "	52·03 "

This was seized upon by the brewing interest as proving that the prospects of life are diminished by total abstinence, while there was a corresponding fluttering and agitation in the temperance dovecotes. It is obvious that no valid comparison is made in the preceding statement between the two groups. The statement of age of the dying, the age of the living being ignored, can only mislead, as it did in this instance. It would be absurd, similarly, to draw any inferences from a comparison of the mean ages at death of bishops and curates, as men do not usually become bishops till they have passed the middle period of life. The low mean age at death of dressmakers has been adduced as a proof of the unhealthy character of their employment. Without denying the latter fact, the low mean age at death of dressmakers is no more a proof of their insani-tary circumstances than is a low mean age at death among the pupils in a boarding school.

Mr. F. S. Neison, in a paper contributed to the Statistical Society in January, 1844, showed very clearly the errors following on the use of this method by comparing the populations of the districts of Bethnal Green and St. George's, Hanover Square. He found that

The number living—	Bethnal Green.	St. George's, Hanover Square.
Aged 23—25, was..	8·9 % of total.	14·2 % of total population.
„ 5 and under..	14·5 „	8·6 „

and he showed that were the population of Bethnal Green to be transferred to St. George's, Hanover Square, and submitted to the conditions of mortality of the latter, the mean age at death at St. George's, Hanover Square, would be reduced from 31.23 to 27.25 years (the mean age at death at Bethnal Green being 25.80 years). It is evident, therefore, that the population of St. George's, Hanover Square, at that time, instead of having on an average 5.42 more years of life, had only 1.45 years more than Bethnal Green.

(2). The proportion between the number engaged in and the number dying in any given occupation, expressed as a rate per 1,000, is also fallacious. As is well known, the death-rate in the general population varies greatly at different groups of ages. The death-rate among those engaged in any one occupation would similarly vary according to the relative number at the different ages engaged in it. In other words, it would depend on the *ages of the living*, which would vary in every occupation, (a) according as persons enter it early or late in life, and (b) according as the numbers that annually enter it increase or decrease. Dr. Farr, in his 14th Report, gives the following example of the mistakes which would follow the adoption of this method. The death-rate of all farmers over 20 years of age were 28 per 1,000, of all tailors 20 per 1,000; but when tested by a comparison of the death-rate among men of corresponding ages, farmers were much healthier than tailors, as seen in the following table:—

Death-rate per 1000 at Six Age-groups of Farmers and Tailors.

Age.	25	35	45	55	65	75
Farmers ..	10.15	8.64	11.09	24.90	55.30	148.62
Tailors ..	11.63	14.15	16.74	28.18	76.47	155.28

The only trustworthy method is to compare the mortality of those engaged in one occupation, and of a given age, with the mortality of those engaged in another occupation and of a *corresponding age*.

This is the method adopted by Dr. Ogle in his report for the decennium 1871—80, and it is his figures which will be chiefly quoted. The report of the decennium 1881—90 has not yet been issued, so that any figures which are given are necessarily to a certain extent out of date.

Sources of Possible Error.—Even supposing that occupational statistics are constructed by the correct method just indicated,

some sources of possible error still attach to them. These are pointed out by Dr. Ogle, who however rightly claims for his results a high degree of trustworthiness, on account of the width of his basis of operations, and the precautions taken to ensure uniformity in the abstraction of the figures on which the statistics are based.

These sources of error exist even when the difficulties connected with the classification of occupations have been overcome, and the fallacies connected with the paucity of data have been avoided.

Paucity of data often forms a difficulty in local occupational statistics, as the number engaged in any given industry is necessarily limited, and the observations of several years must therefore be collected, in order to remove variations due to accidental causes. The scantiness of material seldom however reaches the level of that of the parliamentary questioner who asked Mr. Stanhope if it was his intention to retain a British garrison at a post in Africa where the mortality had been 800 per 1000. The reply admitted this high death-rate, but explained that the garrison in question consisted of a corporal and four men, of whom one was accidentally shot when on a shooting expedition, one was eaten by a crocodile while bathing, a third died of sunstroke, and the fourth died as the result of lying out all night in a drunken fit!

For one difficulty pointed out by Dr. Ogle there appears to be no remedy, and it must always to some extent diminish the value of all calculations of the death-rate in different industries. Many trades, as that of a blacksmith or miner, require great muscular strength, and must be given up by men when they become weakly; and the latter may then raise the mortality of the lighter occupations to which they resort.

Another flaw in occupation death-rates, when taken as tests of the relative healthiness of different industries, is the fact that those who follow these do not start on equal terms as regards healthiness. A weakling will not become a navvy, but a shopman or tailor by preference. The occupations demanding great muscular strength and activity, to some extent then, consist of picked men, stronger at the commencement, and maintained up to a certain standard by the fact that weaklings are drafted into lighter occupations.

After making full allowance for the preceding difficulties, the death-rates of different occupations still furnish most valuable indications of their relative salubrity; and while small differences may be accidental, large differences must be taken as representing real differences of healthiness in the various occupations.

When we pass from a comparison of death-rates from all causes at different age-groups, to a comparison of death-rates from special forms of disease at the same age-groups, the subdivision is greater, and the danger of errors arising from scantiness of material is increased. There are, however, certain diseases concerning which there is abundant evidence of their special association with particular industries, and these will be further discussed shortly.

Outdoor and Indoor Occupations.—From a hygienic standpoint, a vitally important classification of occupations is into (a) out-door, and (b) in-door.

The following table, re-arranged from one given by Dr. Ogle,* brings out this point. It should be explained that the figures relate only to males between 25 and 65 years of age, the death-rates of men between 25 and 45, and between 45 and 65 having been in each case applied to a male population in which those under and those over 45 bear a fixed proportion to each other. The clerical profession, having the lowest death-rate, is taken as the standard and stated as 100; the death-rate of each of the other occupations being stated by a figure proportionate to this standard.

Comparative Mortality of Men aged 25 to 65 years, 1881-2-3.

OUTDOOR OCCUPATIONS.

Gardeners	108	Fishermen	143
Farmers	124	Masons and Bricklayers ..	174
Agricultural Labourers ..	126		

MIXED OCCUPATIONS.

Clergymen	100	Medical men	202
Lawyers	152	Carpenters	148

INDOOR OCCUPATIONS.

Commercial Clerks	179	Tailors	189
Bakers	172	Shoemakers	166
Shopkeepers	158	Bookbinders	210

It is evident that in industrial occupations, the balance is very greatly in favour of outdoor work. With the exception of the clerical profession, those engaged in agriculture have the highest probability of life. Even fishermen, notwithstanding their exceptional proneness to fatal accidents, compare very favourably with those engaged in indoor occupations. In occupations where the evils connected with the inhalation of dust arise, the mitigating effect of work in the open air is felt.

* Transactions International Congress of Hygiene and Demography, Vol. X., p. 14.

Masons and quarrymen who work in the open air have a mortality from lung diseases, which is only from two to three times that of fishermen; while that of Cornish miners and potters, who work in more confined space, was in 1880—82 five to six times that of fishermen (Ogle).

Rural and Urban Industries.—The conditions of urban life involve a larger proportion of indoor occupations than those of rural life. The increased urban population in this country has been the result of an immense increase in manufacturing and mining industries. At the census of 1861, 37·7 per cent. of the total population of England and Wales was rural; at the census of 1881, this proportion had decreased to 33·4 per cent.; and at the census of 1891, to 28·3 per cent. Now the average urban death-rate was 24·8, and the rural death-rate 19·9 per 1000 in the decade 1861—70; 23·1 and 19·0 in 1871—80; and had become 20·3 and 17·3 respectively in 1881—90.* It is evident therefore that rural (*i.e.*, in a large measure outdoor) conditions of life are much more conducive to health than urban conditions. The real difference is greater than is shown by these uncorrected death-rates; for the age-distribution of urban is more favourable to a low death-rate than that of rural districts. Thus, as Dr. Ogle shows, if the annual death-rate in England and Wales at each age-period be applied to the respective urban and rural populations at the census 1881, the death-rate in the urban population would be 20·40 (instead of 23·1); in the rural population, 22·83 per 1000 (instead of 19·0). That is, assuming that the urban and rural populations were equally healthy, the death-rate of the former should have been 4·09 per cent. below, and that of the latter 7·33 per cent. above the mortality of England and Wales as a whole.

It will be noticed that urban death-rates show a greater decline than the rural. This cannot be explained completely by the increased afflux of young and healthy recruits from rural districts; it is an indication that in towns sanitary administration is more active, and the health conditions of life are improving more rapidly than in country districts.

It would be interesting to inquire how far the diseases of workmen with which we are concerned *are town made, and how far they are trade made.* The aggregation of workmen in towns implies a less pure atmosphere, a diminished freedom of access of this atmosphere to their homes and workshops; high rentals, with their concomitant evils of sub-letting and overcrowding of

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* Stating the deaths in town districts to 100 deaths in country districts, out of equal numbers living, there died in towns in 1851—60, 124; in 1861—70, 126; in 1871—80, 122; in 1881—90, 117; and in 1891, 114.

tenements; an absence of gardens and cheap home-grown vegetables; a deficient supply of milk, too often "separated," for their children; and many other evils, which a comparison between country and town life renders obvious. Could our great industries be more widely scattered in small communities, there is no reason to doubt that occupational mortality would decline with increased rapidity. It is well known that miners living some distance from their work suffer less than those living near at hand; and we may reasonably hope that with cheap workmen's trains, enabling workmen to live beyond the outer circle of our towns, great improvement will be seen.

Consumption and Occupation.—Stress has been laid on the distinction between indoor and outdoor, urban and rural occupations. This is essential, inasmuch as impure air is one of the chief causes of disease. The languor, headache, and drowsiness which result from a temporary exposure to a vitiated atmosphere, are followed if the exposure is more chronic by a general lowering of bodily and mental vigour. The tendency to catarrhs is increased, and apart altogether from the provocative action of dust, "colds" and bronchitis are more common than among those living an outdoor life.

Phthisis, or consumption, is the most fatal disease of adult life. In the five years 1886—90, phthisis caused 8·7 per cent. of the total deaths in England and Wales. In the thirty-five most active years of life, from 20 to 55 years of age, phthisis caused 20·6 per cent. of the total deaths of males during the year 1891. In the same year, bronchitis only caused 5·6 and pneumonia 11·7 per cent. of the deaths from all causes at ages 20—55.

The close association between phthisis and indoor occupation has been long known. Dr. Greenhow, in most important reports to the General Board of Health and Privy Council in 1859—62, showed most conclusively from an analysis of the statistics of lung diseases in agricultural and manufacturing populations respectively, that "in proportion as the male and female populations are severally attracted to indoor branches of industry, in such proportion *ceteris paribus*, their respective death-rates from phthisis are increased." In indoor occupations involving much muscular effort, the amount of phthisis is less than in those of a more sedentary character. An examination of the history of 6,000 patients admitted to the Brompton Consumption Hospital showed that two-thirds had indoor occupations, the occupations of milliners, sempstresses, and tailors being specially predominant.

From the records of Millbank Penitentiary during the eighteen years 1825—42, Dr. Baly showed that the mortality

from tubercular disease was three or four times as great as it was in the year 1842 among persons of the same period of life in London generally. A sentence of imprisonment for fifteen years was then equivalent to a sentence of death by phthisis. If time allowed, even more striking instances of the evil effects of indoor occupations, under conditions of overcrowding and deficient ventilation in favouring the development of phthisis, might be given.

With advancing knowledge, heredity as a cause of phthisis has been pushed into the back ground. It is now known that the essential cause is the introduction into the system of the tubercle bacillus. Vitiating air, defective food, fatigue, inherited weakness, act as predisposing causes, by lowering the general health and originating catarrhal inflammations, and thus diminishing the resistance of the organisms to the infection, which is always introduced *ab extra*.

The infective material is inhaled in the majority of cases as dust, which contains the desiccated expectoration of phthisical patients. To diminish this danger, every workshop and factory should have a spittoon provided in each room containing some disinfecting fluid, and the dirty habit of spitting on the floor should be prohibited. By steady and gradual education of workpeople the centres of infection may thus be diminished, and the danger of predisposed persons acquiring phthisis minimised.

The following table given by Dr. Ogle* shows the influence of vitiated air in the production of phthisis and other lung diseases. Fishermen are taken as a standard, their mortality from these diseases being represented as 100.

Comparative Mortality of Males aged 25 to 65.

	Occupation.	Phthisis.	Other Lung Diseases.	The two together
Pure Air	Fishermen	55	45	100
	Farmers	52	50	102
	Gardeners	61	56	117
	Agricultural Labourers	62	79	141
Confined Air .. .	Grocers	84	59	143
	Drapers	152	65	217
Highly Vitiating Air	Tailors	144	94	238
	Printers	233	84	317

* Op. cit., p. 17.

The essential cause of phthisis is the inhalation of dust containing the specific bacillus of this disease. Hence persons engaged in dusty occupations are much more prone to be affected than others who are simply exposed to a vitiated air. To quote Dr. Ogle again :*

Comparative Mortality of Males aged 25 to 65.

	Phthisis.	Other Lung Diseases.	The two together.
Fishermen (as standard)	55	45	100
Coal Miners	64	102	166
Carpenters and Joiners	103	67	170
Bakers	107	94	201
Masons and Bricklayers	127	102	229
Wool-workers	130	104	234
Cotton-workers	137	137	274
Stone and Slate Quarrymen	156	138	294
Cutlers and Scissor Makers	187	196	383
File Makers	219	177	396
Pottery Makers	239	326	565
Cornish Miners	348	231	579

The dust inhaled by carpenters and bakers appears to be comparatively innocuous. The dust from woollen fabrics, and still more from cotton, is much more prejudicial; while mineral dust, as shown in the later occupations given in the table, is highly injurious.

The metallic dust in file-making and cutlery causes a mortality from chest affections which is nearly four times that prevalent among fishermen, who are not exposed to dust. The death-rate from these diseases alone is almost equal to the total mortality from all causes (including accident) among fishermen.

The dust of stone is even more formidable than metallic dust. Masons and quarrymen work in the open air, so their mortality from phthisis is only two or three times as great as that of fishermen. Potters and Cornish miners work in more confined space, and their mortality from these diseases was, at the period to which Dr. Ogle's returns apply, five to six times as high as that of fishermen. There is reason to believe that, owing to improved and increased inspection, the conditions under which potters work and their resultant mortality have greatly improved since that date.

The mortality from phthisis and respiratory diseases among

* Op. cit., p. 19.

Cornish miners is appallingly high, forming two-thirds of their total mortality. On the other hand, coal miners have a remarkably low mortality from these diseases. This may be partly due to the excessive mortality from accidents, for it is evident that any injurious effects of coal dust may not have time to operate under such circumstances. Such an explanation, however, only very partially explains the comparative immunity of coal miners from phthisis. It has been supposed, therefore, that coal dust has some inhibitory power against the development of this disease. A more probable explanation is that in the scattered work of a coal mine, the opportunities of infection by desiccated sputa are less frequent than in most of the other occupations which have been named.

It is evident from the foregoing illustrations that the breathing of impure air, especially when the air carries with it irritating dust in addition to the specific infective material, is the chief cause of phthisis. Working in a cramped or constrained position, involving imperfect expansion of the lungs, strongly predisposes to phthisis. This is shown by the high phthisis mortality among printers and tailors, among women in the hosiery and lace trade, and in sempstresses and dressmakers.

The effects of variations of the temperature and moisture in workshops in favouring phthisis are only secondary in importance. Exposure to the weather is a preservative against phthisis. Variations of temperature only cause it when accompanied by an impure atmosphere and the inhalation of specifically contaminated dust, though they may, even in the absence of such dust, favour the production of bronchitis.

Cancer and Occupation.—The causation of cancer is obscure. That it is, like phthisis, more common in certain families is well known; but there is little doubt that, as in phthisis, this means an inherited vulnerability, rather than the actual transmission of potential disease. One thing is fairly certain that persistent local irritation has very commonly preceded cancer. In cancer of the tongue or lip, there is generally a history of a jagged tooth or the use of a clay pipe. As is well known there has been in the past an excessive amount of cancer among chimney-sweeps, particularly of the scrotum, due to the chronic irritation of soot. Workers in coal-tar and crude paraffin appear also to be subject to cancer in excess of the average amount. It has been suggested by Esmarch and Langenbeck that the relation of tobacco smoke and juice to the mouth is, probably, similar to that of soot, tar, and paraffin to cancer of the scrotum. Charcoal and coal-dust do not appear to have a similar effect in producing scrotal cancer. There is a general impression that chimney-sweep's cancer is declining, but such

scanty figures as are available do not appear to confirm this impression. Dr. Ogle calculates from the figures of 1880—82 that “the liability of chimney-sweeps to malignant disease is about eight times as great as the average liability of all males.” About one-half of these deaths from cancer among chimney-sweeps were from cancer of the scrotum and neighbouring parts.

Mr. Butlin, in a very interesting inquiry,* has shown that scrotal cancer in sweeps is almost unknown in the chief European countries and in the United States of America. The immunity of these countries is ascribable to the fact that hard or stone coal is not generally used, that open fireplaces are not common, and that consequently there is less soot, or a less irritating form of soot than in England. In Belgium, where hard coal and fires similar to those in England are in use, the almost complete immunity from scrotal cancer appears to be traceable to the care taken by the sweeps to prevent their bodies from contact with soot by special arrangements of clothing; and in North Germany, to the practice of daily washing the body from head to foot.

Accidents and Occupation.—Accidents cause a very high proportion of the deaths in certain industries. Happily they claim as time goes on a diminishing number of victims, as will be seen from the following data:—

Annual Death-rate from Accident and Negligence per Million persons living.

Three years	.....	1858—60	.....	653	
Five	“	.....	1861—65	.....	690
“	“	.....	1866—70	.....	678
“	“	.....	1871—75	.....	671
“	“	.....	1876—80	.....	630
“	“	.....	1881—85	.....	580
“	“	.....	1886—90	.....	544

A decrease of 16·7 per cent. under this head in the period reviewed is very satisfactory. It has been impracticable for me to obtain the necessary data for showing the proportion of this gain which has occurred in adult life; but there is no doubt that a large share of the decrease is attributable to the more efficient supervision under the Acts for regulating factories, workshops, mines, &c.

The chief incidence of mortality from accidents at all ages may be gathered from the following data for 1891†:—

* *British Medical Journal*, June 25th, July 2nd and 9th, 1892.

† Fifty-fourth Annual Report of the Registrar-General for England, p. liv.

Deaths to One Million living.

Accident.	Persons.	Male.	Females.
In Mines and Quarries	32	65	—
Vehicles and Horses	86	155	22
Ships, Boats, Docks (not drowning) ..	5	11	—
Building operations	5	11	—
Machinery	8	15	1
Weapons and Implements	8	13	3
Burns and Scalds	77	74	80
Poison, Poisonous vapours	19	27	11
Drowning	93	161	29
Suffocation	78	83	74
Falls	89	114	65
Weather agencies	10	16	4
Otherwise or not stated	64	93	37
All forms of Accident	574	838	326

It will be noted that males are two or three times as subject to fatal accident as females. The excess is especially incident upon the working years of life, but an analysis of the death returns of the quinquennium 1878—82 showed that this excess begins much earlier* in life. Under one year of age the fatal accidents of boys during 1878—82 were 6 per cent. more numerous than those of girls—a difference closely corresponding to the relative number of boys and girls living at that age. In the second year of life the accidents of boys were 30 per cent. more numerous, in the third year 51 per cent., in the fourth year 61 per cent., and in the fifth year 75 per cent. more numerous than the accidents of girls. After this age the preponderance of accidents of males becomes greater, the influence of occupation coming generally into action. The higher male mortality from accident is an explanation of the higher general death-rate of males, the total mortality from violence being too small to affect the general death-rate to any extent, and the difference from this cause being partly counterbalanced by the mortality of females from childbirth and puerperal fever.

The occupations in which fatal accidents are most common will be seen from the following statement. The mortality from all causes among all males aged 25 to 65 years of age in

* Forty-fifth Annual Report of the Registrar-General for England, p. xx.

England and Wales is taken as the standard, and of this amount sixty-seven were due to accident.

Comparative Mortality of Males, 25—65 years old (Ogle).

	All causes.	Accident.
All Males (England and Wales)	1000	67
Miners (S. Wales and Monmouthshire) ..	1081	229
Miners (N. Riding & other Ironstone Districts) ..	834	206
Miners (Durham and Northumberland) ..	873	196
Miners (Staffordshire)	929	172
Miners (West Riding)	772	161
Fishermen	797	152
Stone, Slate Quarries	1122	148
Cab, Omnibus Service	1482	84
Plumbers, Glaziers, Painters	1169	71
Brewers	1361	64
Innkeepers	1521	45
Costermongers, Hawkers	1879	53
Butchers	1170	35
Farmers	631	30
Wool Manufacture	1032	27

The figure for fishermen is probably below the mark because of the number drowned, whose bodies are not recovered, and who escape registration.

The diminution of accidents as the result of efficient supervision and regulations has been very marked. In the majority of industries, the number of deaths from accident is now small in proportion to the total deaths from all causes. Among all males they form 6·7 per cent. of the total deaths; among Welsh miners, they only cause 22·9 per cent. of the total deaths at ages 25 to 65. The proportion is still much too high; and when the workmen themselves are more conscientious in their abstinence from smoking in mines, &c.; when they are better educated, and more thoroughly appreciate the importance of hygienic precautions; when the hours of labour have been so reduced that the neglect arising from fatigue will not occur, as in pointsmen on railway lines, the number of accidents will shrink still more.

Even now it is against the chronic diseases due to dust and to overcrowding and to defective ventilation that the chief fight needs to be waged; and it is in this department of industrial hygiene that the largest scope for the saving of health and life lies.

Alcohol and Occupation.—The influence of even moderate doses of alcohol is in most instances to diminish the capacity for work, and more especially to diminish the power of endurance. Excessive doses of alcohol not only produce the temporary

incapacity for work, partial or complete, which is their most obvious effect, but when systematically imbibed, lead to increase of sickness and to premature death. Alcohol has been well described by Dr. Dickinson as the "genius of degeneration;" and the degenerative diseases produced by it are by no means confined to the intemperate; they are seen, perhaps, quite as frequently in those who, though never intoxicated, indulge in frequent "nips" between meals.

In certain occupations, the amount of alcoholic disease is very great. It is true that no man is compelled to drink; but in actual practice it is found that the constant exposure to the temptation to drink is almost as certain to produce chronic alcoholic poisoning, as is similar exposure to the fumes of mercury, or white lead, or yellow phosphorous, to produce the characteristic effects of these poisons. In fact, the pursuit of the occupation of a tapman or publican, in the majority of instances, implies a slow process of suicide. This will be abundantly evident from the following figures* :—

Annual Death-rates per 1000 at Four Ages among Clergymen, Ministers, and among Publicans and Wine Merchants, 1880-1-2 (Ogle).

Ages.	Clergymen and Ministers.	Publicans, Innkeepers, Wine and Spirit Merchants.
20—25	1.72	7.81
25—45	4.64	18.02
45—65	15.93	33.68
65 and upwards	83.96	85.81

There is no influence prejudicial to health in the life of publicans, &c., which can account for their excessive death-rate at each group of ages, as compared with the corresponding death-rates in the clerical profession, except the one factor of alcoholic excess.

The official figures of the Registrar-General give a very incomplete statement of the mortality caused by alcoholism. So long as the present objectionable method of requiring the medical practitioner to give the death certificate to the relatives (instead of sending it sealed to the registrar) is continued, there is little hope that the real facts as to alcoholism, or as to syphilis, will appear on death certificates. Were the truth known, these two great causes of disease and death would probably be found to be more fatal than all the specific infec-

* Dr. Ogle's Supplement to the Registrar-General's 45th Annual Report.

tious diseases put together; and they, especially the former, have this additional importance, that the deaths caused by them occur chiefly in the most useful periods of life. One of the commonest diseases due to alcoholism is cirrhosis of the liver; and as this is the chief cause of mortality under the head of "liver diseases and ascites," the latter may be taken as a more correct index of the amount of alcoholic excess in England and Wales than intemperance, alongside of which it is tabulated below:—

Period.	Death-rate per Million persons living from—	
	Intemperance.	Diseases of Liver and Ascites.
Three years 1858—60 ..	40·3	394·0
Five " 1861—65 ..	41·6	416·0
" " 1866—70 ..	35·4	417·6
" " 1871—75 ..	37·6	427·8
" " 1876—80 ..	42·2	423·6
" " 1881—85 ..	48·0	372·0
" " 1886—90 ..	55·8	324·8

The indication of decrease of intemperance furnished by liver diseases is confirmed by the falling off in the number engaged in the liquor trade, which was equal to 17·9 per cent. for equal populations between 1871 and 1881, and to 3·8 per cent. for equal populations between 1881 and 1891.

The figures contained in the following table tell their own tale:—

Comparative Mortality Figures in Men aged 25—65 from Special Causes (Ogle).

	Alcoholism.	Diseases of the Nervous System.	Suicide.	Gout.
All Males	10	119	14	3
Innkeepers	55	200	26	13
Brewers	25	144	26	9
Butchers	23	139	23	5
Commercial Travellers ..	23	139	31	6
Cab, Omnibus Service ..	33	134	16	11
Costermongers	19	207	44	3
Tailors	11	144	16	4
Grocers	10	—	17	—
Painters, Plumbers ..	12	—	—	10
File Makers	—	262*	—	—

* Including deaths from suicide.

	Liver Diseases.	Diseases of the Circulatory System.	Diseases of the Urinary System.
All Males	39	120	41
	—	—	—
Innkeepers	240	140	83
Brewers	96	165	55
Butchers	96	132	55
Commercial Travellers	61	—	44
Cab, Omnibus Service	54	160	65
Costermongers	47	227	69
Tailors	48	127	45
Grocers	52	—	48
File Makers	41	180	123
Painters, Plumbers	48	143	100

Innkeepers head the list under three headings—Alcoholism, Liver Diseases, and Gout; and in the four remaining columns they stand third on the list. Were it not for the special incidence of renal disease from lead poisoning, on file-makers and painters, innkeepers would also head the list under this disease.

Phthisis has not been tabulated above, though there is good evidence that it is increased by alcoholic excess.

Under another head, that of Accidents, alcoholism is responsible for a large increase in mortality. Excluding miners, fishermen, &c., whose occupations expose them peculiarly to fatal accident, the comparative mortality from accident is higher than in most other occupations among brewers, innkeepers, and butchers. The latter must be grouped among those who suffer severely from alcoholic excess, the effects of which are doubtless enhanced by excess of animal food. They are, as a class, among those who have been described as “digging their graves with their teeth.”

Effects of Excessive or Too Protracted Work.—Time is only left to briefly touch on this subject. The excessive use of any part of the body inevitably brings in its train evil results. The deafness occurring in boiler-makers and riveters; the gradual loss of power of distinguishing the varying qualities of tea by tea tasters; the localised muscular cramps and spasms, followed by palsy, occurring in writers and violinists, and in hammermen, are instances of this law.

Muscular strain from over-exertion is a common cause of hernia; and the same cause, more particularly among smiths, porters, dock loaders, &c., produces aortic aneurism. In regard to the latter condition, it is noteworthy that Dr. Drummond,

in his address in Medicine at the annual meeting of the British Medical Association in August, 1893, says that since he commenced his investigations on the subject, no indisputable case has come under his notice in which a history of syphilis was wanting in cases of true aortic aneurism. There is no doubt that, at least in a large proportion of cases, specific arteritis precedes the aneurism, and is an important determining factor in its causation.

The increased use of machinery must be beneficial by diminishing the necessity for sudden and violent exertion. The extension of work by machinery is the most prominent feature of the present century. Did time allow, it would be interesting to inquire whether the good derived from it more than balances the evils due to the increased monotony of occupation, to noise and uproar, and to the greater proclivity to accidents. As the increasing use of machinery is however inevitable, it may be more useful to congratulate ourselves that the general substitution of collective work in factories and workshops for the home handicrafts facilitates supervision of the conditions of work, and thus enables the evils arising from dust and vitiated air to be partially overcome.

The too protracted continuance of work which is not of necessity excessive, is an evil which is probably in the long run as detrimental to the interests of the master as it is to the workers. In occupations, like those of miners and railway employés, where the lives of others may depend upon the alertness and scrupulous care of the workmen, the legislature will have little hesitation in intervening between master and man. When Dr. Guy and other eminent men in 1848 advocated the case of the journeymen bakers, who demanded that they might have at least ten hours out of the twenty-four for themselves, it was objected in Parliament that "it was intolerable and impossible in a free country such as this, to apply to labour in dwelling houses and workshops a minute system of inspection and supervision such as was found practicable in our factories." The political economists were up in arms, and the continuance of "freedom of competition" without legislative restraints was advocated as the only way to sound commercial success. Much was said about "interference," and very little about humanity and justice. As Dr. Guy nobly stated the case for the journeymen bakers: "It is a bitter mockery to talk about grown-up men being able to make their own bargains. . . . The contest now going on . . . must ere long take a more definite shape between the natural feelings of a Christian man, and the cold unbending theory of a perfect freedom of human act."

Since that day the righteous sentiments of the country have

led to industrial legislation decade by decade, of extended scope and increased stringency. In the case of many shop assistants and others

“ Whose hard toil
Doth scarce divide the Sunday from the week,”

overwork still exists, not on special occasions, but systematically and persistently, though the early closing movement is, especially in the larger shops, doing much to improve the conditions of labour. To say, as some masters do, “I can make better use of your leisure than you would,” is an argument which is only fitting between the slave driver and the slave. Happily a large number of masters now realise that their relationship to their employés involves responsibility as well as profits. If they allow detrimental conditions, whether it be defective drainage, or defective ventilation or warming, or inefficient appliances for the removal of dust, or any other defect to remain, which it is within their power to remove, their responsibility for the ill-health of their employés is undoubted. One of the most important deductions from scientific teaching is that no event can be considered as *accidental*, or as the result of a mere concurrence of chances. Fixed laws co-operate in the development of every event; and given ill-health or actual disease in the employés in any shop, workshop, or factory, it is more than probable that the conditions under which they have worked for from one-third to two-fifths, or even half of every working day, have been largely instrumental in producing it.

With an increased sense of responsibility on the part of employers, we must look to the influences exerted by education, and by a higher development of the sense of responsibility on the part of workpeople, for the removal of that callousness and indifference which now form the chief obstacles to improvement. In certain occupations the production of unhealthy dust is unavoidable; and the refusal of workmen to wear respirators, or to wash themselves after exposure to deleterious dust, is a common cause of mischief.

The time is ripe for great improvements in industrial sanitation; and when the statistical history of the last decade of this century comes to be written, there is little doubt that it will record a lowered industrial mortality as the result of the present activity in improving the conditions under which the industries of this country are carried on.