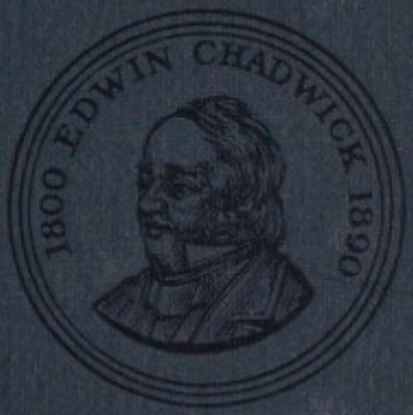
Vital statistics explained : some practical suggestions / by Joseph Burn.

VITAL STATISTICS EXPLAINED



VITAL STATISTICS EXPLAINED

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VITAL STATISTICS EXPLAINED

SOME PRACTICAL SUGGESTIONS

BY

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WITH A PREFACE BY

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PREFACE

It was a piece of good fortune that, when the Chadwick Trust was seeking for someone to lecture on Vital Statistics, we were led to approach Mr. Burn. The aim of the Trust has been to secure as lecturers those who are able to speak with authority on the subject they handle, to engage the interest of advanced and post-graduate students of sanitary science, and at the same time to enlist the attention of the public. When the matter in hand is such a subject as Vital Statistics the achievement of this aim is no easy task. To invest figures with attractiveness and popular appeal, and even to awake enthusiasm in his audience was, however, the successful effort of Mr. Burn. His lectures at Liverpool were instinct with the true Chadwickian spirit. Like Farr, who was discovered by Chadwick, he tells his hearers to "keep their eye on the death rate." He shows how this should be standardised to permit of just comparisons being made, and he then proceeds to analyse it as regards age and the several causes of death, distinguishing the preventable from the rest, and showing how potent in reduction are sanitary environment, removal of filth, and the separation of the infected from the sound. For those who wish to venture further Mr. Burn explains, with admirable lucidity, the method of "osculatory interpolation," and develops this further in a valuable appendix bristling with statistics. Figures, we are told,

never lie, but we are also reminded that liars sometimes figure; but with Mr. Burn as guide we feel we travel in safe and wholesome company, and the Chadwick Trust have done well to rely on him as a faithful figure-head.

WILLIAM J. COLLINS.

July, 1914.

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VITAL STATISTICS

INTRODUCTION

THERE is undoubtedly a very general impression that any explanation of statistics must be not only entirely uninteresting, but also so difficult to understand that it can only be suitable for discussion amongst mathematicians. I am hopeful that I shall succeed in showing that this impression is entirely erroneous, and that a record of Vital Statistics is necessarily a record of the most important homely facts which, when properly understood, must inevitably arouse the keenest interest.

The present is a particularly auspicious time to discuss this subject, because the statistics given in the reports of the Registrar-General are now published in a greatly improved form, and far-reaching changes have been introduced into the methods of collecting and presenting the results of our last census.

Of such great importance are these changes, that I think it is not an overstatement of the case to say that, for the first time in the history of our nation, it is possible to discuss and analyse the enormous mass of statistics in a coherent and intelligent manner.

It needs but very little knowledge and explanation to enable any intelligent person to recognise the salient features of these statistics, but a certain amount of

knowledge is absolutely necessary in order to obtain the most useful results, and to make the correct deductions from the figures given. If I succeed in proving how important to the well-being and progress of the nation are the features revealed by the study of Vital Statistics, I shall feel amply repaid for any trouble I have taken.

The study of Vital Statistics is the link connecting the statesman, the historian, the medical practitioner, the statistician, and the actuary, but it appeals to each in a different way. The statesman is concerned with questions relating to taxation, parliamentary representation and economic matters generally; the historian with the rise and decline of nations; and a medical man with obtaining a true conception of the healthiness of any given district, which he can only discover by analysing the rates of mortality and the age distribution of the community. The statistician concerns himself with general sociological conditions, and, finally, the actuary, is necessarily interested in the probabilities of longevity which are the bedrock of all his varied and intricate calculations.

The subject falls naturally into three main divisions :—

(1) The census as an index to the development of national life, with a criticism of the methods adopted in its collection and tabulation.

(2) The annual reports of the Registrar-General, with special references to the number and causes of death. Indications of the progress of sanitary reform.

(3) The preparation of mortality tables : (*a*) national, (*b*) municipal, (*c*) occupational. Practical uses of mortality tables by medical officers and others.

CHAPTER I

THE CENSUS AS AN INDEX TO THE DEVELOPMENT OF NATIONAL LIFE—ITS COLLECTION AND TABULATION

As the result of inquiries at the British Museum, I find that there is no tangible evidence of a census of the people having been taken in the ancient Egyptian or Babylonian Empires, though tablets setting forth censuses of cattle, corn, etc., for taxation purposes, dating back to 2500 B.C. are to be seen there. Reference is made to these tablets by Dr. Boscawen in his book, "The First of Empires."

The first record of a periodical census of the population is that of the Greeks, probably introduced by Solon between 658 B.C. and 638 B.C.

The most perfect census in ancient times of which we have any record appears to have been that taken by the Romans. The first enumeration took place in 566 B.C., subsequent enumerations being taken at intervals of five years; then indifference supervened, with the result that the inter-censal period increased first to ten years, later to fifteen years, and eventually, in the time of Vespasian the taking of a census was discontinued.

It would appear that the taking of a census is one of the criteria of advanced civilisation, the censuses just referred to having been taken when the various nations were at the zenith of their power.

The reintroduction of the census, as we know it, is of comparatively recent adoption—the first modern census

being that of Sweden in 1749, followed by that of the United States of America in 1790. The first census for Great Britain was effected in 1801, but only after considerable opposition, it being considered by many in the light of a preparatory measure for some more efficient plan of taxation, or a new scheme with respect to the levy of the militia.

The census of 1801 formed the subject of a bulky volume, entitled "Abstract of the Answers and Returns made to an Act passed in the forty-first year of His Majesty King George the Third, intituled 'An Act for taking an Account of the Population of Great Britain and the Increase and Diminution thereof.'"

On the opening page, there is a Schedule of Questions, addressed not to the heads of families, but to the rector, vicar, curate, or officiating minister, and overseers of the poor. These questions are as follows:—

"1st. How many inhabited houses are there in your parish, township or place; by how many families are they occupied; and how many houses therein are unoccupied?

"2nd. How many persons (including children of whatever age) are there actually found within the limits of your parish, township, or place, at the time of taking this account, distinguishing males and females, and exclusive of men actually serving in His Majesty's regular forces or militia, and exclusive of seamen either in His Majesty's service or belonging to registered vessels?

"3rd. What number of persons in your parish, township, or place are chiefly employed in agriculture; how many in trade, manufactures, or handicraft, and how many are not comprised in any one of the preceding classes?

"4th. What was the number of baptisms and burials in your parish, township, or place in the several years 1700, 1710, 1720, 1730, 1740, 1750, 1760, 1770, 1780, and each subsequent year to the 31st day of December, 1800, distinguishing males from females?

"5th. What has been the number of marriages in

your parish, township, or place in each year from the year 1754 inclusive, to the end of the year 1800 ?

" 6th. Are there any matters which you think it necessary to remark in explanation of your answers to any of the preceding questions ? "

One can well imagine the worry and perplexity which these questions must have caused. However, at length, a mass of detailed statistics of the most elementary nature was brought together, the net result of which is embodied in a single page containing a table of figures and a few observations. These are given on p. 6.

It will be noticed that in this table of statistics, the last column is obtained by cross-casting columns five and six (headed Persons—Male, Female), but this is quite at variance with the figures in columns seven, eight, and nine. There are, in fact, about one million of persons who are not included in the return of occupations.

In spite of observation 1, the relative numbers of the 1801 and 1811 censuses appear to indicate that the enumeration at the first census was exaggerated.

One is apt now to look back with commiseration on our forefathers in their attempts at obtaining census returns, and it may, therefore, serve a useful purpose if we examine one or two quite recent first attempts of other nations.

With regard to Russia, the first census was taken in 1898, but I understand that the accuracy of the results is not above suspicion. In many cases the facts appear to have been misrepresented. It was only after twenty-four years' discussion that the bad harvests of 1891 and 1892 induced the Russian Government to undertake the labour of a general census. It is rather interesting to notice that the first idea of taking an English census was in 1753, but nothing was done until 1801, when the

SUMMARY OF ENUMERATION

M.DCCC.I.

	HOUSES			PERSONS		OCCUPATIONS			
	Inhabited	*By how many Families occupied*	*Uninhabited*	*Males*	*Females*	*Persons chiefly employed in Agriculture*	*Persons chiefly employed in Trade Manufactures, or Handicraft.*	*All other Persons not comprized in the Two preceding Classes*	*Total of Persons*
ENGLAND	1,467,870	1,778,420	53,965	3,987,935	4,343,499	1,524,227	1,789,531	4,606,530	8,331,434
WALES	108,053	118,303	3,511	257,178	284,368	189,062	53,822	266,573	541,546
SCOTLAND	294,553	364,079	9,537	734,581	864,487	365,516	293,373	833,914	1,599,068
ARMY including the Militia	–	–	–	198,351	–	–	–	–	198,351
NAVY including Marines	–	–	–	126,279	–	–	–	–	126,279
SEAMEN in Registered Shipping	–	–	–	144,558	–	–	–	–	144,558
CONVICTS on Board the Hulks	–	–	–	1,410	–	–	–	–	1,410
TOTAL	1,870,476	2,260,802	67,013	5,450,292	5,492,354	2,135,805	2,136,726	5,707,017	10,942,646

OBSERVATIONS

1. *The Total Population of Great Britain must exceed the Number of Persons specified in the above Summary, inasmuch as there are some Parishes from which no Returns have been received.*
2. *The Number of Houses in Ireland has been nearly ascertained by the Collection of a Hearth Money Tax; and therefrom it has been computed that the Population of that Part of the United Kingdom somewhat exceeds Four Millions of Persons*
3. *The Islands of Guernsey, Jersey, Alderney, and Sark, the Scilly Islands, and the Isle of Man, are not comprized in this Enumeration. The Total Population of these Islands has been usually estimated at about Eighty Thousand Persons.*

prevalent dearth and distress brought the matter to a head.

The data for the first, and, so far, the only Russian census, were taken not direct from the population, but from the local police in each district. Questions concerning taxation and military service, etc., etc., undoubtedly led many people to give untrue answers. It will thus be seen that the faults of the initial English census were very closely reproduced. It would seem that the clerks employed to deal with the mass of data collected were not specially qualified for so difficult a task, but after seven years of hard work the results were published. An examination of these results discloses many anomalies, and, I believe, that it is generally felt that the results are not sufficiently reliable for the purposes of the statistician. A proposal to take a further census in 1915 is at the present time before the Duma, and this will be looked forward to with much interest, as undoubtedly experience and modern tabulating appliances will contribute to greater accuracy.

So early as 1872 a Census Register Act came into force in Japan, by which the dates of birth of the members of each family were recorded in census registers kept by the registrar of each town and village, and every change, such as birth, death, marriage, etc., occurring thereafter was required to be registered. The idea, was, of course, to avoid the difficulties connected with periodical census enumeration, by means of continuous records. However, in 1898, the impossibility of making continuous records had become apparent, and a new Census Act was passed, which for all practical purposes appears to have been based on our own latest census methods.

Reverting to our own system, I have already given a description of the census schedule employed in 1801.

The same form was again used in 1811, but in 1821 a return of the ages of the people was first introduced. This important feature was discontinued in 1831, but was reintroduced in 1841. At the present time it appears inconceivable that the exclusion of this question could ever have been the subject of discussion.

In 1851 the first householder's schedule was issued, and comprised the following particulars : (1) Name, (2) Relation to head of family, (3) Condition (civil), (4) Sex, (5) Age last birthday, (6) Rank, profession or occupation, (7) Where born, (8) If deaf and dumb, or blind.

A criticism often levelled against census statistics is their lack of various useful details, but it should be remembered that not only is any tabulation of detail extremely costly, but any undue elaboration may vitiate other and more important matters. It is also essential to remember that merely to ask an extra question on the census paper does not by any means insure a correct answer being given, and unreliable statistics are naturally worse than useless.

To emphasise how strongly I feel with regard to this important matter, I may perhaps be pardoned for referring to a letter published in the *Times* so recently as January 29th, 1914 :—

"*Re* The Census Figures and the Deaf.

"*To the Editor of the 'Times.'*

"Sir,—After long and irritating delay, the census figures for 1911 have at last been published, and if those relating to the deaf are any criterion by which to judge the others, their practical utility is not great.

"Only one simple question was asked in the census schedule as to deafness, and this was not only insufficient but misleading. It was : 1. Infirmity : If any person included in this schedule is (1) Totally deaf, or deaf and

dumb ; (2) Totally blind ; (3) Lunatic ; (4) Imbecile, or feeble-minded ; state the infirmity opposite that person's name, and the age at which he or she became afflicted.

" It will be noted that partial deafness--no matter of what degree—was ignored, and total deafness and deaf-mutism alone considered. A comparatively small percentage of the deaf are totally dumb ; therefore the question is misleading to the class of parents from whom the majority of deaf children spring.

" If the census is worth doing, it is worth doing well, otherwise it is a gross waste of public money. That the figures quoted in relation to the deaf are inadequate is practically confessed by the compilers of the volume, who warn their readers that they are based on ' no very certain foundation.' Those whose duty it is to frame the questions in the census schedule would have no difficulty in commanding the assistance of experts, and until such questions are asked as will elicit reliable information, no figures will be obtained that will bear criticism. At present, the result of the parturient mountain is ' ridiculus mus.'

" I am, Sir,
" Yours faithfully,
(Signed) " MACLEOD YEARSLEY."

Whilst heartily sympathising with the writer in his desire for more detail, I feel sure that he is hoping to attain the impossible. Undoubtedly expert assistance on any such important matter as this should always be available, but the actual form of the questions asked must inevitably be governed by the hard truths which we have learned from long experience. Had the question been framed to elicit information as to partial deafness, I am convinced that no useful result would have been obtained.

I do not believe that reliable information will ever be obtained from those questions, the answers to which appear to cast reflections on any member of the family. It is surely better that such questions should be omitted altogether, leaving the information to be obtained from other and more reliable sources, than that the question

should be recast in such a form as might lead investigators to base important conclusions on unreliable data.

The census of 1911, the twelfth of the series, is a monument of foresight and enterprise. It is only when it is compared with the first British census that we realise the wonderful advance that has been made. The householder's schedule has been most carefully revised, and nearly all the information that can be relied upon is, in my opinion, now collected. A copy of this schedule is given at the end of the volume.

Undoubtedly the most important facts collected relate to age and sex. With regard to age, it is, I think, preferable to ask for the date of birth rather than the age last birthday. This is no new suggestion, and I am aware that many discussions have been held in reference thereto. I would merely say that for any given person the date of birth is constant throughout life, while "age last birthday" varies annually.

A great improvement has been effected by the amalgamation of the two questions relating to sex and age, for it must be remembered that the particulars of the householder's schedule have to be transferred to summary registers. Prior to 1911 this was done by the enumerators, and in the report of the Census Committee of 1890, we read in the evidence of one of the registrars that "in copying into the enumeration books there were one or two *little* mistakes which I had to correct, where they had put down male for female, but *nothing further than that.*" The enumerator in question was an assistant overseer. If *he* could make such serious mistakes so lightly, what was to be expected from such men as are described in the following extract from the same report :—

"Enumerators are appointed by a registrar, who may appoint personal friends whether suitable or not; or

he may be influenced by charitable motives, as one who appointed ten men principally from amongst his own friends, eight being clerks, one a French polisher, and one a house decorator."

Further :—

"A Bethnal Green registrar appointed a newspaper seller, who lost a number of his schedules on the day of the census, which led to great difficulty and inconvenience, I believe."

Very considerable improvement has been effected with regard to the enumeration. Not only are the enumerators appointed with greater care, but they have been relieved of a portion of their work, viz., the copying of the particulars from the householder's schedule into the enumeration books. They now send the original schedules to the Central Census Office, where the data are dealt with by an efficient staff under strict supervision and the work is facilitated by the employment of the wonderful electrical sorting and counting machine, known as the Hollerith machine.

I am indebted to the proprietors of the machine for the excellent photographs which I am able to reproduce here, and for the information they have furnished as to the construction and working of the machines.

The machines can be best described as a *system*, since different kinds of machines are used to obtain the finished result.

Cards (see diagram on p. 12), form the basis of the system. Upon these cards are printed what are technically known as "fields," each field representing, in the case of Vital Statistics, sex, age, occupation, civil condition, *i.e.*, whether married or single, etc. The fields may contain but one column of numerals, *e.g.*, sex, where male may be represented by the figure 1, and

female by 2; while others may contain two, three or more according to the range of numbers to be recorded.

The system being a numerical one, all facts are translated into numbers, thus, for example, in the census, all possible occupations to the number of about 600 were indexed and numbered, the appropriate number being recorded on the householder's schedule by a staff of clerks.

A hole punched in one column of numerals can be made to represent any one of ten facts, or the combination of two holes in two columns, any one of ninety-nine and

so on. In each field, the right-hand column represents units and, reading from right to left, the second column represents tens, and so on.

To punch the card, it is placed in the key punch and holes are punched by the operator striking keys resembling the keys of the typewriter. The card is punched column by column, from field to field, and can be punched at a speed of from 250 to 850 cards per hour, according to the number of holes to be punched in each. The operation presents no more difficulty than ordinary typewriting; at the Census Office the operators were young girls taken fresh from the elementary schools of the metropolis,

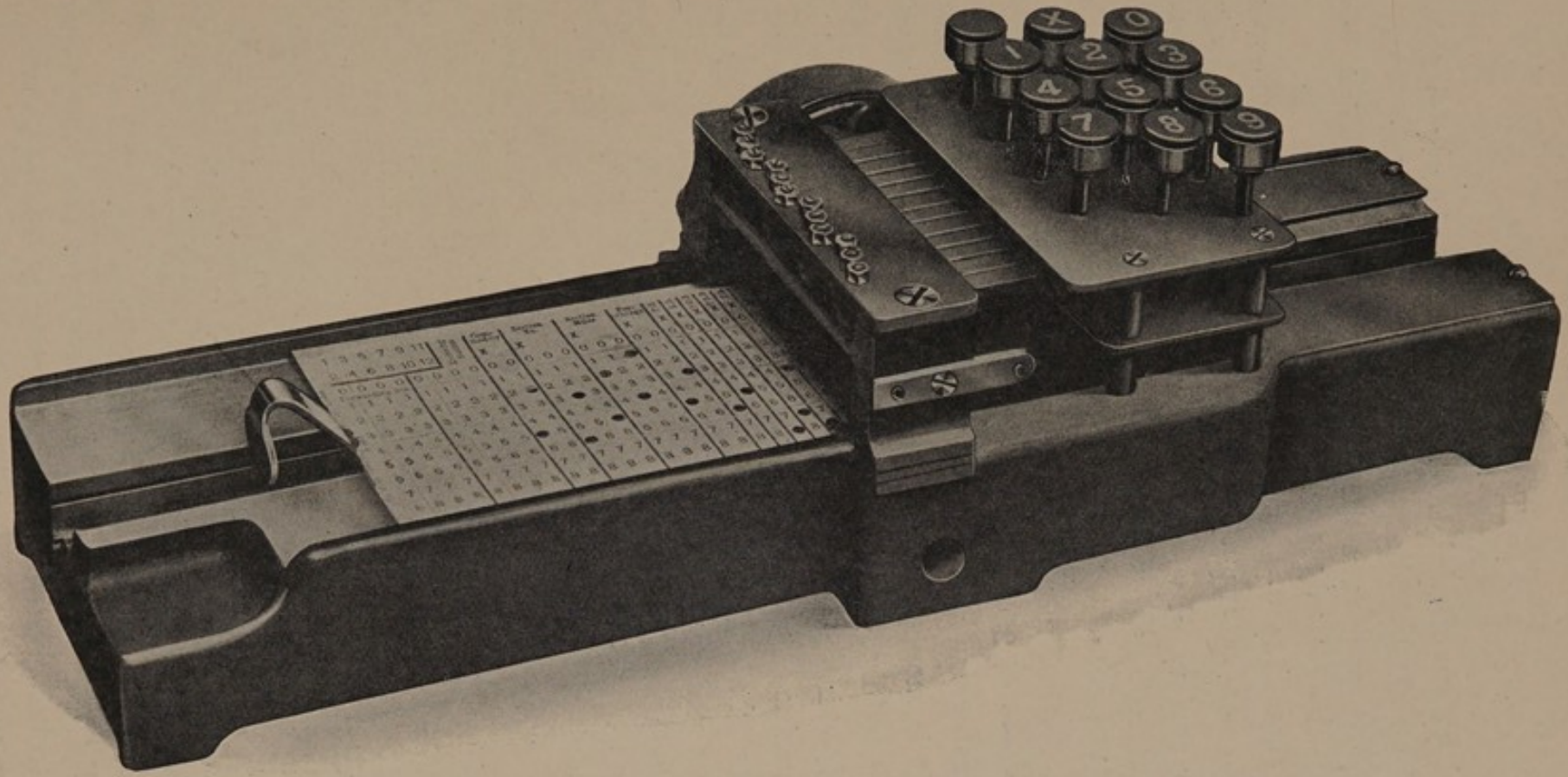


PLATE I.—Hollerith Key Punch

and so expert did they become that they were able to maintain a speed of from 2,000 to 2,500 a day.

The cards were then checked by being " called over " with the original document.

One card was punched for each of the 36,070,492 persons included in the census, and the whole operation was performed within a period of about twelve to fifteen months.

After the cards were punched they were ready for the sorting machine. This machine will sort cards at the rate of 250 per minute, or 15,000 per hour, and one operator can attend to two or three machines at a time, as it is merely necessary to keep it continually supplied with batches of punched cards and to remove the sorted cards at intervals. A batch of punched cards is placed in a magazine at the top of the machine without any regard to order whatever, and through the medium of a very ingenious mechanism they are sorted and deposited into proper pockets, according to the punching appearing upon them.

The mechanism of this machine may be briefly described as follows: Fine steel bands run from the top of each pocket up to the table where they meet just below the first card of the batch. As this card is forced downward, an electrical contact is effected through the hole that has been punched in the card; this operates the machinery so that the bands separate at the correct place and the card falls at once into a shoot which conducts it to the correct pocket. If, for example, the hole is punched over the figure 5, then the bands are opened between the fourth and fifth band, and the space between leads direct into the fifth pocket.

By way of illustration, assume that the census cards are to be sorted into male and female, and each group is to be sorted into ages. First the machine is adjusted to

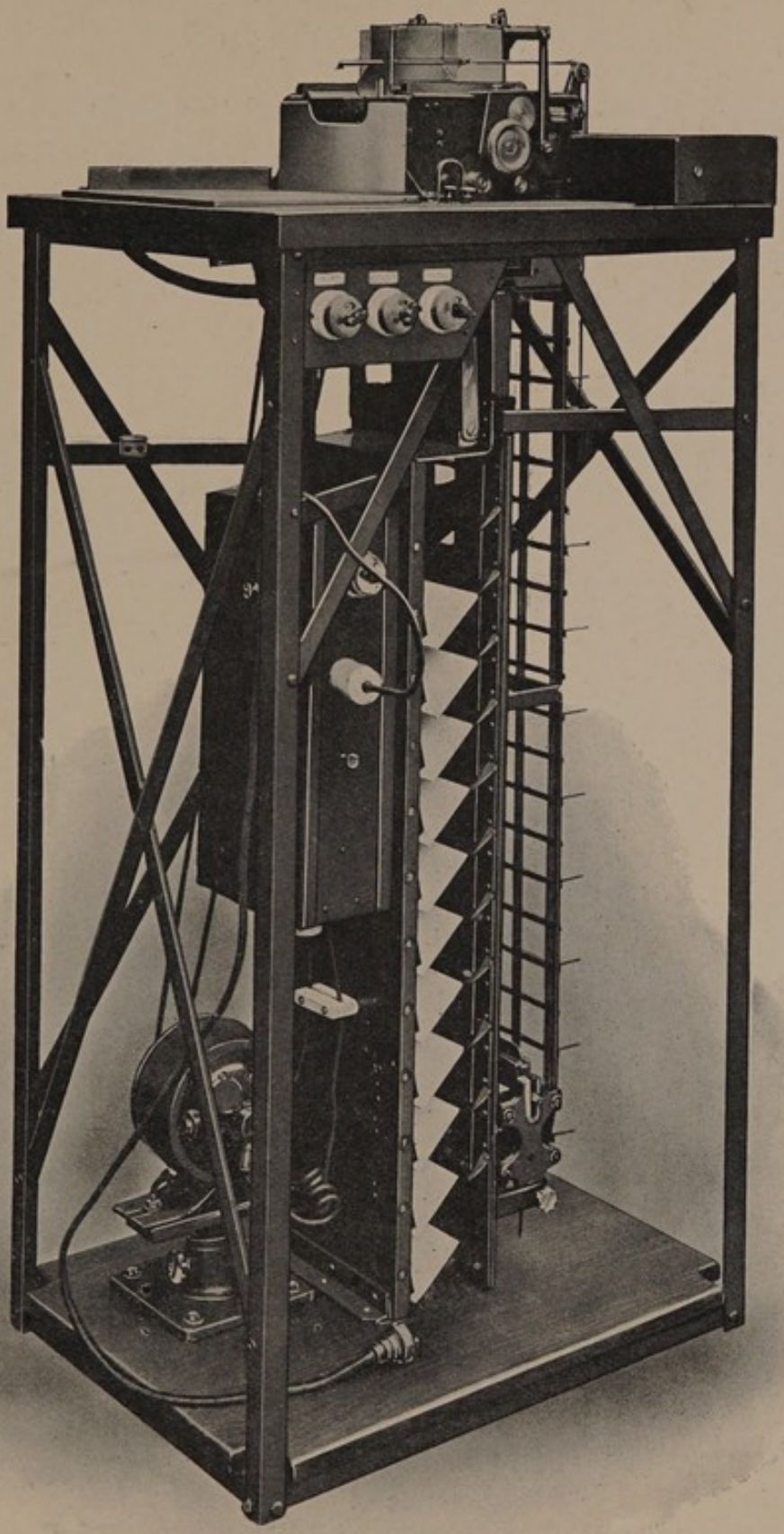


PLATE II.—Hollerith Sorting Machine.

operate on the field headed Sex, and the cards are sorted accordingly into the two groups. Next the machine is adjusted to operate on the units column of the age field, and the cards representing male lives are thus sorted into groups consisting of the ages 0, 10, 20, 30, etc., 1, 11, 21,

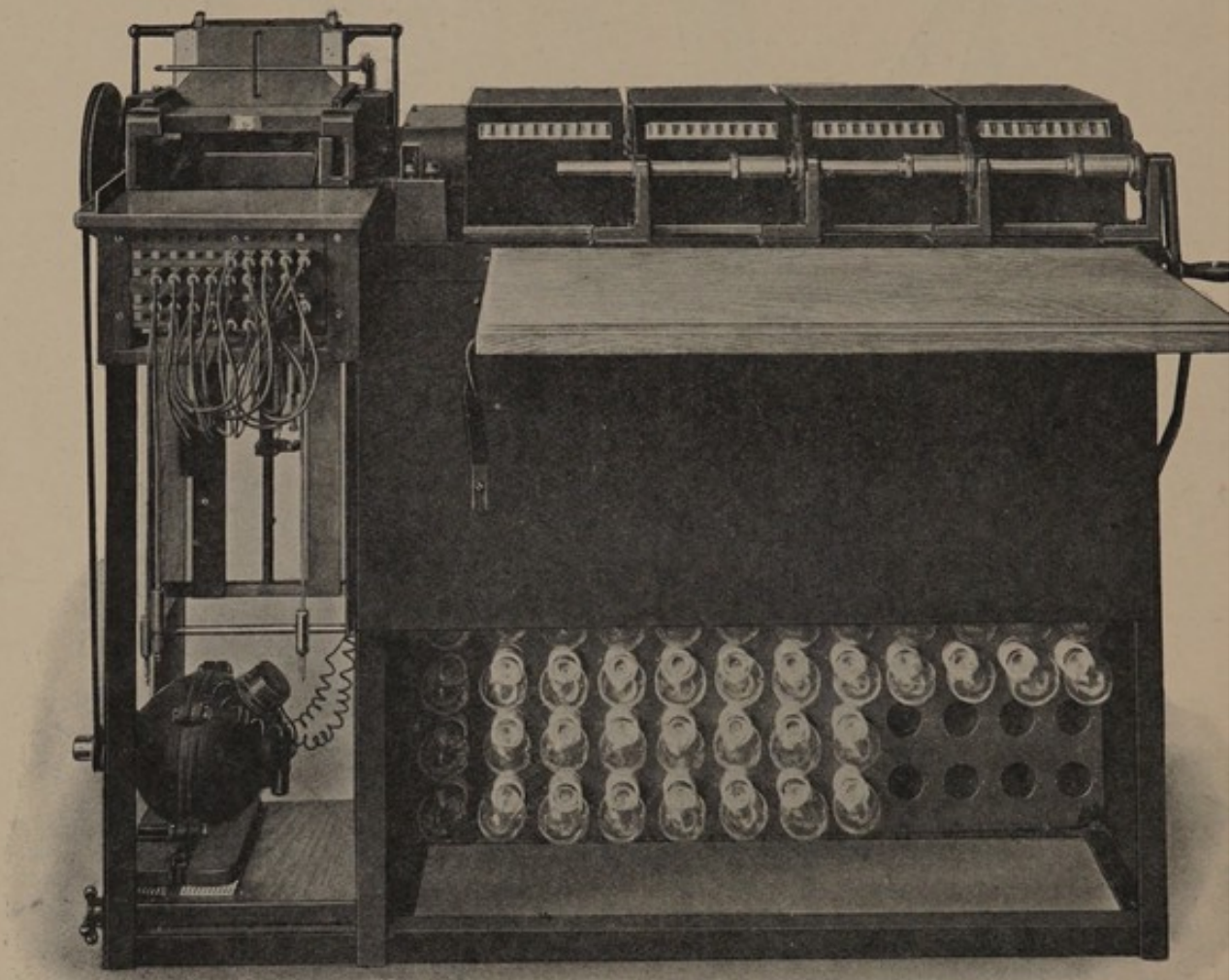


PLATE III.—Hollerith Tabulating Machine.

31, 41, etc., the final group being 9, 19, 29, etc. Each of these groups is again sorted according to the tens column, and thus all the cards for the same age are brought together in three operations at the rate of 5,000 an hour. As there were about fifteen machines installed at

the Census Office, the whole of the 36,070,492 cards were separated into groups according to sex and age in less than 500 working hours. This feat would have been absolutely impossible under the old method.

After being sorted, the cards are counted on the tabulating machine, of which an illustration is given on p. 16. The cards are placed in the magazine, and the machine is adjusted to tabulate the fields required. The current is then switched on, and the facts are accurately tabulated and the results shown on an indicator, from which the totals are read off.

A most useful improvement in the householder's schedule is the extension of the questions relating to marriage. In future it will be possible to refer to our own national statistics when dealing with the many very important questions relating to the fertility of marriage. It may be recalled that in 1911 the Government actuaries, in their preliminary investigations as to the working of the proposed National Health Insurance Act, had to turn to New Zealand for data on which to base their estimates as to the cost of the maternity benefits. I regret that, except in the case of Scotland, the data collected in answer to these questions have not yet been published. I shall refer to the Scottish returns in Chapter III.

CHAPTER II

A COMPARISON OF THE POPULATIONS OF GREAT BRITAIN, FRANCE, AND GERMANY

In the following diagram are given four graphs showing the populations of—

(1) The United Kingdom.
(2) England and Wales.
(3) France.
(4) Germany.

Dealing first with the lowest graph, that of England and Wales, it will be seen that the population, which was just under 9,000,000 in 1801, had increased to 10,000,000 by 1811, and 12,000,000 in 1821.

If these figures are reliable, they mean that in the course of twenty years, the population of England and Wales increased by as much as one in three. This is a remarkable rate of increase, and one which I find it difficult to believe, although it should be pointed out that this rate of increase did actually happen in Germany during the twenty years from 1891—1911. It is now, of course, impossible to verify the figures given, but personally, I am inclined to think that the census return of 1801 can only be regarded as a huge collection of guesses, whilst that of 1811, although much better, was still woefully lacking in accuracy.

It is remarkable how steadily the population of England and Wales has progressed. In the following

table (Table A) I give some further detailed figures. It will be seen that, if we disregard the doubtful figures of the first four censuses, the highest rate of increase for

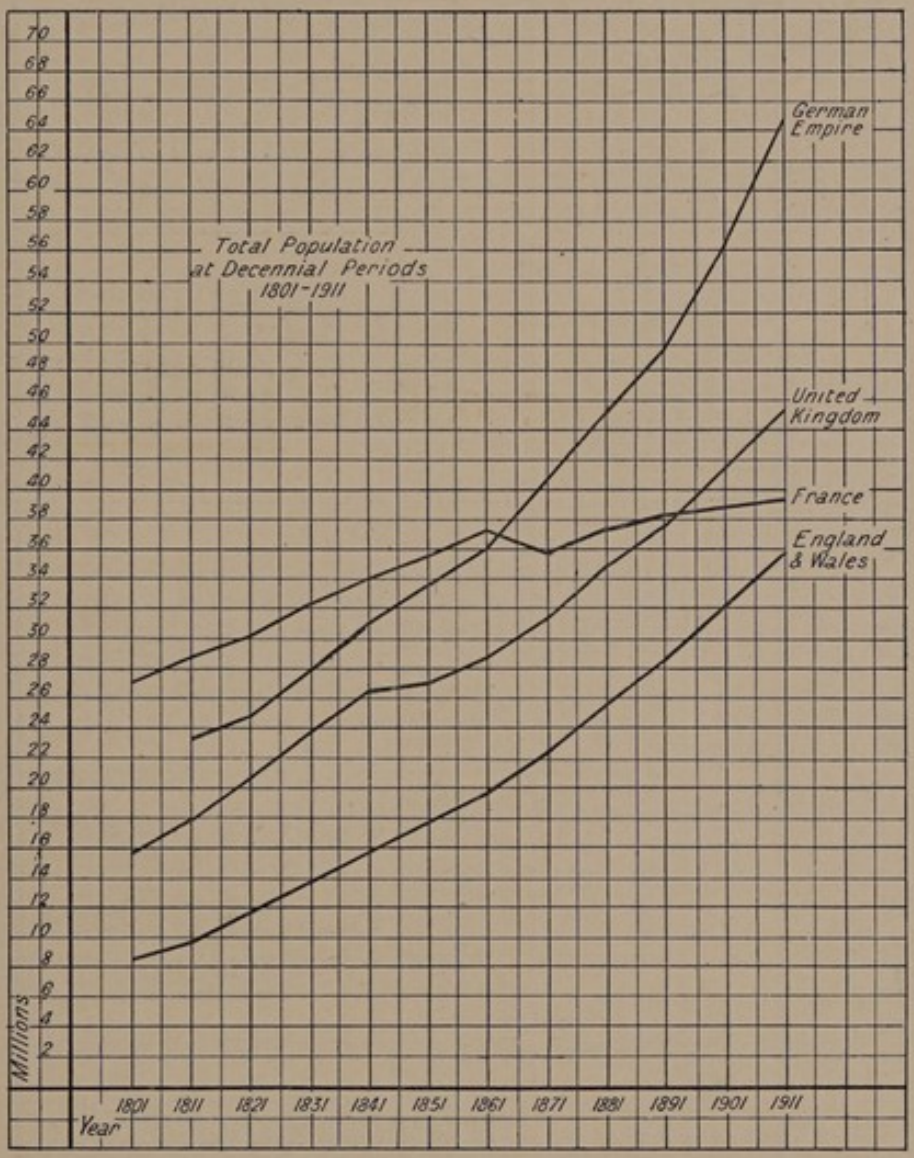


Diagram 1.

England and Wales occurred between the years of 1871 and 1881, and the lowest was during the decennium just past.

In Table B I set out some figures relating to the years 1871 to 1911. It will be noticed that column (4) gives

England and Wales. Population and Rates of Increase.

Table A.

Census Year.	Population.			Increase of Population since last Census.	Decennial Increase per cent. of Population.	Number of Females to 1,000 Males.
	Persons.	Males.	Females.			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1801	8,892,536	4,254,735	4,637,801	—	—	1,057
1811	10,164,256	4,873,605	5,290,651	1,271,720	14·00	1,054
1821	12,000,236	5,850,319	6,149,917	1,835,980	18·06	1,036
1831	13,896,797	6,771,196	7,125,601	1,896,561	15·80	1,040
1841	15,914,148	7,777,586	8,136,562	2,017,351	14·27	1,046
1851	17,927,609	8,781,225	9,146,384	2,013,461	12·65	1,042
1861	20,066,224	9,776,259	10,289,965	2,138,615	11·90	1,053
1871	22,712,266	11,058,934	11,653,332	2,646,042	13·21	1,054
1881	25,974,439	12,639,902	13,334,537	3,262,173	14·36	1,055
1891	29,002,525	14,052,901	14,949,624	3,028,086	11·65	1,064
1901	32,527,843	15,728,613	16,799,230	3,525,318	12·17	1,068
1911	36,070,492	17,445,608	18,624,884	3,542,649	10·89	1,068

what is termed the natural increase, whilst column (3) shows the actual increase, that is, the natural increase consequent on births and deaths as modified by the net results of migration. It is obvious that, so long as the figures for emigration exceed those for immigration, the actual increase must be less than the natural increase.

ENGLAND AND WALES. ACTUAL AND NATURAL INCREASE.

TABLE B.

Census Year. (1)	Enumerated Population of England and Wales. (2)	Actual Intercensal Increase. (3)	Natural Increase. (4)	Difference between Natural Increase and Actual Increase to be Accounted for as Loss by Excess of Emigration over Immigration. (5)
1871	22,712,266			
		3,262,173	3,426,480	164,307
1881	25,974,439			
		3,028,086	3,629,475	601,389
1891	29,002,525			
		3,525,318	3,593,648	68,330
1901	32,527,843			
		3,542,649	4,044,647	501,998
1911	36,070,492			

There are only two ways in which people can enter a country, viz., by birth or immigration, and there are only two ways by which they can leave, viz., by death or emigration. It follows, therefore, that by comparing the natural increase and the actual increase, we shall obtain the net results of migration. These I have set out in column (5) of the above Table B.

We can now better appreciate the causes at work that

affect the regularity of the figures represented by the graph already referred to (see p. 19).

In the following table (Table C) and diagram are

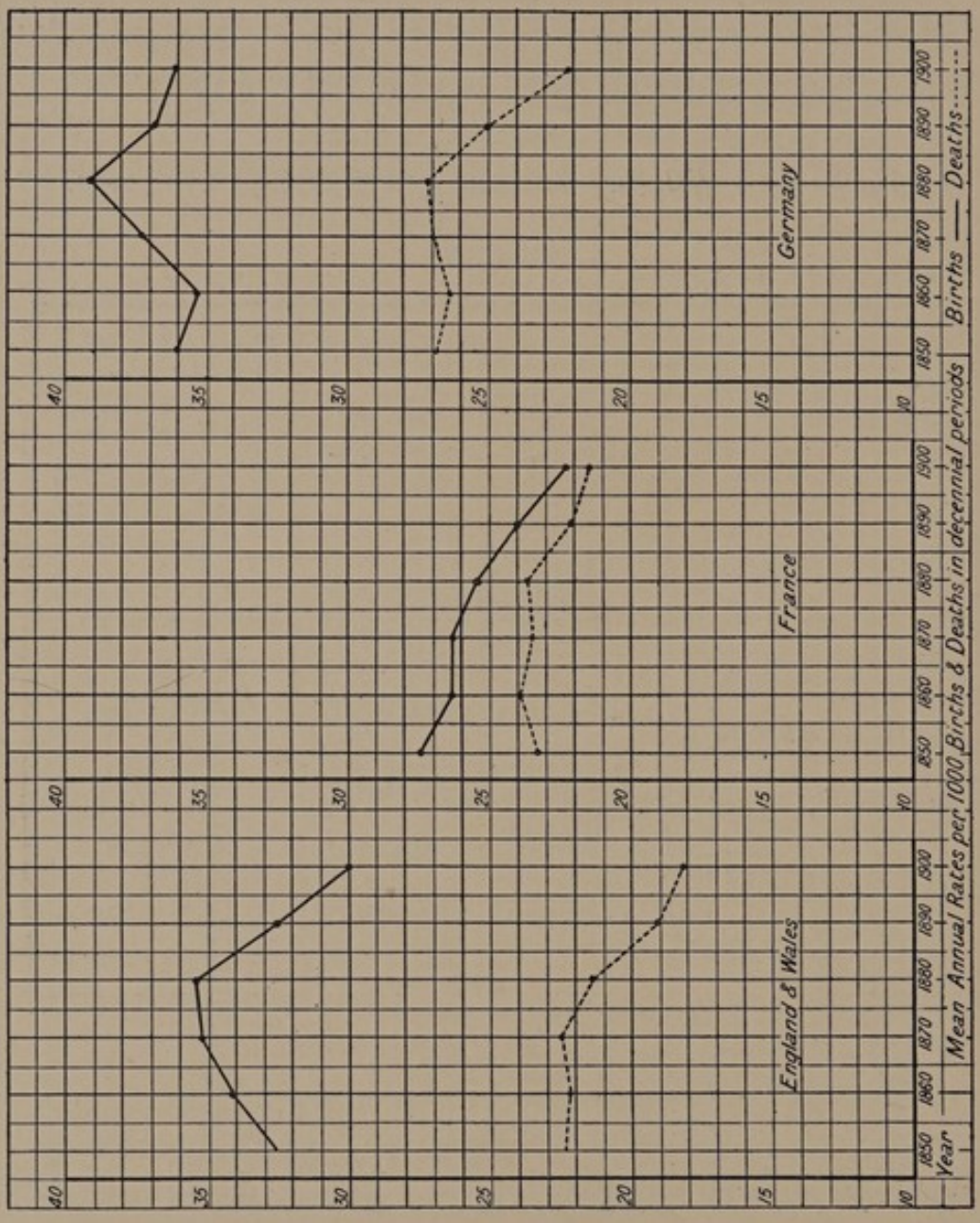


Diagram 1A.

given the mean annual birth and death rates for England and Wales, France, and Germany, in periods of ten years. The highest birth rate in England and Wales, viz., 35·4 per 1,000, occurred between the years

Mean Annual Rates per 1,000 of Births, Deaths and Natural Increase in Population, in Decennial Periods.

Table C.

Period.	England and Wales.			France.			German Empire.		
	Births.	Deaths.	Natural Increase.	Births.	Deaths.	Natural Increase.	Births.	Deaths.	Natural Increase.
1841—1850	32·6	22·4	10·2	27·4	23·3	4·1	36·1	26·8	9·3
1851—1860	34·1	22·2	11·9	26·3	23·9	2·4	35·3	26·4	8·9
1861—1870	35·2	22·5	12·7	26·3	23·6	2·7	37·2	26·9	10·3
1871—1880	35·4	21·4	14·0	25·4	23·7	1·7	39·1	27·2	11·9
1881—1890	32·5	19·1	13·4	23·9	22·1	1·8	36·8	25·1	11·7
1891—1900	29·9	18·2	11·7	22·2	21·5	·7	36·1	22·2	13·9

The figures for France and the German Empire relative to the period 1901—1910 were not available when I was preparing my lectures. It is now known that there has been a most extraordinary fall in the German birth rates, consequently the deductions drawn from the 1900 figures will probably require some modification.

of 1871 and 1881, since when it has persistently declined to 29·9 in 1891—1900. In Germany a similar condition exists, but the fall in the German birth rate is much less marked, viz., from 39·1 in 1871—1880, to 36·1 in 1891—1900.

A point, which must strike any careful observer, is the astounding difference in the birth rate of the three countries ; the rate has fallen persistently since 1871, and it will be noticed that the birth rate of Germany is greater now than ours has been at any time during the whole of the period since 1841. The birth rate of France has been low throughout ; seventy years ago it was only 27·4, and by 1891—1900 it had declined to 22·2. Thus it will be seen that merely to refer to the rates of the three countries for 1891—1900 is misleading.

By taking the difference between the birth and death rates, as shown in the third columns of each section, the rate of "natural increase" in each country is obtained.

The almost stationary condition of the French population is a matter of supreme interest, more especially when compared with the annual rate of increase in the German Empire, which for 1891—1900 was 13·9 per thousand. This is approximately equal to the rate experienced in England and Wales during the period 1871—1880, which is the highest on record.

It may be mentioned that the data given in the last table have been taken from the official publication of the Ministère du Travail et de la Prévoyance Sociale, and, as stated at the head of the table, the rates given are the mean annual rates for each decennial period. Hence they differ from the similar rates for England and Wales in the following table, which have been taken from Vol. I. of the Census of England and Wales, 1911.

STATISTICS FOR ENGLAND AND WALES.

Intercensal Period.	Increase per cent. by Births.	Decrease per cent. by Deaths.	Gain per cent. by Excess of Births over Deaths or Natural Increase.
1861—1871	37·56	23·98	13·58
1871—1881	37·89	22·80	15·09
1881—1891	34·24	20·27	13·97
1891—1901	31·57	19·18	12·39
1901—1911	28·56	16·13	12·43

These rates represent the total increase per cent. over the whole of the decennium, whereas the rates in the previous table are the average of the ten yearly rates operating in each year of the decennium.

It is reassuring to find that, whilst there is a decreasing birth rate in this country, remarkable increases are shown in the population of our Colonies. In this connection, I was very much struck with the following passage, which I read in a copy of a most interesting book presented to a very large number of children by the Mayor of Birkenhead (Mr. James Moon), in honour of His Majesty the King's recent visit :—

"THE FRENCH-CANADIAN.

"Canada west of the Great Lakes is essentially modern. It was made possible by the railway, and was permeated from the first with a new spirit. But Eastern Canada, still the greater part as regards population, though the West and the Middle-West march to overtake it with giant strides, has, mixed with the civilisation of the twentieth century, much of the quaintness and picturesqueness of the Europe of the eighteenth century. The French-Canadian, who is the dominant factor in the population of Eastern Canada, is a Frenchman of the era

before the Revolution—a Frenchman without scepticism, and with a belief that twelve children constitute rather a small family, and sixteen children a family of reasonable size." (Extract from "The British Empire," Chapter III. by Frank Fox.)

Returning to the population curves on p. 19, it will be noticed that the graph of the United Kingdom shows an extremely regular progression, much more so than that of England and Wales. This, of course, is due to the inclusion of the population of Scotland and Ireland. The combined populations of these countries is denoted by the difference between the respective ordinates in the graphs of the United Kingdom and of England and Wales. The most remarkable feature is, perhaps, the sudden halt between 1841 and 1851. Students of history will at once recognise the results of the disastrous Irish potato famine of 1846. Another point of interest to be noted is that in 1892 the population of the United Kingdom equalled that of France.

Dealing now with the graph which represents the population of France, we see that, although the population increased with comparative regularity until 1861, there is a sudden dip from about 37,500,000 on that date to 35,000,000 in 1871, this phenomenon being due to the loss of Alsace-Lorraine in 1870. The position in 1861 was just about regained by 1881, but since then the rate of increase has been very slow, and it appears more than probable that by 1921 the population of France will barely exceed that of England and Wales, and will not greatly exceed one half of that of Germany.

The graph of the German Empire is the most startling of the four, commencing as it does well below that of France. The populations of the two countries were about equal between 1861—1871, and at the present time that of Germany is more than 60 per cent. higher than that of

France. As I have already indicated, 1921 is likely to see the population of the German Empire nearly equal to that of England and Wales and France combined.

Turning from a consideration of the growth of the total populations of separate nations, it will be instructive to notice some of the features of the sex and age distribution.

A very useful method of analysing census returns is to ascertain the total number living whose ages do not exceed any given age. Thus, taking the population of England and Wales in 1911, there were—

3,854,383	under the age of	5	years.
7,551,179	,,	10	,,
11,050,867	,,	15	,,

and so on.

In the diagram given on p. 28, the curves corresponding to these figures are set out for the 1911 census figures of England and Wales, the German Empire for 1910, and France for 1906. It is to be regretted that although the total population of France in 1911 is published, the distribution according to age is not yet available.

These curves are such as to enable us to deduce several interesting results with considerable ease and simplicity. For example, assuming that the population and age distribution of France has varied but slightly during the period 1906—1911, we see that, whereas the total population of France exceeds that of England and Wales by nearly three millions, yet the number of persons aged 52 or less is the same in both countries. Thus, at what may be termed the effective ages, the population is the same in both countries. This means that the three millions by which the population of France exceeds that of England and Wales must consist solely of persons aged 53 and upwards.

The immense superiority of the German population at the effective ages is as striking as that shown by the figures in the previous diagram. The final ordinate of

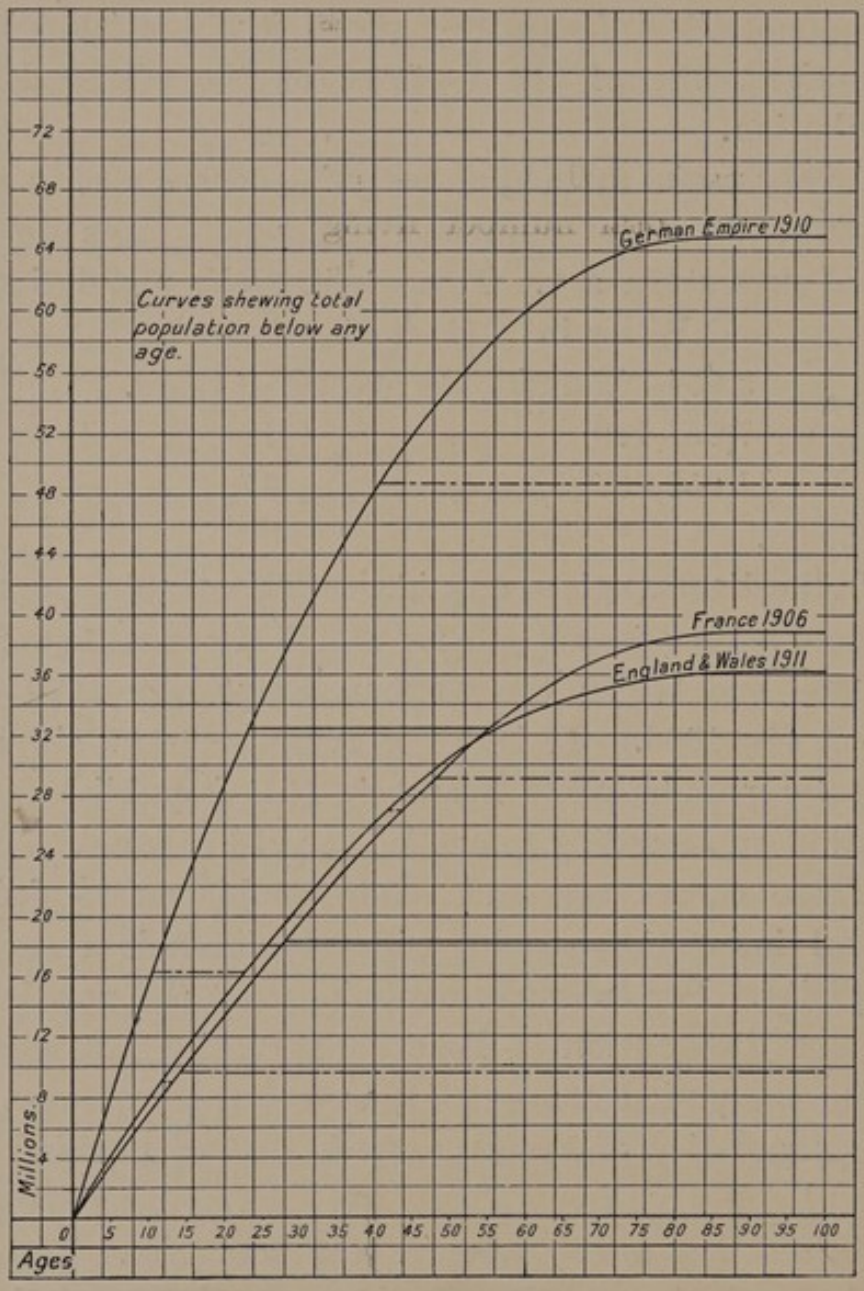


Diagram 2.

each curve has been bisected by the black horizontal line called the median line, and each half is again bisected by a dotted line, called respectively the upper and lower

quartile, and from these the median ages of Germany, England, and France are found to be 23·5, 25·75, and 30 respectively. In other words, exactly one half of the total population of Germany is below age 23·5 ; one half of the population of England and Wales is below age 25·75, whilst in France one half is below age 30. Again, one half of the population is living between ages 10·75 and 40·75 in the case of Germany, between ages 12 and 42 in England, and between ages 14·25 and 48·25 in France.

Taking these points in order, the three countries stand as follows :—

	Germany.	England.	France.
One quarter of the population is under age . .	10·75	12	14·25
One half of the population is under age . . .	23·50	25·75	30·00
Three quarters of the population is under age . .	40·75	42·00	48·75

Therefore, as far as youth and strength are concerned, the order of merit is Germany, England, and France.

	Germany.		England.		France.	
	Male.	Female.	Male.	Female.	Male.	Female.
One quarter of the population is under age . .	10·5	11·00	11·75	12·5	14·00	14·75
One half of the population is under age . .	23·25	24·00	25·25	26·5	29·5	30·25
Three quarters of the population is under age . .	40·00	41·75	41·25	42·5	47·5	49·00

In diagram 3, which represents the female and male population separately in two sets of curves, the same peculiarities are displayed.

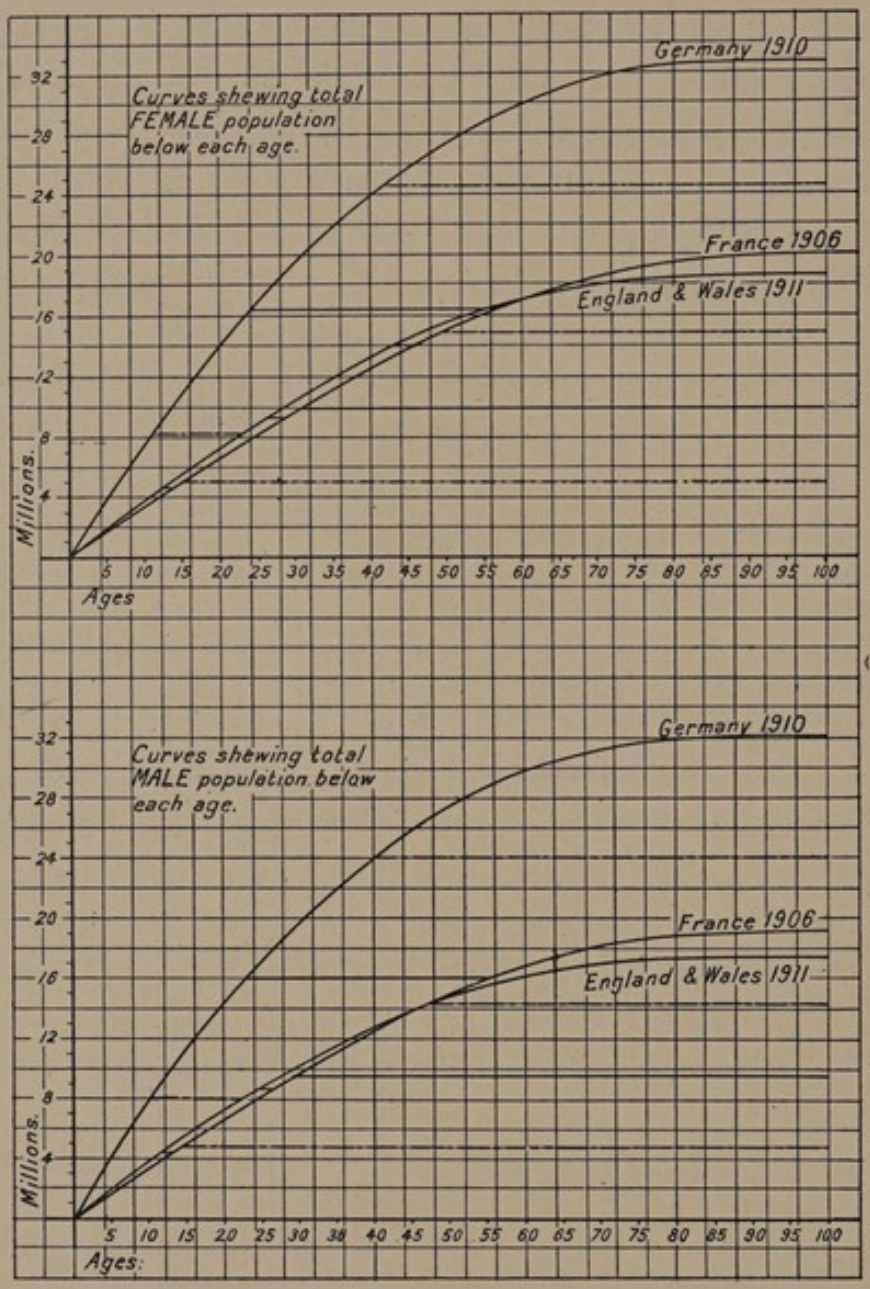


Diagram 3.

It will be noted that the French and English curves cross at about age 60 in the case of females, and at age 45 in the case of males. A brief explanation will show the

significance of this. In Diagram 2, on p. 28, it will be seen that the curves representing the total population crossed at age 52, indicating that the French population as a whole is much older than that of England and Wales. From Diagram 3 it will be seen that this condition is much more marked in the case of the male population, for there are more Frenchmen aged 45 and over than is the case in England and Wales, so that the peculiarity in the total population is due to the smaller proportion of the younger male population.

The number living between any two given ages is evidently denoted by the difference between the two ordinates. If we assume that a man is physically at his prime between the ages of 18 and 35, we see that Germany has a reserve of about 9,000,000 males from which to recruit her armies, as against 5,000,000 each in England and Wales and France, that is to say, 13·9 per cent. of the total German population is available for defence, as compared with 12·9 in France. For the whole of the United Kingdom the number of males living between these ages is about 6,250,000, which is equivalent to 13·8 per cent. of the total population. Again, in the case of women, the child-bearing period is taken as from 15—45 in the annual report of the Registrar-General; the French and German women living between these ages are about 8,834,000 and 14,831,000 respectively. These figures are of paramount importance when considered in relation to the corresponding numbers of a decade previous, viz., about 8,750,000 and 12,766,000, for, whereas German females have increased by 16 per cent. at the reproductive ages, the similar class in France has remained practically stationary. Thus, quite apart from all other considerations, here is an obvious reason for the fall which has been taking place in the French birth rate.

These investigations raise some very interesting points in connection with comparisons which are often made between the birth rates of different countries or periods. It is usual to calculate such rates upon the total number of the population, but it is evident that, if there is a relatively smaller proportion of women living at the reproductive ages, this would have a great effect upon the true birth rate. To find the causes for this variation in the age distribution of the population, we must investigate the birth rates and death rates of previous years, for it is clear that the apparent birth rate not only depends upon conditions ruling at the present time, but is largely dependent upon conditions ruling in times gone by.

In Diagram 4 is given a representation of the population of England and Wales in quinary age-groups, the column of any one age-group representing the population living between those ages. Thus for the first group, 0—5, we have the following figures :—

1871	3,071,000
1881	3,521,000
1891	3,553,000
1901	3,717,000
1911	3,854,000

These figures show that the national nursery had nearly three-quarters of a million more occupants in 1911 than in 1871. The rate of increase, however, has been irregular. This point will be dealt with more fully a little later on when I am dealing with death rates.

This diagram also discloses a large number of interesting variations, which have occurred in the age distribution of the population, and two prominent features should be noted : First, that in 1871 the groups of ages as represented were such that a line drawn through the central points gives us a curve convex to the base. In 1911 the

curve will be found to follow an entirely different course, having two points of contrary flexure, viz., at ages 20 and 30. This is due to the fact that at the present time our population contains a much larger proportion of lives at the working ages. Secondly, we are enabled, I think, to trace the effects of one of the greatest sanitary reforms ever introduced. I mean the inauguration of surgical antisepsis in 1867, which was extended to obstetrics in

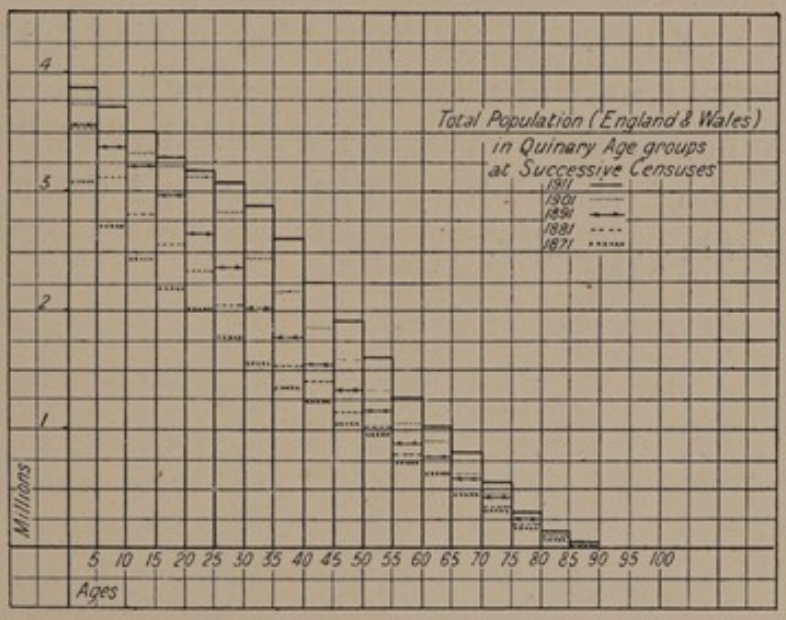


Diagram 4.

the early eighties, and led up to the Midwives Act of 1902.

In 1871 there were 937,000 females living between ages 25 and 30. In 1881 the survivors of this group, who were then living between ages 35 and 40, numbered 796,000, or just under 85 per cent. of those living in 1871. If the current rates of mortality had remained constant, the survivors in 1911 of the group of females between ages 25 and 30 in 1901 would have been only 1,272,000, but as a matter of fact as many as 1,352,000 actually survived. The saving of life in the corresponding group

for the male population is also very striking. The survivors in 1911 of the 1,329,000 males aged between 25 and 30 living in 1901 numbered 1,262,000. Had the rate of mortality ruling for the period 1871—1881 been experienced in 1901—1911, there would have been only 1,174,000 survivors; that is to say, the improvement in the mortality is represented by the saving of 88,000 male lives. As I have just said, the saving in the life of females was 80,000, and the total saving was, therefore, 168,000, or 6·42 per cent. Even after making full allowance for the effects of migration, and the improvements in the habits of the people, this is a wonderful tribute to the efforts of the sanitary reformers, and the medical profession in particular.

CHAPTER III

THE ANNUAL REPORTS OF THE REGISTRAR-GENERAL—MARRIAGE RATES AND INFANTILE MORTALITY

As I have already indicated, the last annual report of the Registrar-General will always be notable on account of the very many improvements which were introduced.

Until the report for 1911, the returns furnished to the Registrar-General were arranged according to registration areas, whilst the returns furnished to the Local Government Board were classified in administrative areas, the two sets of areas not coinciding.

It will be readily recognised that, so long as the various statistics collected by the Local Government Board related to districts dissimilar to those dealt with by the Registrar-General, it was quite impossible to make full use of the results disclosed. Everyone who is engaged in public health administration will fully appreciate the great change which has been accomplished by the strenuous work of Bernard Mallet, Esq., C.B., the present Registrar-General.

The annual report of the Registrar-General refers to "Births, Deaths and Marriages" on the title page, but the report itself rightly places marriages in the forefront, for it is impossible to discuss the changes in the birth rate without considering the corresponding anterior changes in the marriage rate.

The annual number of persons, out of each 1,000 living, whose marriages took place during the years 1881,

1891, 1901, and 1911 respectively in England and Wales, were as follows :—

Year.	Marriage Rate per 1,000 of the Population.
1881	15·1
1891	15·6
1901	15·9
1911	15·2

At first sight it would appear that the marriage rate is being fairly well maintained ; the comparison with the whole population is, however, fallacious. It is evident that in a population which is not absolutely stationary, either as regards its total numbers or its age distribution, there must necessarily be some variation in the proportion of marriageable persons. It must also be remembered that by far the greater number of marriages occur between the ages of 20 and 30, and, therefore, in order to obtain any reliable measure of the marriage rate, it is necessary to ascertain the marriage rate amongst persons of a marriageable age.

The following table gives these rates for the periods mentioned above :—

Average Annual Marriage Rates per 1,000 of Unmarried Persons aged 15 Years and Upwards.

Years.	Bachelors.	Spinsters.
1880—1882 . .	58·7	59·0
1890—1892 . .	57·1	55·7
1900—1902 . .	54·7	53·0
1911 . . .	50·7	50·8

The table discloses a steady and continuous fall over the thirty years. Expressed in terms of marriages the fall means that had the rate for 1880—1882 been ruling in

1911 there would have been about 30,000 more marriages in that year.

Another important tendency is disclosed by a consideration of the mean ages of bachelors and spinsters at

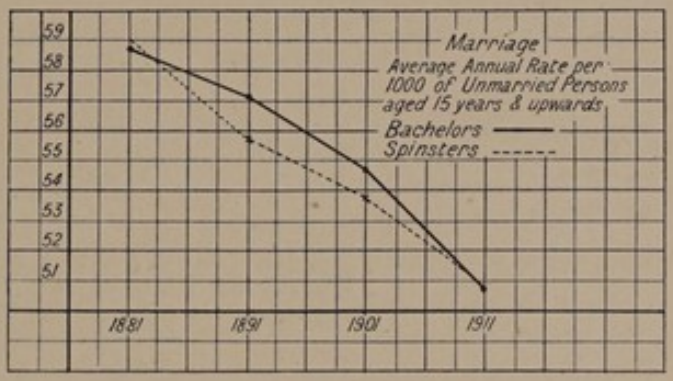


Diagram 5.

the date of marriage during the years 1896—1911, as given in the following table :—

MEAN AGE OF BACHELORS AND SPINSTERS AT MARRIAGE, 1896—1911.

Year.	Bachelors.	Spinsters.
1896	26·59	25·08
1897	26·63	25·10
1898	26·62	25·14
1899	26·65	25·16
1900	26·68	25·23
1901	26·76	25·31
1902	26·88	25·36
1903	26·91	25·37
1904	26·93	25·37
1905	27·01	25·43
1906	27·03	25·46
1907	27·10	25·54
1908	27·19	25·63
1909	27·29	25·73
1910	27·36	25·79
1911	27·46	25·81

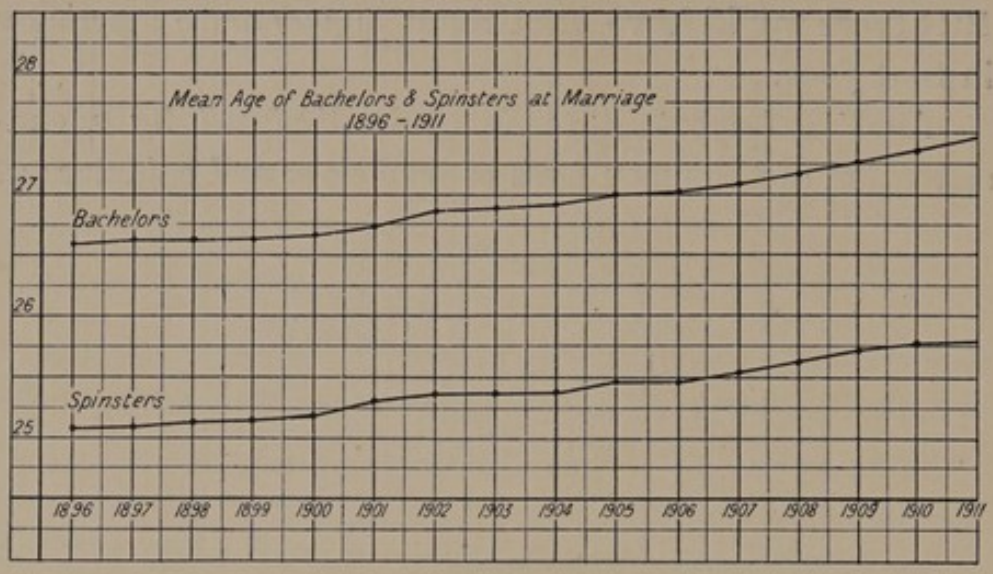


Diagram 5A.

The regularity with which the average age at marriage of both sexes is increasing is worthy of note. One cause contributing to this result is the much smaller percentage of minors who marry, thus :—

NUMBER OF MINORS' MARRIAGES OUT OF 1,000 MARRIAGES AT ALL AGES.

Years.	Husbands.	Wives.	Years.	Husbands.	Wives.
1876—1880	77·80	217·00	1896—1900	51·2	168·00
1881—1885	73·00	215·00	1901—1905	46·3	153·10
1886—1890	63·20	200·20	1906—1910	40·3	139·40
1891—1895	56·20	182·60	1911	39·3	133·30

The table on p. 39 gives a further illustration of the modern fashion of later marriages.

The meaning of this is that of each 1,000 married women between ages 15 and 45, 13 were below age 20 in 1871, as against 5 in 1911 ; 139 were between the ages

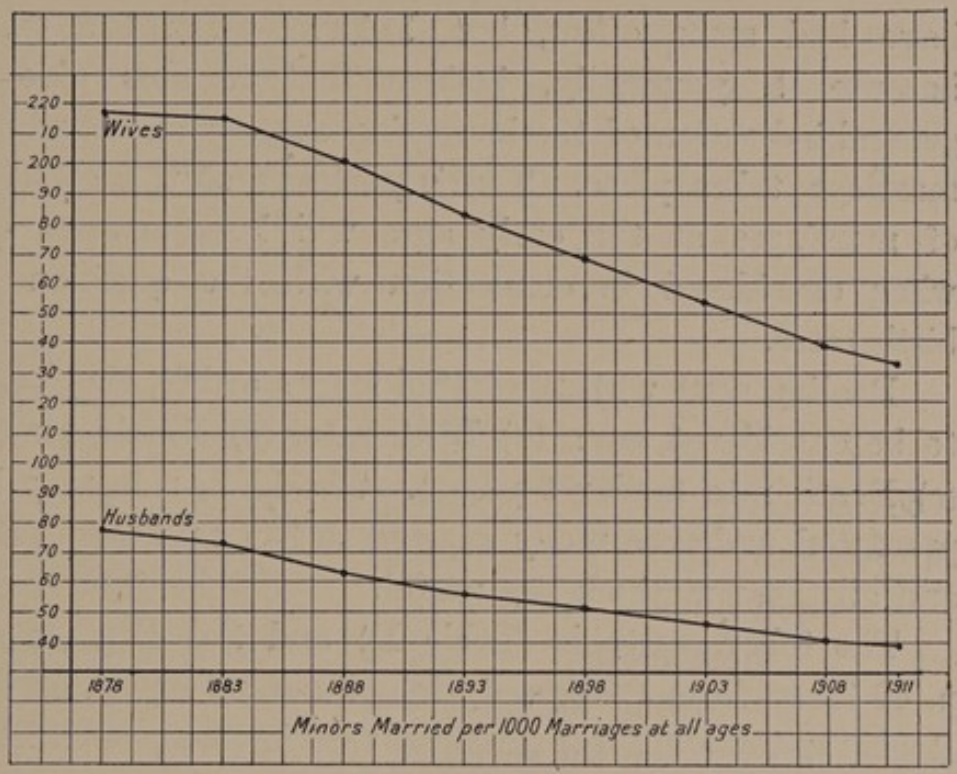


Diagram 6.

Census Year.	The Proportion per cent. at each of Four Age-Groups of the Married Women aged 15—45.			
	15—20.	20—25.	25—35.	35—45.
1871	1·3	13·9	45·5	39·3
1881	1·1	13·7	45·6	39·6
1891	0·9	12·8	46·0	40·3
1901	0·7	11·8	46·8	40·7
1911	0·5	9·4	46·0	44·1

20 and 25 in 1871, as against 94 in 1911 ; 455 were between the ages of 25—35 in 1871, as against 460 in 1911 ; and, in 1871, 393 were between ages 35—45, while in 1911 the number was 441. These figures are, of course, not conclusive, and are only indications of the tendency to defer marriage. The age distribution of the population must

have had some effect, but I have given the table because I, personally, believe that it *does* give a general indication of the increasing average age at which marriage takes place. The importance of this scarcity of marriages at the early ages will become apparent when considered in connection with the question of birth rates.

Dealing next with the initial stages of life, the forces to be considered are: (*a*) Birth rate, (*b*) Marriage rate, (*c*) Death rate (under 5 years). The birth rate may be presented under as many aspects as the marriage rate, and all these methods are useful.

The following table (Table D) and the diagram on p. 42 taken from the seventy-fourth annual report of the Registrar-General show the birth rate for the past thirty-five years analysed in various ways.

It is certainly a matter for congratulation that the rate of illegitimacy has fallen from 14·4 per 1,000 in 1876—1880 to 8·0 per 1,000 in 1911. From the percentages given in the second section of each column, it will be seen that not only is the birth rate on the total population falling rapidly, but the birth rate as calculated on the married female population has fallen to an even greater extent.

It is clear that causes other than a fall in the marriage rate must have operated to reduce the birth rate. One of these causes is undoubtedly that to which I have already referred, viz., the later age at which women marry. The average age of spinsters at marriage at the present time is 25·81, as compared with 25·08 in 1896. This tendency to later marriage becomes of considerable importance when we consider it in the light of the marriage data derived from the last census of Scotland, which, as I have already stated, was the only one available in April,

TABLE D.

Period.	(*a*). Birth Rate Calculated on Total Population at All Ages.		(*b*) Fertility Calculated on the Female Population aged 15—45 years.		(*c*). Legitimate Fertility Calculated on the Married Female Population aged 15—45 years.		(*d*). Illegitimate Fertility Calculated on the Unmarried and Widowed Female Population aged 15—45 years.	
	Rate per 1,000.	Compared with Rate in 1876—80, taken as 100.	Rate per 1,000.	Compared with Rate in 1876—80, taken as 100.	Rate per 1,000.	Compared with Rate in 1876—80, taken as 100.	Rate per 1,000.	Compared with Rate in 1876—80, taken as 100.
1876—1880	35·3	100·0	153·3	100·0	296·3	100·0	14·4	100·0
1881—1885	33·5	94·9	144·3	94·1	282·4	95·3	13·5	93·8
1886—1890	31·4	89·0	133·4	87·0	267·1	90·1	11·8	81·9
1891—1895	30·5	86·4	126·8	82·7	258·3	87·2	10·1	70·1
1896—1900	29·3	83·0	118·8	77·5	242·9	82·0	9·2	63·9
1901—1905	28·2	79·9	112·9	73·6	230·5	77·8	8·4	58·3
1906—1910	26·3	74·5	105·3	68·7	212·9	71·9	8·1	56·3
1911	24·4	69·1	97·8	63·8	196·2	66·2	8·0	55·6

1914, when my lectures were being prepared. In the third volume of the report we read :—

" There is a level chance of a young woman marrying at 17, being the mother of at least ten children, and that, as the age of the wife at marriage advances, the level chance applies to a smaller sized family. Thus this

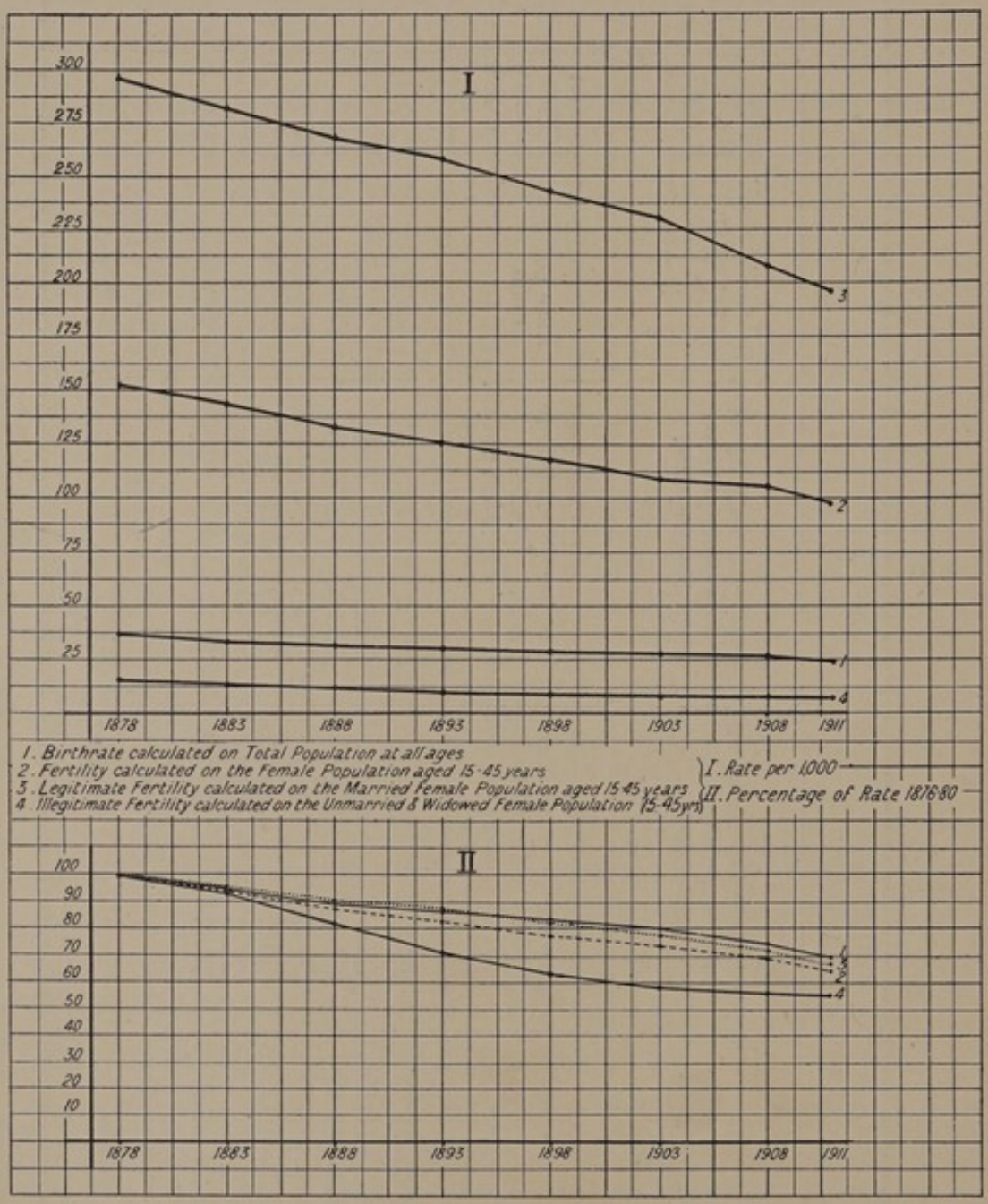


Diagram 7.

chance in the case of a woman marrying at 20 is that she will be the mother of at least nine children, for age of wife 25, at least six children, for age of wife 30, at least four children, for age of wife 35, at least two children, and for age of wife 40, at least one child."

This shows very clearly the influence of the age at marriage on the birth rate.

Another most potent cause of the falling birth rate is undoubtedly that of deliberate restriction. It is a curious fact that whereas, in the early part of the nineteenth century, the public mind was agitated by the fear of the country becoming over-populated, the opposite is now the case.

The vital question to be considered in dealing with the period of infancy is, however, not "How many children are born?" but "What proportion of children born survive the perils of infancy?"

It will, therefore, be interesting to note the progression of the death rate per 1,000 living under the age of 5 years during each of the decennial periods from 1841—1911.

Decennium.	Deaths per 1,000 Children living between Ages 0 and 5.
1841—1850	66·0
1851—1860	67·6
1861—1870	68·6
1871—1880	63·4
1881—1890	56·8
1891—1900	57·7
1901—1910	46·0
1911	43·7

This table very clearly illustrates the beneficent work accomplished by sanitary reformers. A consideration of the various causes of infantile death will indicate the directions in which continued efforts are still required.

Out of 17,693 deaths of children in London under 5 years of age during 1913, no less than 13,843 were the result of the following causes, of which it is safe to say that many are preventable :—

Cause.	Number of Deaths.
Diarrhœa	3,234
Pneumonia	2,628
Premature birth	2,006
Measles	1,460
Accidents	1,106
Tuberculosis	1,050
Bronchitis	986
Diphtheria	773
Convulsions	600

The extent to which this slaughter of the innocents could be moderated is evident when we consider that careful feeding would eliminate many cases of diarrhœa. The prevalence of measles is largely increased by the prejudice against early notification and by failure to take the necessary precautions during the later stages of the illness. The mortality from measles is greatly increased by some secondary disease contracted during convalescence, such as broncho-pneumonia, which in 1911 was found to accompany measles in 6,449 cases out of a total of 13,128. Is it too much to say that but for lack of care, more particularly during convalescence, many of these lives might have been saved ?

The question of ante-natal pathology is at present engaging the attention of the medical profession, and we can, therefore, hope that the wider knowledge which is bound to ensue will result in a decreased rate of mortality due to premature birth.

In spite of the old proverb which says that accidents will happen in the best regulated families, it is nevertheless a fact that accidents are to a great extent preventable,

more especially those which are responsible for so many terrible deaths amongst very young children.

With regard to tuberculosis, it is now well established that this is a distinctly contagious disease, the infection being mainly conveyed by contaminated milk and the sputum of persons in an advanced stage of the disease. It must not, however, be forgotten that unhealthy environment is a most important factor in increasing the liability to the disease. I am thankful to say that great progress has been made in the past with regard to all three of the above causes, but much still remains to be accomplished.

A striking instance of the infectious nature of tuberculosis is given in " The Conquest of Consumption," a small volume by Dr. Latham and Mr. Garland. The authors, quoting from Engelmann, cite the case of a newly-built flat.

" This was occupied for eight years by three families in succession ; all of them had presented a clean bill of health until the family, X., took up their residence in the same quarters. In this family the mother was a consumptive when she came. She died in the flat. Shortly after her death—that is after a year's tenancy—the family left. The flat was now occupied by the family, Y., of seven healthy persons. After a year's stay this family left, and some years later the father, mother and one son died of consumption, and another son of tuberculous peritonitis. The third family, Z., now took the rooms. All were healthy. Of this family one child died of tuberculous meningitis, one of wasting disease, and another suffered from tuberculous hip disease. Subsequently, the father died from consumption, and a brother of tuberculous meningitis. The mother acquired consumption, and a child developed tuberculous disease of the glands. A fourth healthy family, W., came into the flat. The mother became consumptive, two children died of tuberculous meningitis.

" In this case the flat was free of the disease for eight

years. Then came a tuberculous tenant. In a period of twelve years at least thirteen cases of tuberculous disease were traced to this source. The dwelling was never vacant, and during the whole period was never painted, cleaned, or disinfected. A striking fact is that in the other flats of precisely the same character in the building, where cleaning was not neglected, no single case of consumption or other forms of tuberculosis could be traced."

In Germany and France the statistics as to the causes of death among the whole population are not available prior to 1906. It is, therefore, impossible to effect any comparison between these countries with respect to mortality from various diseases.

In the following table (see p. 48) some figures are given representing the death rates of males and females at eleven groups of ages in the cases of England and Wales, Germany, and France for the three years 1900, 1901, 1902, which are the latest available for this purpose. The incidence of mortality varies to a noticeable extent. Thus, the German male death rates are higher than ours up to age 24, and it will be noticed that, at the infantile ages, the German mortality is 80·33, as against a rate of 58·29 per 1,000 for England and Wales. Between ages 25 and 74 the German rates are slightly lower than ours, but rise above again after age 75. In the case of France, the male death rate at infantile ages is slightly lower than ours, but from ages 5 to 44 it is in excess, noticeably so between ages 20 and 34; between 45 and 74 it is again lower, and after that age is about 16 per cent. higher.

In Chapter II. I referred to the immense superiority of the German population over that of France at the effective ages. This feature is strikingly emphasised in the death rates given in the table. Between ages 20 and 25 the French death rate is 45·4 per cent. higher than the German rate; between ages 25 and 35 it is 33 per cent.

higher, and between ages 35 and 45 it is 14·5 per cent. in excess.

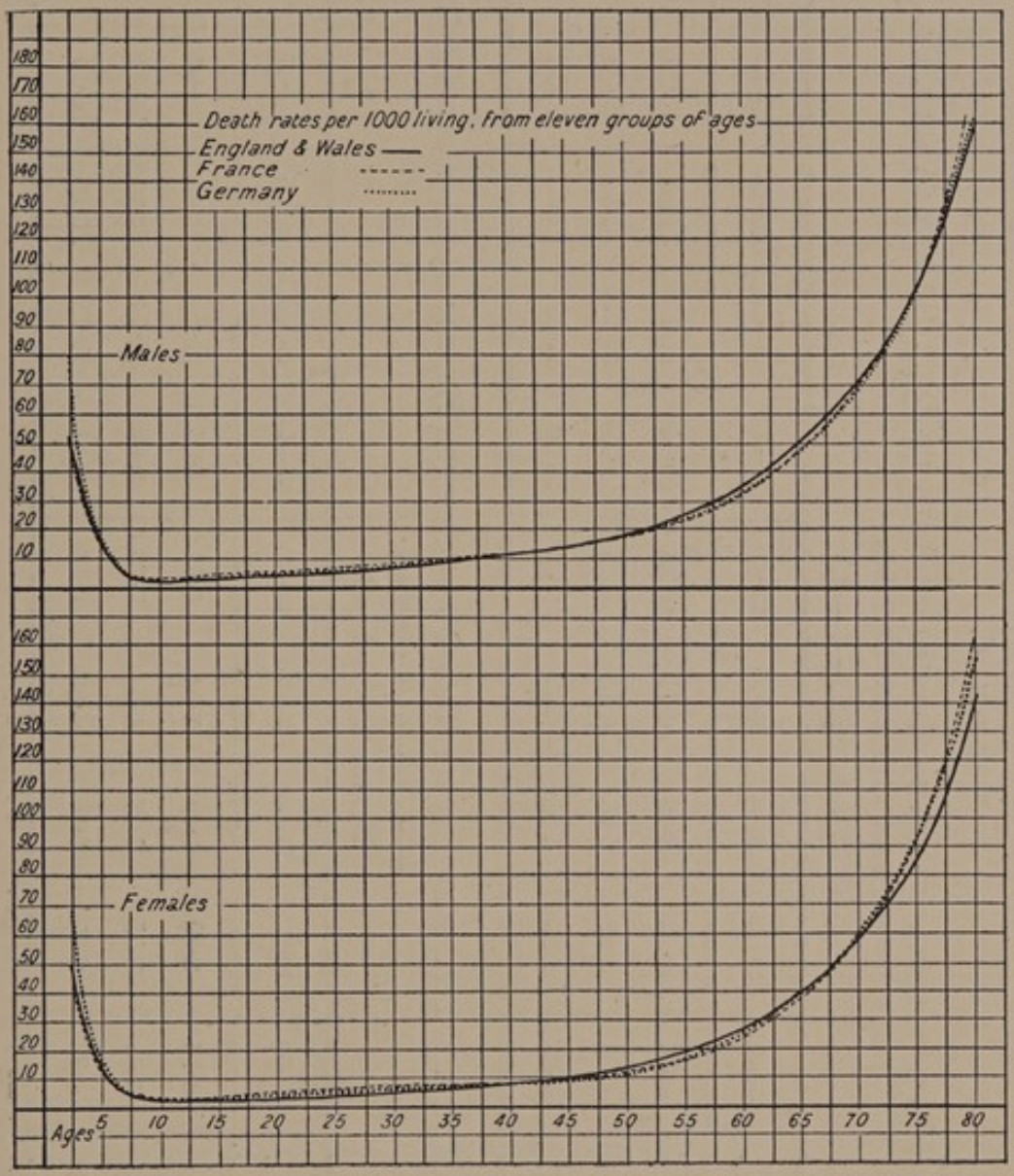


Diagram 8.

The rates of mortality amongst the female population of the three countries are set out in the lower portion of the table, and, by comparing the rates, it will be seen that very similar characteristics are exhibited to those of the male population.

Table E.

Death Rates per 1,000 Males living at Eleven Groups of Ages in England and Wales, France, and the German Empire.

Years 1900—1—2.

Countries.	Under 5 years.	5—10	10—15	15—20	20—25	25—35	35—45	45—55	55—65	65—75	75 years and upwards.
England and Wales.	58·29	4·06	2·28	3·49	4·77	6·38	10·94	18·67	34·80	70·25	158·18
France . . .	51·74	4·69	3·00	5·08	8·10	8·19	11·56	17·54	31·50	69·50	183·78
German Empire .	80·33	4·47	2·59	4·06	5·57	6·16	10·10	17·69	32·49	67·56	161·97

Death Rates per 1,000 Females living at Eleven Groups of Ages in England and Wales, France, and the German Empire.

Years 1900—1—2.

Countries.	Under 5 years.	5—10	10—15	15—20	20—25	25—35	35—45	45—55	55—65	65—75	75 years and upwards.
England and Wales.	48·76	4·16	2·40	3·21	3·94	5·44	8·84	14·26	27·45	59·03	143·48
France . . .	43·55	4·81	3·55	5·27	6·88	7·75	9·08	12·72	24·35	58·81	163·58
German Empire .	68·07	4·58	2·75	3·72	4·86	6·43	8·24	11·73	25·13	60·60	154·67

A consideration of these facts is worthy of attention. First, there is the widely debated question—"Is a high birth rate necessarily associated with a high death rate among infants?" It has been maintained that such is the case, and I must own that a comparison of the birth and death rates for the three countries, England and Wales, Germany, and France, does at first sight appear to support this contention. My own feeling, however, is that there is not necessarily any connection between the two. In the case of other countries, a careful study of the figures relating to earlier periods leads me to the belief that the fall in the death rate is due to causes altogether unconnected with the lower birth rate. With regard to England and Wales the decrease in the infantile death rate is to some considerable extent accounted for by the decreased mortality from measles, scarlet

England and Wales.

AGES 0-15.
MEAN ANNUAL DEATH RATES
PER MILLION LIVING.

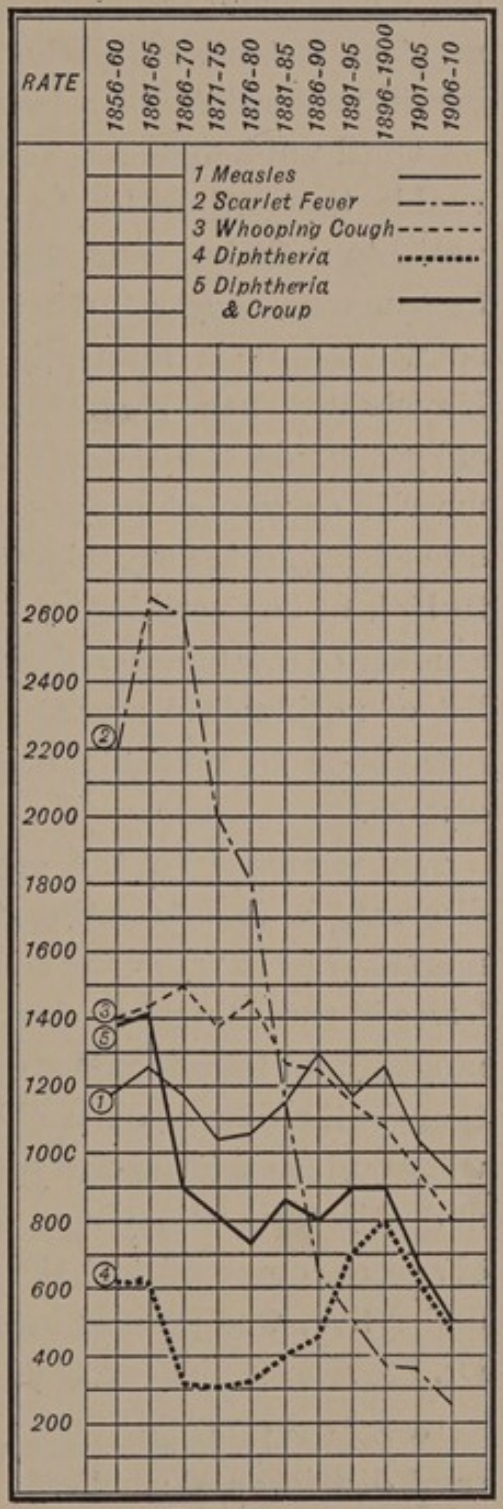


Diagram 9.

fever, whooping cough and diphtheria. The course of these diseases is well shown in the diagram on p. 49.

Scarlet fever shows signs of being nearly subjugated, but measles and whooping cough are still prevalent to too great an extent. Diphtheria, although less in evidence, is still responsible for a large number of infantile deaths.

Until public opinion has been educated sufficiently to enable the authorities to enforce complete isolation of patients suffering from these diseases, it is impossible to be sanguine of any further great improvement. In this connection it is interesting to note that the city of Manchester has recently obtained powers making it obligatory on the parents of all children suffering from measles or whooping cough to notify the cases. On the other hand, it is disturbing to find that, apparently owing to lack of co-operation on the part of the inhabitants, a number of local authorities who had added measles to the list of notifiable diseases, have applied for and received permission to revoke the orders for notification of this disease.

In reference to the general question of contagious diseases, it is interesting to notice that the infantile mortality from whooping cough appears to be considerably lower in rural than in urban districts. In *all* districts the mortality of infants under one year of age is much greater than in the case of older children. It is, however, somewhat curious that for the years 1905—1910 the proportion of deaths from whooping cough for infants under one year of age, as compared with the total deaths amongst children under five, was greater in rural than in urban districts. Dr. Stevenson, in commenting upon this point, says :—

"Probably families are on the average largest in the rural districts and smallest in the large towns—the census tabulation will show whether this is the case in England

as it has been found to be in Ireland. If so, the fact may help to account for the apparent anomaly. For children without elder brothers or sisters must be much less exposed to risk of infection under one year of age than the younger members of families, and such relatively protected children would necessarily be fewer proportionately in the country. It seems very doubtful, however, whether this consideration can suffice of itself to account for the facts."

Both in the case of whooping cough and measles, the fatal cases are much more prevalent when such diseases as rickets and infantile diarrhœa appear as complications. It is, I think, generally admitted that a very large number of cases of infantile diarrhœa could be prevented by means of greater attention to sanitation and diet. Necessarily, any lessening of this trouble would tend to reduce infantile mortality from measles and whooping cough. The Local Government Board publishes annually some most useful leaflets on this subject, which I strongly commend to the notice of all those who are interested in the important matter of sanitation and public health. The leaflet dated July 25th, 1913, which deals with the prevalence of epidemic diarrhœa amongst children, is particularly instructive.

At first sight it would seem unlikely that we, here in England, could learn any useful lessons from the once fever-stricken districts of Panama, and yet I verily believe that many thousands of lives might be saved if only we could follow the example of our American friends. France lost 22,189 men in the Panama Isthmus in five years. America has lost less than 5,000 men in ten years, and has now succeeded in transforming the whole region from one of the most deadly into one of the healthiest localities of America. All praise to that sanitary hero, Surgeon-General William Crawford Gorgas. Briefly stated, by

clearing the district of mosquitoes malaria has been eradicated.

In England the ordinary house-fly carries the germs of tuberculosis, ophthalmia, and many other diseases, including that of diarrhœa, which, in 1910, killed in London alone no less than 1,811 children under two years of age. It is well to kill flies, but the real remedy is to destroy their breeding places by the frequent removal of refuse, and by other simple means, which are already well known and only need to be carried into effect.

CHAPTER IV

CRUDE AND STANDARDISED DEATH RATES—THE PROGRESS OF SANITARY REFORMS

THERE are two forms in which death rates may be expressed, viz. :—

(*a*) Crude death rate.

(*b*) Standardised death rate.

If the total number of deaths occurring within a defined period of time in a certain community is taken and divided by the total number living at the central point of the period, the result will be the crude rate for that period. It is customary to express the death rates in reference to one year, and, therefore, if the period for which the deaths have been taken is any other period, the result must be adjusted accordingly. The rate thus obtained is the rate per unit, and, if multiplied by 100, 1,000, or 1,000,000 is known as the rate per cent., rate per thousand, or rate per million, as the case may be.

The crude rate of mortality was used when discussing the natural increase in populations.

If it is desired to institute a comparison of the death rates in each of several communities, we must take into account the factors of sex and age distribution of the population. In order to see the necessity for this, suppose one community to be formed from occupants of alms-houses aged 75 and upwards, while another community comprises men between the ages of 20 and 25. The crude

death rates, we will suppose, to be 120 and 10 per thousand respectively. It might be argued, if we were unacquainted with the age constitution of those communities, that the former must be most unhealthily situated to produce so high a death rate, and that the latter must be unusually healthy. The facts are exactly the reverse; the apparently low death rate of 10 per 1,000 is more than twice what it should be, and the apparently high rate of 120 per 1,000 is very low. A more exact measure for comparison must be found, therefore, than the crude death rate, and this is obtained by calculating what is known as the standardised death rate.

The connecting link between the crude death rate and the standardised death rate is known as the index death rate. The index death rate can only be obtained with exactitude at each census, when the numbers living in each age-group are known.

In order to obtain the index death rate for any district it is first necessary to ascertain the number of deaths that would occur in the district if it were experiencing the same rate of mortality at each age as the whole of the country. The rates of mortality for the whole country are known for the same groups of ages as those in which the population of the district is tabulated, and consequently it is merely a matter of multiplication to obtain the expected deaths of any district according to the standard rate. The number of deaths thus obtained is known as the "expected deaths."

By dividing the total expected deaths for any given district by the total population of that district we obtain the index death rate for that district.

The ratio between the index death rate of the whole country and the index death rate of a particular district is termed the "standardising factor," and, by multiplying

the standardising factor into the crude death rate, we obtain the standardised death rate. That is to say, by means of the standardising factor, we are able to weight the crude death rate for the district so as to allow for the incidence of the age and sex distribution of the population.

Thus, if the age and sex distribution of a particular district is exactly the same as that of the whole population, the standardising factor is unity. If there is a larger proportion of lives in the community which are normally subject to very heavy rates of mortality, *e.g.*, the old or very young lives, then the standardising factor will be less than unity, while, if the opposite conditions prevail, the factor will be greater than unity. The standardised death rates, therefore, do not represent any actual rates of mortality, but are hypothetical rates, which enable true comparisons to be instituted between the rates of various districts.

By way of illustration, it may be useful to show how to obtain the standardising factor for Liverpool. The index death rate for the whole country is 15·192 per 1,000. The index death rate for Liverpool is 14·715 per 1,000; therefore the standardising factor is $\frac{15{\cdot}192}{14{\cdot}715} = 1{\cdot}0324$.

The crude death rate of Liverpool is 20·2 per 1,000, therefore the standardised death rate for Liverpool is $20{\cdot}2 \times 1{\cdot}0324 = 20{\cdot}854$.

The following is an illustration of the use of standardised death rates :—

	Crude Death Rate.	Standardised Death Rate.
City of Liverpool . . .	20·2	20·9
Clitheroe Rural District .	19·8	14·3

By a consideration of the crude death rates alone it might be imagined that the rural district of Clitheroe is but little more healthy than the city of Liverpool, but the

standardised death rates show that, whereas the Liverpool death rate is high, Clitheroe, on the other hand, experiences a death rate practically equal to that of the whole of England and Wales. The standardised death rates show that Clitheroe must contain a large proportion of people who should normally be subject to higher death rates, that is, a large proportion of very old people, or very young people.

An excellent explanation of the methods of obtaining the standardising factors and the standardised death rates is given in the seventy-fourth annual report of the Registrar-General.

Dealing now with the causes of death amongst the general adult population, the Registrar-General gives, for the whole of the country, the number of deaths tabulated under no less than 189 different headings. For separate districts it is quite impossible to analyse the results so minutely, and therefore the list of 189 is condensed into a shorter list of only twenty-nine, that is to say, a number of similar causes of death are included under a general heading.

Formerly, the grouping of causes of death for separate districts consisted of only sixteen headings. The list now used is known as the International List, and is employed by many other countries, as well as by our own Local Government Board, and this is, of course, a very great advantage for purposes of comparison. There is, however, necessarily some disadvantage in the breaking of continuity with previous records. For instance, in the case of phthisis, which at the present time is a matter of such great importance, the change in the method of grouping makes it impossible to effect certain desirable comparisons with previous years unless troublesome adjustments are made.

Owing to the improved methods of classification employed since the advent of the present Registrar-General, a complete record of the deaths is now available in each of the more important administrative areas, classified according to :—

(*a*) Cause of death.

(*b*) Age groups.

(*c*) Sex.

It will readily be seen that this great improvement places a new and powerful instrument in the hands of all those interested in the public health, and one which they should certainly not neglect.

The diagram on p. 58 shows the mortality from certain epidemic diseases.

Dealing first with enteric fever, which occupies the first place in the International List, we can trace the history of this disease since 1869, independently of typhus and pyrexia, with which it was included previous to that date. To quote from the 1910 report :—

"It will be seen that the statistical history of enteric fever mortality can be divided into three main periods, two of decline from 1869—1885 inclusive, and from 1900 to the present date, and one showing no decline from 1886—1899. The first period, however, may be sub-divided into two portions ; that prior to and including 1875, the date of the Public Health Act, which shows a very slight decline, and that from 1876—1885 which shows a sudden and relatively an enormous reduction in the mortality."

I am unable to give any definite opinion as to the causes of the cessation in the improvement from 1886—1899, but I may mention that during the same period the death rates from all causes exhibited a somewhat similar characteristic.

It is satisfactory to note that the period of suspended

improvement has been followed by an almost continuous fall, and the death rate from this disease is now only about fifty per million persons.

ENGLAND AND WALES.

ALL AGES.
MEAN ANNUAL DEATH RATES
PER MILLION LIVING.

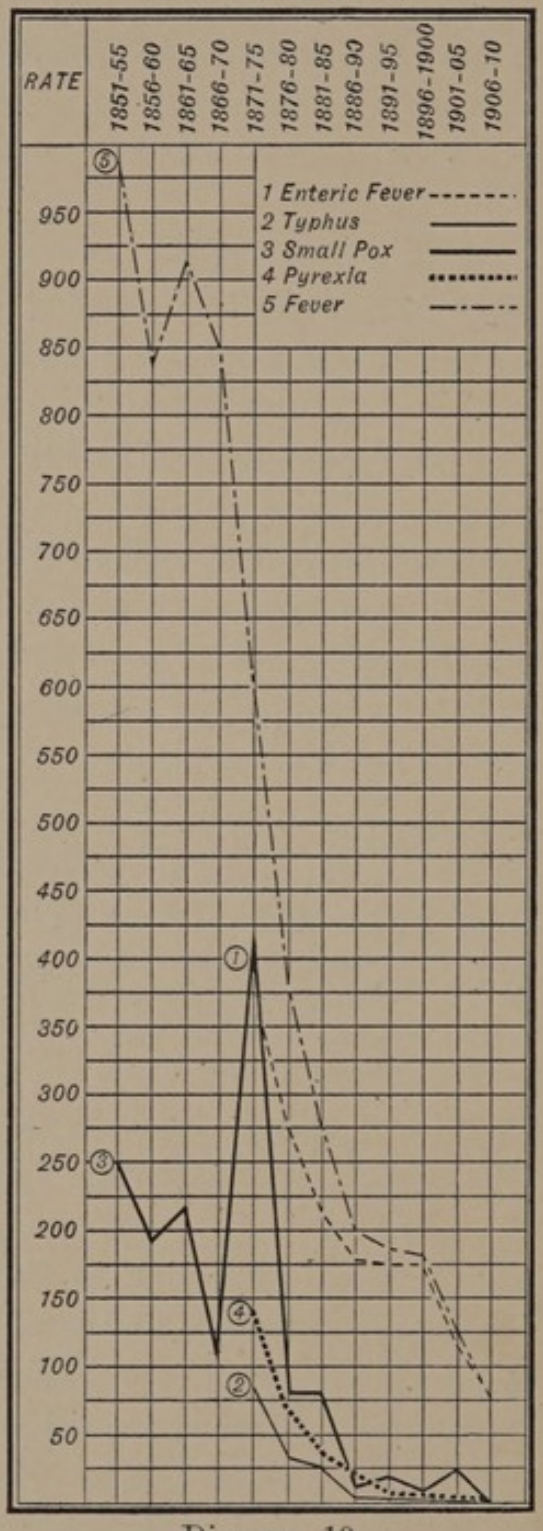


Diagram 10.

Following on a sudden increase in the death rate from small-pox from 1871—1875, there was an immediate and continuous fall until the year 1906, since which time it may be said to have been practically non-existent.

Turning next to a consideration of the national scourge of phthisis and tuberculosis generally, the diagram on p. 59 shows the rates from 1851—1910 in groups of five-yearly periods.

The first evident point to notice is that the rates of mortality are very much higher for males than females; the second point is that there has been an enormous decrease in the rates of mortality from this cause, which,

if the facts are truly represented by the statistics, has decreased by considerably more than 50 per cent. during the period of sixty years. I think, however, there is room for doubt as to whether the two sets of figures are really comparable. On the one hand, improved diagnosis

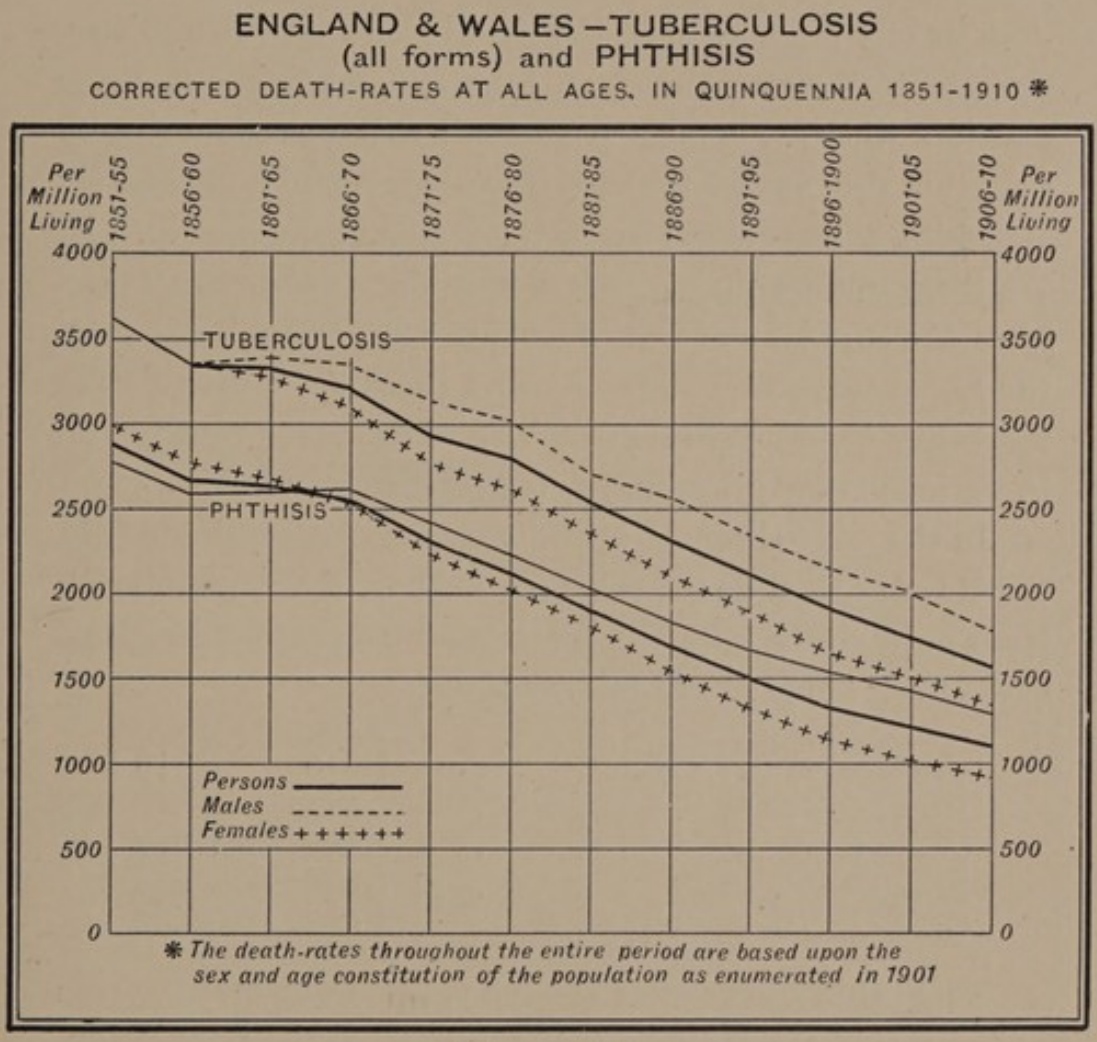


Diagram 11.

has resulted in the allocation of some deaths to this cause which, especially in the case of old persons, were previously returned under other headings, such as bronchitis. On the other hand, there is just a possibility that in the earlier years many fatal cases of lung affection associated with expectoration were certified as phthisical. However

this may be, if it is permissible to consider that the diagram correctly represents the course of the disease, is it possible for us to hope that the scourge may have practically disappeared by the middle of the present century ?

In warfare the first consideration is to recognise the strongholds of the enemy, and, in the same way, I think that in our fight against the deadly enemy, tuberculosis, the greatest care should be taken in tracing out those districts where it is most prevalent, then endeavouring to ascertain the reasons for such prevalency, and immediately attacking those causes by every means in our power. In the diagrams on pp. 61, 62, I reproduce two maps taken from the supplement to the forty-second annual report of the Local Government Board, and these show the relative mortality from phthisis in each administrative county and in various county boroughs, for males and females.

In the annual report of the Registrar-General for 1911 the standardised death rates per million of the population from pulmonary tuberculosis for various parts of England and Wales are given as follows :—

	Males.	Females.
England and Wales . .	1,210	910
Rural districts . . .	841	818
County boroughs . .	1,499	1,048
London	1,677	969
Other urban districts . .	1,042	826

This table shows very clearly that the mortality from consumption increases with the density of the population, and that the increase is much more marked with regard to males than to females.

In the report of the medical officer of the Local Government Board for 1912—1913, the death rate from phthisis in age groups for all the above, except England and Wales, are given, and these, in the main, confirm the standardised death rates given above. There are one or

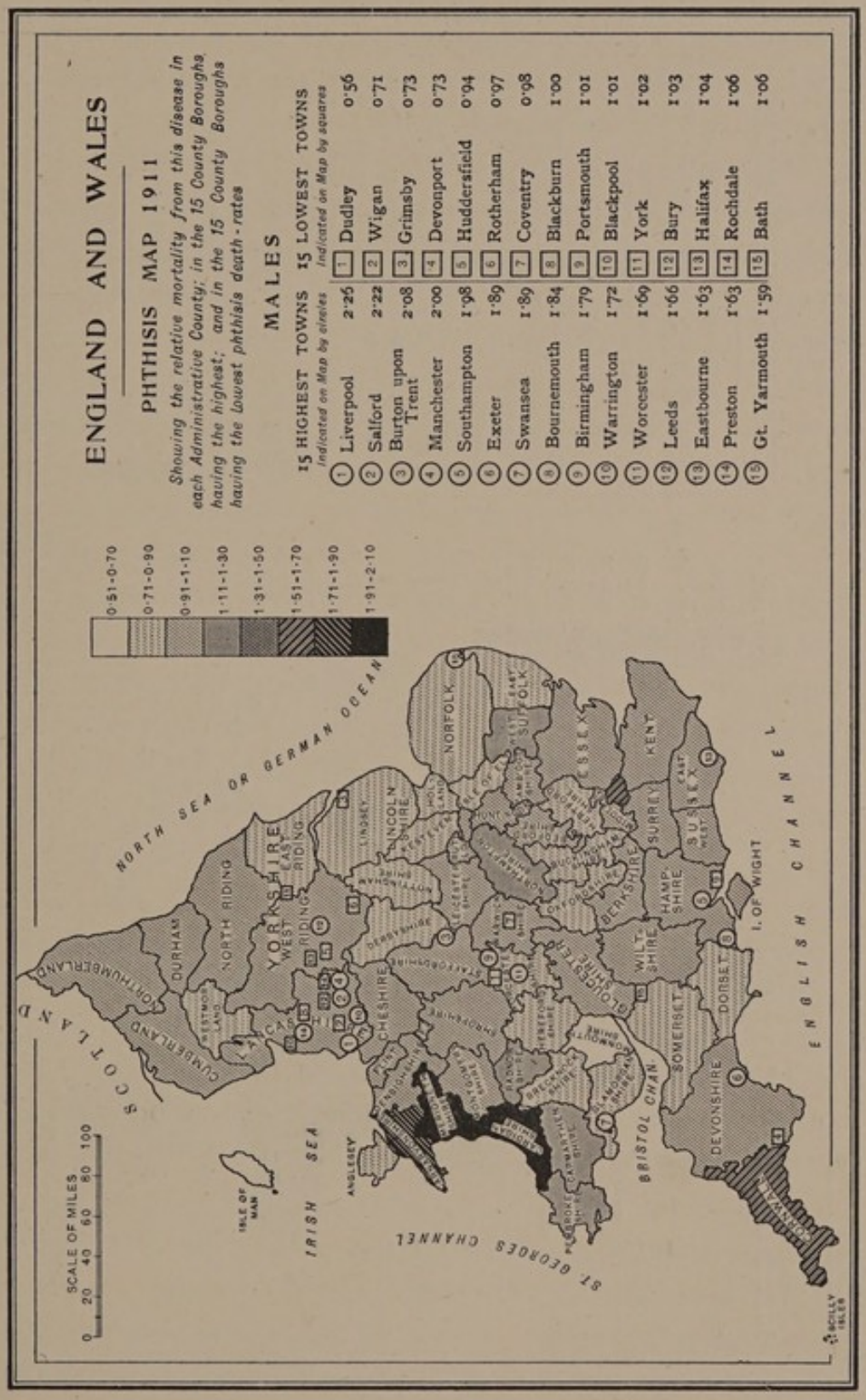
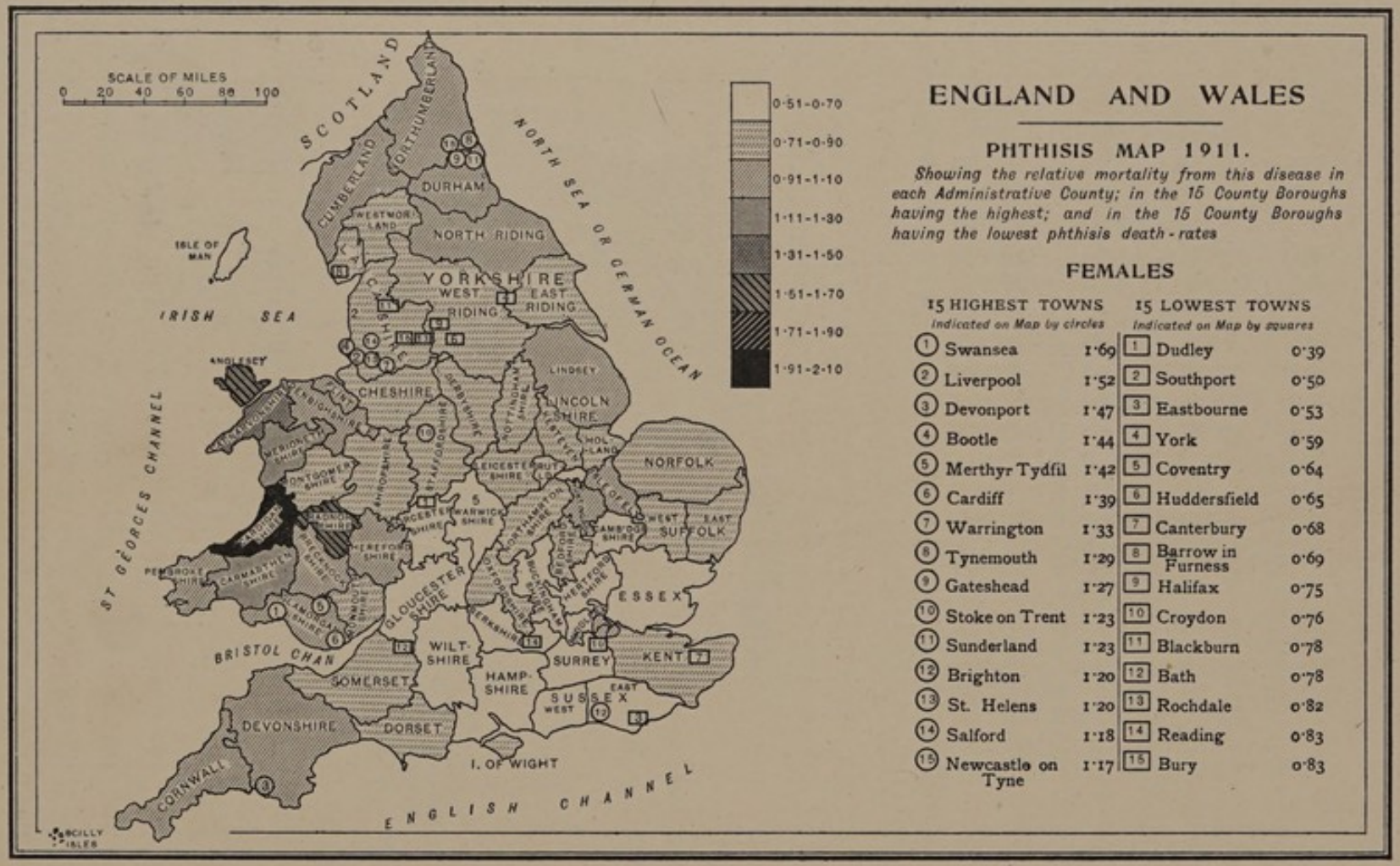

ENGLAND AND WALES
PHTHISIS MAP 1911
Showing the relative mortality from this disease in each Administrative County; in the 15 County Boroughs having the highest; and in the 15 County Boroughs having the lowest phthisis death-rates
MALES
15 HIGHEST TOWNS
Indicated on Map by circles
1 Liverpool 2·26
2 Salford 2·22
3 Burton upon Trent 2·08
4 Manchester 2·00
5 Southampton 1·98
6 Exeter 1·89
7 Swansea 1·89
8 Bournemouth 1·84
9 Birmingham 1·79
10 Warrington 1·72
11 Worcester 1·69
12 Leeds 1·66
13 Eastbourne 1·63
14 Preston 1·63
15 Gt. Yarmouth 1·59
15 LOWEST TOWNS
Indicated on Map by squares
1 Dudley 0·56
2 Wigan 0·71
3 Grimsby 0·73
4 Devonport 0·73
5 Huddersfield 0·94
6 Rotherham 0·97
7 Coventry 0·98
8 Blackburn 1·00
9 Portsmouth 1·01
10 Blackpool 1·01
11 York 1·02
12 Bury 1·03
13 Halifax 1·04
14 Rochdale 1·06
15 Bath 1·06
0·51-0·70
0·71-0·90
0·91-1·10
1·11-1·30
1·31-1·50
1·51-1·70
1·71-1·90
1·91-2·10
SCALE OF MILES
0 20 40 60 80 100
NORTH SEA OR GERMAN OCEAN
IRISH SEA
ST GEORGES CHANNEL
ENGLISH CHANNEL
BRISTOL CHAN
SCOTLAND
NORTHUMBERLAND
CUMBERLAND
DURHAM
NORTH RIDING
YORKSHIRE WEST RIDING
YORKSHIRE EAST RIDING
LINCOLNSHIRE
NORFOLK
SUFFOLK
ESSEX
KENT
SURREY
SUSSEX
HAMPSHIRE
I. OF WIGHT
BERKSHIRE
OXFORDSHIRE
BUCKINGHAMSHIRE
GLOUCESTERSHIRE
WILTSHIRE
SOMERSET
DORSET
DEVONSHIRE
CORNWALL
CHESHIRE
DERBYSHIRE
STAFFORDSHIRE
SHROPSHIRE
WORCESTERSHIRE
HEREFORDSHIRE
MONMOUTHSHIRE
GLAMORGANSHIRE
CARMARTHENSHIRE
PEMBROKESHIRE
CARDIGANSHIRE
MONTGOMERYSHIRE
MERIONETHSHIRE
CARNARVONSHIRE
ANGLESEY
ISLE OF MAN
SCILLY ISLES

Diagram 12.



ENGLAND AND WALES

PHTHISIS MAP 1911.

Showing the relative mortality from this disease in each Administrative County; in the 15 County Boroughs having the highest; and in the 15 County Boroughs having the lowest phthisis death-rates

FEMALES

15 HIGHEST TOWNS *indicated on Map by circles*		15 LOWEST TOWNS *indicated on Map by squares*	
(1) Swansea	1·69	[1] Dudley	0·39
(2) Liverpool	1·52	[2] Southport	0·50
(3) Devonport	1·47	[3] Eastbourne	0·53
(4) Bootle	1·44	[4] York	0·59
(5) Merthyr Tydfil	1·42	[5] Coventry	0·64
(6) Cardiff	1·39	[6] Huddersfield	0·65
(7) Warrington	1·33	[7] Canterbury	0·68
(8) Tynemouth	1·29	[8] Barrow in Furness	0·69
(9) Gateshead	1·27	[9] Halifax	0·75
(10) Stoke on Trent	1·23	[10] Croydon	0·76
(11) Sunderland	1·23	[11] Blackburn	0·78
(12) Brighton	1·20	[12] Bath	0·78
(13) St. Helens	1·20	[13] Rochdale	0·82
(14) Salford	1·18	[14] Reading	0·83
(15) Newcastle on Tyne	1·17	[15] Bury	0·83

Diagram 13.

two points worthy of notice, however. In the first place, the rates at the younger ages for males and females are practically equal, the excess mortality amongst the males occurring at the later ages. As regards the various districts, it is curious that although phthisis is considered more particularly a disease of the younger middle ages, the death rate amongst males in London reaches a secondary maximum at age 60 (about 3,700 per million), the rate at this age only being exceeded by that at age 40 (3,750 per million). With regard to the females for London, the rate reaches its maximum at age 40 (about 1,750 per million), and thereafter rapidly decreases. Dr. Stevenson attributes the excessive rates shown at the old ages in London to better diagnosis.

The rate for county boroughs exceeds that for London up to about age 27 for males and age 37 for females, thereafter being consistently below. In the Local Government Board report, also, the standardised death rates for 1911 are given for each county borough. From these tables it appears that, for 1911, Liverpool shows the highest rate amongst males (2,260 per million), and is closely followed by Salford (2,220 per million). Amongst females, Swansea shows the highest rate (1,690 per million), Liverpool being second with 1,520 per million.

A word of warning should be given, however, in dealing with local tuberculosis statistics. While inaccuracies with regard to age and sex distribution are eliminated by using standardised death rates, and corrections for deaths in institutions have been made, there still remains a certain proportion of the death rate which is due to persons who have contracted the disease in districts other than that in which the death occurs. Another reason for caution, and one that particularly affects large towns, is the migration into these towns of vagrants, casual

labourers, and other of this class amongst whom the death rate is excessive. This has a very considerable effect on the death rate from tuberculosis in such towns as London and Liverpool and Manchester. With regard to the two latter, the immigrants include the Irish casual labourers, amongst whom the death rate is high.

I am unable to trace any reliable statistics which would enable me to show the improvement which has taken place in Liverpool in the past, but it is pleasing to be able to record, on the authority of the medical officer of the Local Government Board, that the death rate from tuberculosis both in Liverpool and Manchester has shown great reduction, and that some of the best anti-tuberculosis work in the country is being done in these cities.

It was with the liveliest satisfaction that I recently read Dr. Hope's short paper which he contributed in 1912 to the National Conference on the Prevention of Destitution. In this admirable little *résumé* Dr. Hope mentions that, in 1854, owing to the Irish famine, there was a great influx of the poorer class Irish into Liverpool. In order to meet the demand for cheap dwellings, a number of back to back tenements were erected, which were undoubtedly hot-beds of disease. These have now been absolutely replaced, and, with the many other sanitary improvements that have been effected, I have little doubt that still greater reductions in the death rates from phthisis, as well as other causes, will very shortly become apparent.

I must warn anyone interested in mortality rates from phthisis or tuberculosis that, in standardising the crude rates of mortality for any particular district, the standardising factors are not those to which I have previously referred as published in the Registrar-General's report, but are those published in the supplement to the forty-

second annual report of the Local Government Board. They are available for the more important areas for (*a*) phthisis, (*b*) tuberculosis other than phthisis, and (*c*) for all forms of tuberculosis.

The subject of phthisis cannot be dismissed without some reference to the question of over-crowding. It is not possible to deal with this point in any very satisfactory manner, as the necessary information has only been collected in the three last censuses, viz., those of 1891, 1901 and 1911, and, as I have already stated, the initial returns collected on any subject are always more or less unreliable. In the case in point only those householders who occupied less than five rooms were required to answer the question in 1891 and 1901, and it was therefore necessary to assume that the house contained more than four rooms in every case where the question was unanswered. This must have led to a certain amount of under-statement. Again, the term "room" was not defined until 1911, and it is quite possible that many a humble dwelling became possessed of more than four rooms owing to a too generous interpretation of the term. I therefore give the following diagram (see p. 66) with a distinct warning that too much importance must not be attached to it, and that it is chiefly interesting as showing a most welcome reduction in over-crowding, a reduction which may be confidently expected to yield the most beneficent results. The horizontal divisions in each pillar represent the percentage of the population living in tenements, with one, two, three, four, or more than four rooms respectively; the shaded portion of each section denotes the percentage of the occupants living in over-crowded conditions, *i.e.*, with more than two persons in a room. That is to say, that in a four-roomed house there must have been at least nine persons.

So far I have dealt with those diseases which appear to be amenable to medical treatment, or are rendered less virulent by better sanitation. The remainder of the

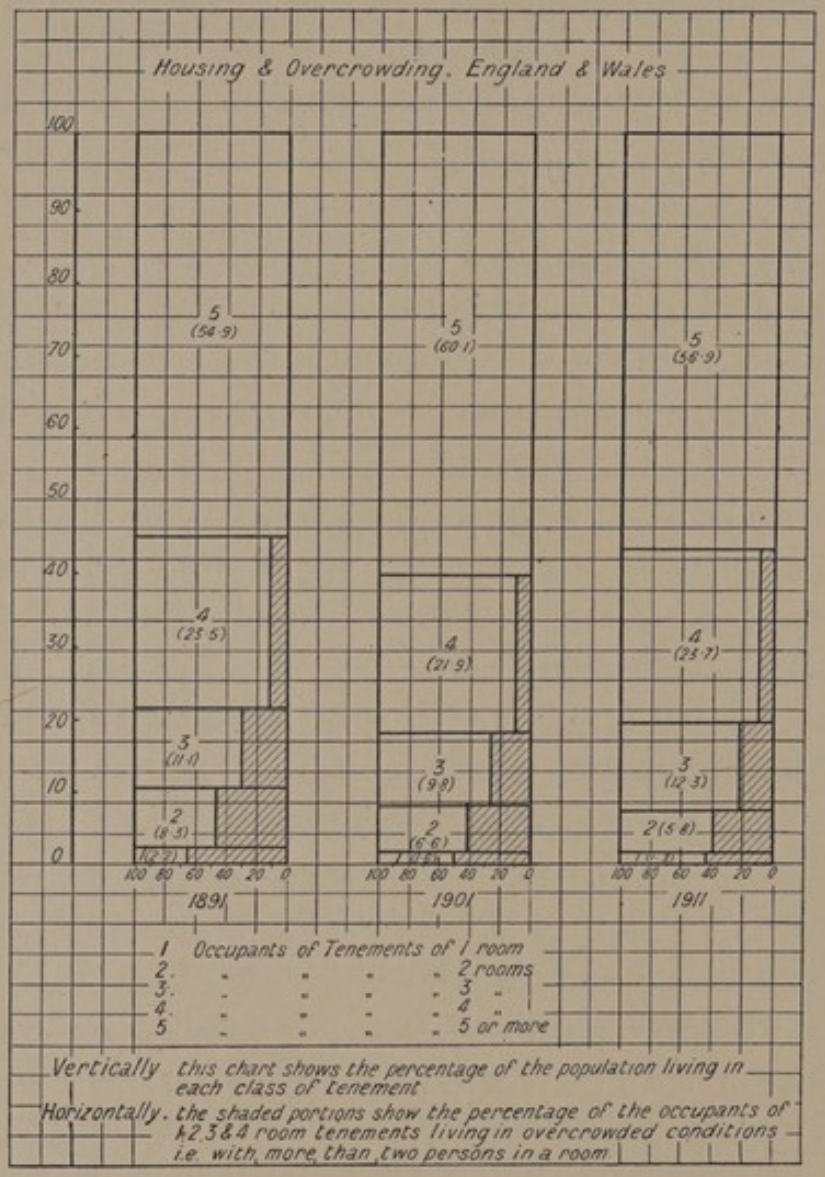
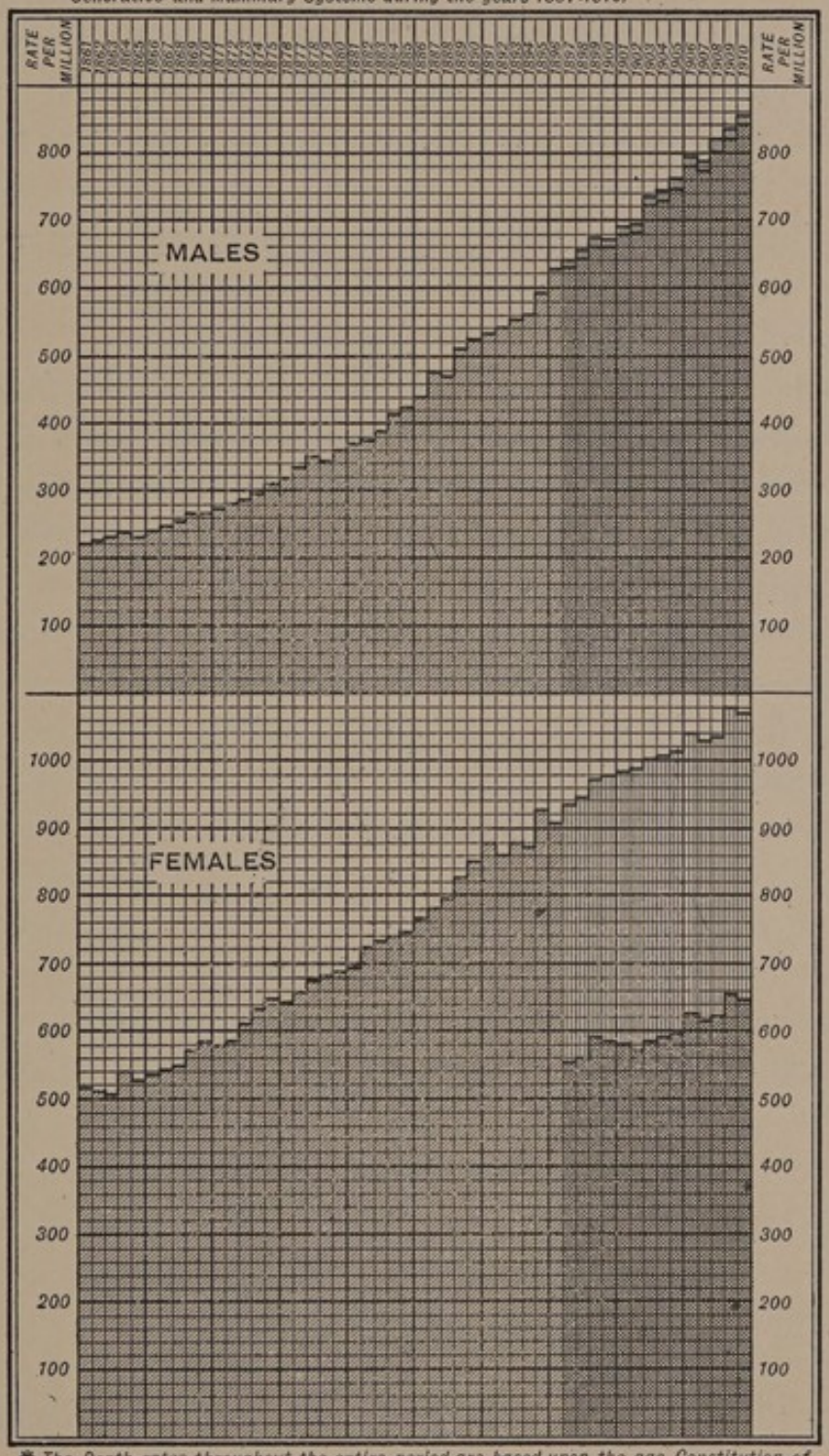


Diagram 14.

twenty-nine causes mentioned in the Registrar-General's list do not call for special reference, with the notable exception of cancer. In the diagram on p. 67, I give the corrected death rates from cancer during the years 1861—1910 for males and females respectively, which

ENGLAND & WALES – CANCER
CORRECTED DEATH-RATES AT ALL AGES 1861-1910 *

Note:- The portion shaded vertically represents the mortality ascribed to cancer of the Generative and Mammary Systems during the years 1897-1910.



* *The Death-rates throughout the entire period are based upon the age Constitution of the population as enumerated in 1901.*

Diagram 15.

apparently show an alarming increase. I remarked, when discussing phthisis, as to the effect of better diagnosis, and the same applies with added force in the case of cancer, for there is no doubt that this disease has not always been duly noted in the certificate of death.

It is stated in the supplement to the sixty-fifth annual report that " the practice of writing to medical attendants for further information concerning indefinitely stated causes of death, has resulted in the addition of a large number of deaths under the heading of cancer."

One satisfactory feature is evident—the less rapid rate of increase of the disease during recent years among females. This, I think, is probably due to better diagnosis in the earlier stages of the disease, when it is more susceptible to treatment.

The records of recent years indicate the wonderful progress which the army of workers for the improvement in sanitation and the general health of the population has accomplished, and cannot but act as an incentive to all to press forward with unabated vigour.

CHAPTER V

THE PREPARATION OF MORTALITY TABLES: (*a*) NATIONAL, (*b*) MUNICIPAL, (*c*) OCCUPATIONAL

THE subject of life tables, or mortality tables, as they are usually termed, is of enormous importance, for it is by the aid of such tables alone that improvements in the death rates can be accurately measured. This is true whether the comparison relates to the death rates of the whole population or to particular sections of the population. It is also equally true of the death rates of particular diseases or occupations.

It is well known that the mortality rates prevailing amongst persons engaged in different occupations vary very considerably, and it would be of great value if tables representing the general mortality rates relating to the more usual occupations in various districts could be readily obtained. Speaking from my own personal experience, I am bound to confess that such tables are almost impossible to calculate. The difficulty is that persons engaged in any given occupations subject to rates of mortality differing from those of the general population, remain in such occupations whilst well, but on becoming in any way impaired take up some other occupation, either from choice or necessity, and when death occurs are classified in accordance with their more recent occupation. Generally, it is found that men actually engaged in any specialised occupation are subject to abnormally

low rates of mortality, whilst amongst those who retire, especially at the middle ages, the rates of mortality are considerably above the average.

Voluminous statistics are given in Part II. of the supplement to the sixty-fifth annual report of the Registrar-General as to occupational mortality. Particulars are given of the deaths in 105 occupational groups, both while actually employed and after retirement. These figures in some measure meet the difficulty mentioned above, but the deaths are necessarily classified according to the occupation given on the certificate, and, as already pointed out, this may or may not be the occupation in which the disease was contracted. Such statistics, therefore, have only a limited value. I would refer students of this most interesting branch of my subject to a paper by Dr. James Crawford Dunlop, published in the *Transactions of the Faculty of Actuaries*, in Vol. 5, p. 1, in which the Registrar-General's figures are exhaustively dealt with.

Before discussing national and municipal tables, it will be desirable to state clearly the meaning of the term "mortality table." The best definition I can find is that given in the Institute of Actuaries Text-Book, viz., "A mortality table is the instrument by means of which are measured the probabilities of life and the probabilities of death." That is to say, a mortality table is a mathematical instrument by means of which we are able to extract the true facts that are buried in the rough material or crude data.

The mortality table has been described by Dr. Farr, to whose genius the first population mortality tables for England and Wales are due, as representing a generation passing through time. It records the births of a certain number of children, say 100,000, and tabulates the

number surviving on each successive birthday, until in extreme old age there are no survivors remaining.

By taking the difference between the numbers tabulated as surviving at successive ages, the numbers dying between those ages are obtained. The probability of dying within a year at a particular age is the ratio between the number living at that age, and the number dying before the next birthday. Similarly, the probability of living for a year at a particular age is the ratio of the number surviving to a given age $(x + 1)$, compared with the number living at the previous age x. Thus, the probability of dying in a year at age 20 is found by dividing the number of deaths between 20 and 21, by the number living at age 20 ; and the probability of living a year at age 20 is found by dividing the number surviving to the exact age 21 by the number living at the exact age 20.

In constructing a mortality table, it is not possible to trace a particular body of persons from birth to extreme old age. In the first place the observations would embrace a period of about 100 years, and this alone would vitiate the results brought out by the table, quite apart from the impossibility of tracing the lives through so long a period. As we know that the rates of mortality vary from time to time, it is advisable that the period over which the observations extend should be limited.

If a body of lives is traced in the manner suggested above, the rate of mortality shown by such a table at age 0 would be the rate that was experienced 100 years ago, whilst the rate of mortality at age 50 would be the rate experienced 50 years ago, and it would only be at the extreme old ages that the rates could be said to represent present-day mortality. What is required is a table which will give for each age the rates of mortality which are being experienced at the *present time*. In constructing this we

tacitly assume that the survivors of those just born will be experiencing the same rates of mortality 50 years hence as those persons who are now aged 50. What the rate of mortality will be 50 years hence it is impossible to forecast, nor for the purposes of the present inquiry is it necessary that we should attempt to do so.

There are many ways of constructing mortality tables, all of which will more or less accurately fulfil the required conditions, and it would be a simple matter to give examples of the methods which have been adopted in the construction of many well-known tables. I think, however, that it will be of greater practical value if I confine myself to a description of a method which can be readily and easily applied by those who do not profess to be expert mathematicians. I do this with great confidence in view of the fact that it will enable those interested to obtain, with the expenditure of comparatively little labour, a series of tables which will exhibit the rates of mortality experienced in successive years, and from which the progress that is being made may be accurately measured. I shall, however, content myself with a brief outline of the method here, leaving the details which are necessary for its application to the appendix.

As explained above, in order to ascertain the rates of mortality, we require to know the numbers living and the numbers dying at each age, and if we are in possession of these facts, we can obtain rates of mortality. So long as both the numerator and the denominator of each fraction refer to the same persons, it is not necessary that all the numerators and denominators should refer to the same body of persons, and, indeed, if we are to obtain for each age the rates of mortality which are being experienced during the same period, it is essential that they should not refer to the same body of persons. The numbers living at each

age can be obtained from the census returns, and the numbers dying from the Registrar-General's annual returns. We are, therefore, in possession of the data which enables us to obtain the rates of mortality experienced in this country to within a few months of the present time.

I have already pointed out that the mortality table represents the life history of a large population all of whom are assumed to have been born at the same moment. If we endeavour to form a mortality table by means of the census returns and the register of deaths, we are at once met with the evident difficulty of the varying population. If we took the population according to a given census and compared it with the deaths which occurred in several succeeding years, the results would be incorrect for several reasons, one of which is that the population will probably have increased during the period for which the deaths were recorded.

In order to involve the least possible error, the census figures are compared with the deaths recorded during a period for which the census figures used are the central point. As the census is taken on April 3rd, and the deaths are recorded in calendar years, the census figures are adjusted so as to bring them up to the centre of the year, viz., June 30th. The result of taking the deaths for a period before and after the census date is that we do not obtain the rates of mortality and survival which I have above described, but what are known as "central rates of mortality," and further adjustments are necessary in order to obtain the rates in the form most suitable for practical use.

Another difficulty to which I must refer is the impossibility of getting correct ages recorded. For instance, if a man dies at any age approximating to 50, it is quite usual

for that round figure to be stated. To overcome this serious difficulty, we are obliged to deal only with groups of ages, obtaining the records for intermediate ages by means of graduation. I have thought it advisable to mention these few points in order to prevent anyone coming to the conclusion that the methods I have used are unduly complicated. Far from this being the case, I have purposely discarded every refinement and have, as I have already explained, set out a method which, whilst giving sufficiently correct results, has been made as simple as possible, so that it may be readily used by anybody of average knowledge and ability.

My object in delivering the Chadwick lectures was to assist all those who are striving for sanitary reform and the improvement of the public health. I believe that the Registrar-General, by means of his greatly improved form of statistical returns, has placed in our hands a very powerful instrument which we cannot afford to neglect. I have endeavoured to show how this instrument can be most readily used.

I hope and believe that in the future mortality tables will be formed at comparatively short intervals, both for the whole of the country and for many separate districts, so that the rates may be compared and the progress towards improved mortality rates indicated clearly and indisputably. I think that, to make such tables as useful as possible, they should show, not only the mortality rates for each year of age, but also for each age the rates of mortality due to various diseases. I have taken particular care with regard to infantile ages, because, as I have previously said, it is by saving our infantile population that we can best safeguard the future of our nation.

I call for volunteers to help in what I verily believe to

be a work of paramount importance. I am trying to break down the old superstition that statistics in general and census returns in particular are of no practical value, if not worse than useless. I hope that I may succeed, and I believe that I shall.

I shall give some examples of mortality tables such as I hope will in future become general, and it will be seen from these that in many cases excessive rates of mortality are still prevalent from certain diseases. Whilst thankfully acknowledging the great progress which has already been achieved, I am asking that in each district an up-to-date analysis of mortality may be made, and instant steps taken to remedy any preventable excess.

The Registrar-General in his annual reports will, in the future, publish the estimated population as at June 30th in each year, and, although the figures will necessarily be approximate, the methods of adjustment will be such that they can be used without hesitation. The data used in the illustrative tables which I have constructed, have been taken from the seventy-fourth annual report of the Registrar-General, and refer to the year 1911. From these I have constructed rates of mortality for England and Wales and for Liverpool, and thence I have passed back to the mortality tables, which have thus been constructed by an inverse process. It will be seen that by this method the mortality table represents the future progression of the present generation, if the existing rates of mortality continue to be experienced.

The figures given by the Registrar-General are tabulated in five-yearly age-groups up to age 25, in ten-yearly groups from 25 to 85, with a final group for ages 85 and upwards. We require to know the number at each individual age, and in the detailed account I have shown

how a very close approximation to these numbers may be obtained.

Briefly, the method employed is that known as osculatory interpolation, the terms on each side of the interpolated value being involved in proportions varying with their proximity to such value. The interpolation could have been effected by means of a freehand curve, but this would have been open to the objection that no two operators would have arrived at identical results. Where the table is constructed by a mathematical formula, a definite rule can be adopted, and every operator, whatever his degree of skill, must, if he follows the rules set out, derive the same results. Where the tables are required for comparison, this is an essential condition. The method is not applicable to infantile ages, and for these the system adopted has been based on the births and deaths of recent years.

CHAPTER VI

PRACTICAL USES OF MORTALITY TABLES BY MEDICAL OFFICERS AND OTHERS—CAUSES OF DEATH AND THEIR PREVENTION

I NOW want to illustrate by means of the mortality tables for England and Wales, London and Liverpool, the lesson which may be learnt from this branch of Vital Statistics.

In Diagrams 16 and 17 on pp. 78 and 82, are shown the rates of mortality according to :—

(1) The sixth English life table based on the two censuses 1891 and 1901, and the deaths for the intervening ten years.

(2) The table constructed for the purpose of the National Insurance Act based on the estimated population at June 30th, 1909, and the deaths for the years 1908–9–10.

(3) The life table for London based on the two censuses 1901 and 1911, and the deaths for the intervening period.

(4) A Liverpool life table based on the population and deaths in Liverpool for the year 1911. (See Appendix, Schedules G and H.)

(5) A life table on the basis of the population and deaths in 1911 in England and Wales. (See Appendix, Schedules E and F.)

The last-mentioned table and the Liverpool table I constructed for the purposes of the Chadwick lectures by the method to which I have already referred.

Considering first those tables based on the population of England and Wales, the point which must at once

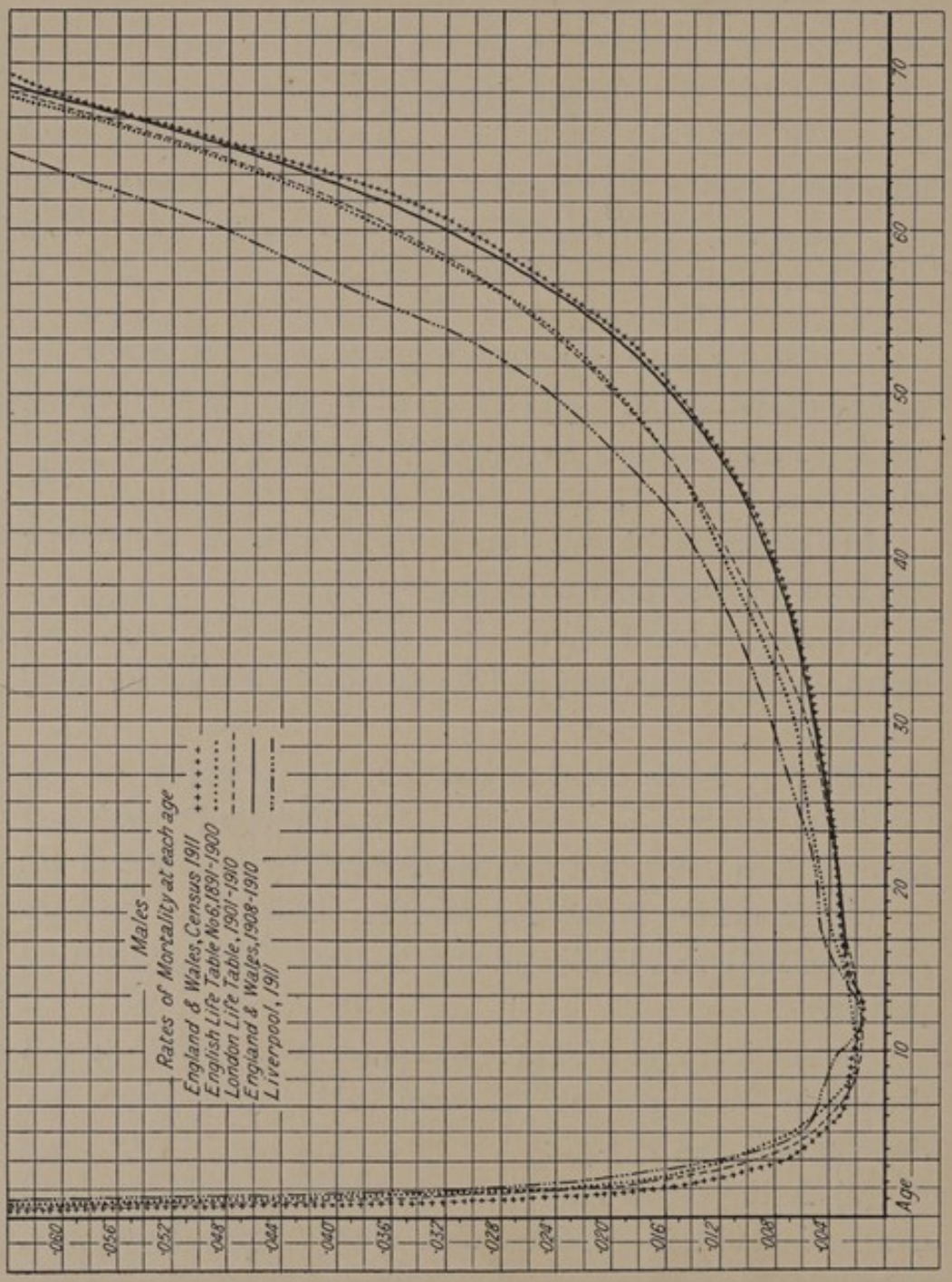


Diagram 16.

strike observers is the marked improvement in the rate of mortality experienced during the past ten or fifteen years. The National Health Insurance table, which commences

at age 15, is consistently below the sixth English life table, and it will be noticed that the lower mortality rates are most marked at the effective working ages, viz., from 30 to 50. These tables show the improvement that has taken place over an average period of thirteen years. The table for 1911 confirms the National Health Insurance table, and shows even lower mortality rates.

The Registrar-General's reports are not published until two years after the period to which the figures refer. The year 1911 is, therefore, the latest to which reference can be made. The steady improvement in the vitality of the country is so important that I thought it would be interesting to endeavour to discover if it was continued up to 1913. I have, therefore, examined most carefully the rates of mortality in the industrial branch of my own office over the range of ages shown in the diagram. The rates are based upon 20,000,000 policies, the holders of which are living in every part of the United Kingdom, so that they fairly represent the population. In fact, so representative is our business, that we can say that we have our finger on the pulse of the nation, and we always find that a change in our experience is confirmed by the Registrar-General's figures when they are published subsequently.

My examination of the Prudential rates of mortality for 1913 shows that the improvement is maintained, the death rates being consistently less at every age. This means an enormous increase in the numbers of working years of life saved to the nation. A more eloquent tribute to the labours of those concerned in public health can hardly be found.

The fact that all four experiences show a continuous reduction in mortality rates indicates that the improvement is not due to exceptional causes, and is striking evidence

that the efforts of sanitary reformers generally are producing a rich harvest in the improved health, and, I think I may add, the happiness, of the people of these islands.

Dealing now with the two local tables, viz., London and Liverpool, it will be seen that the rates for both districts exceed those of the general population, the London rates, however, being the lower of the two.

I think that it should be the ideal of each district to reduce its mortality rates, so that they will compare favourably with the rest of the country. It is unfortunately the fact that the wastage of life in urban districts is greater than in rural districts, and the reason given is that in the latter the conditions of life are so much better. Pure air, the freedom from dust and dirt, and all that this implies, give the rural dweller a better chance of life than the townsman. While agreeing that the rural dweller has these advantages, I am convinced that many of the disadvantages from which the townsman now suffers are preventable and will be prevented in the future to such an extent that the rates of mortality for urban districts will be equally as favourable as those of rural districts.

The life of the citizen is as valuable to the community as that of the rural worker, and he has the right to demand that, as his property is protected from the crimes of evil doers, so his health and the health of his family shall be protected from the curse of preventable diseases, caused in too many cases by persons whose thoughtlessness amounts to criminality.

The standardised death rate shows that Liverpool's mortality is higher than the average for England and Wales. The diagram enables us to see where the excess occurs. Dealing first with the males, the deaths amongst infants under 1 year of age were not very dissimilar, being 141 per 1,000 for England and Wales, and 163 per 1,000

for Liverpool. Between ages 1 and 2 the death rates were 40 per 1,000 and 73 per 1,000 for England and Wales and Liverpool respectively, and from 2—5 they were 9 per 1,000 and 15 per 1,000. That is to say, whereas for the first year of age, the excess was only 16 per cent., from age 1 to age 5, the excess was over 70 per cent. From age 5 to age 25 the excess was approximately 42 per cent. From 25—45, the principal working years, it was 64 per cent., and from 45—65 the rates were 21 per 1,000 for England and Wales, and 34 per 1,000 for Liverpool, an excess of 61 per cent.

With regard to the females the diagram on p. 82 shows that the rates were lower throughout life than those for the males with the exception of the age-group 5—15, where the rates are practically the same for both males and females. The female rates, although higher than those of the general female population, compare more favourably than is the case with the males ; the incidence of the excess is, on the whole, distributed over the various age-groups in much the same proportion as in the case of males.

I now come to the analysis of the causes of death, and it is to this analysis that I attach the utmost importance. The standardised death rate showed the excess. The mortality tables to which I have just referred showed what proportion of this excess was attributable to each age. It is the function of the analysed tables to show to what causes the excess at each age is due. The publication of the data in the Registrar-General's 1911 report enables this to be ascertained for the first time. The deaths from various causes are given in this report for the age-groups 0—1, 1—2, 2—5, 5—15, 15—25, 25—45, 45—65, and 65 and over. In future reports they will, I hope, be given for smaller age-groups, because this will permit of a closer

analysis being made than is possible at the present time, For the purpose of my analysed tables I have grouped

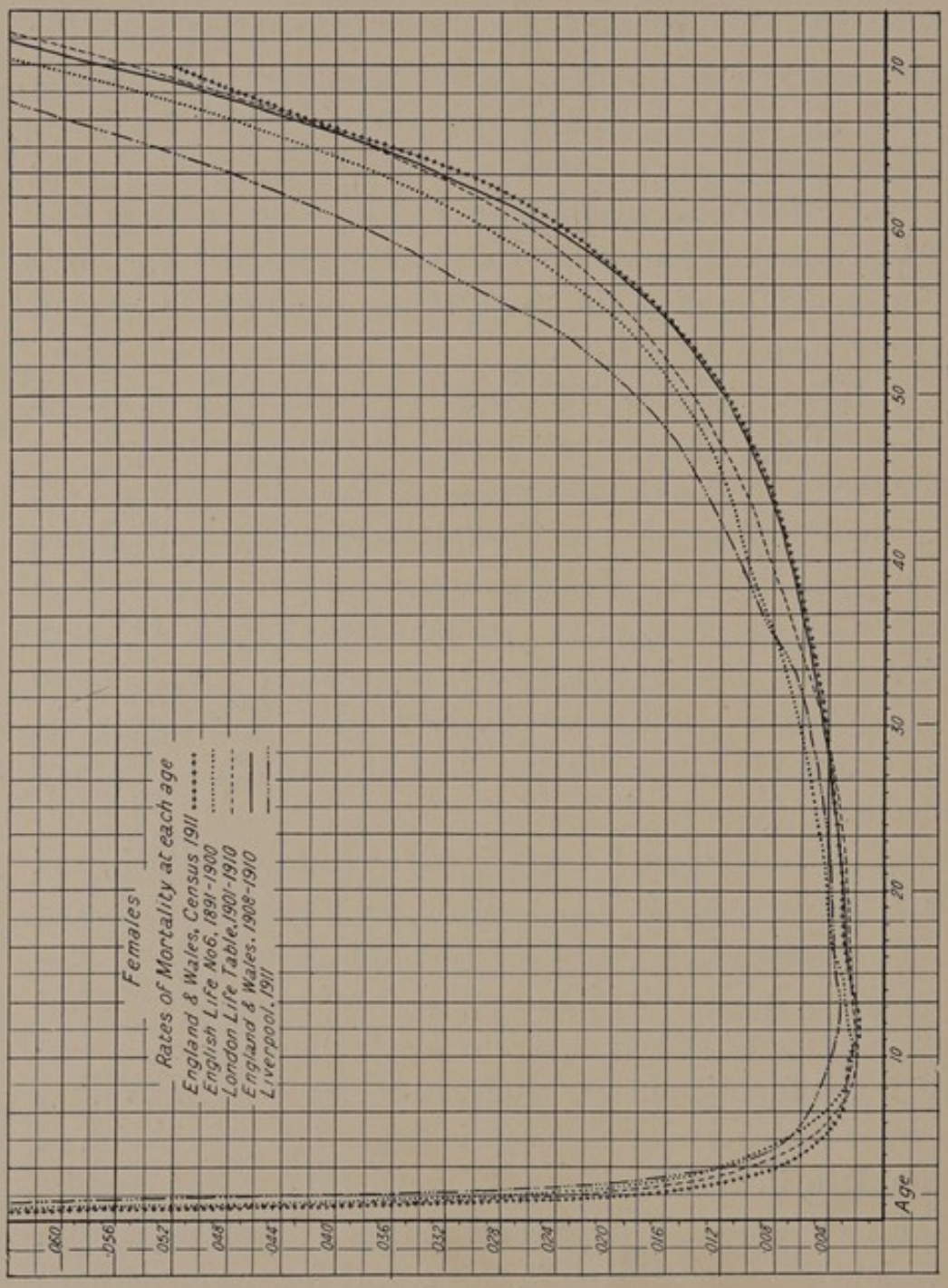


Diagram 17.

the various diseases into five classes, and for each age-group I have split up the death rate into its component parts. I am thus able to show for each age-group the

proportion of the rate that is attributable to each of these five causes. The grouping I have adopted is as follows :—

A. Tuberculosis, including pulmonary tuberculosis, tuberculous meningitis, and other tuberculous diseases.

B. Cancer.

C. Other diseases of known microbic origin. These include enteric, small-pox, influenza, rheumatic fever, puerperal fever, erysipelas, bronchitis, pneumonia, and other respiratory diseases.

D. Infantile complaints, including measles, scarlet fever, whooping cough, diphtheria, diarrhœa, congenital debility. This group has been confined to ages under 15.

E. All other causes of death.

In the diagram on p. 84 is shown the mortality rates for England and Wales for males in 1911, sub-divided according to these five causes. The area between the base line and the first line shows the proportion due to tuberculosis ; the area between the first line and the second line, the proportion due to cancer ; and so on, as indicated in the diagram. The fifth or top line, which encompasses the whole area, represents the total death rate. It is instructive to notice that if we exclude the deaths from infantile complaints included in group D, the curve is very much reduced. For instance, at age 2 it is about halved, whilst at age 1 it is reduced to about one-third. I would particularly call your attention to the high rates of mortality due to tuberculosis at the early ages ; the rate steadily decreases until age 7, thereafter it steadily increases until about age 50, and then decreases for the remainder of life.

In the diagram on p. 85 are shown the analysed rates of mortality for Liverpool males in 1911.

There are several features in this diagram to which I would direct attention. With regard to tuberculosis, it

will be seen that it presents the same characteristics as that for England and Wales, but in an exaggerated form.

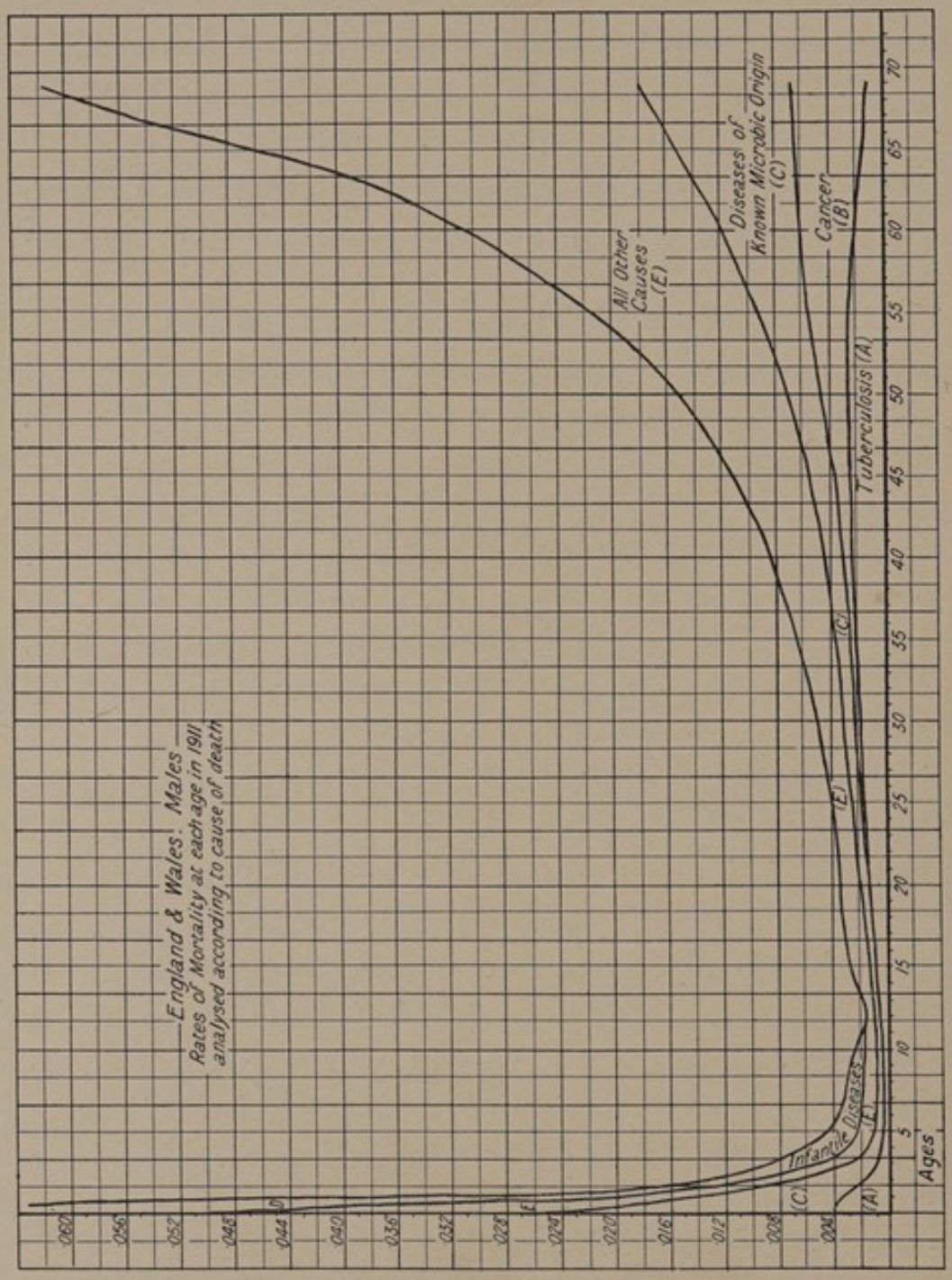


Diagram 18.

A large proportion of the total death rate is due to the diseases of known microbic origin, which include bronchitis and pneumonia and other respiratory diseases, and

the point I wish to emphasise is that they are, at least to a very great extent, preventable. In fact, all the causes

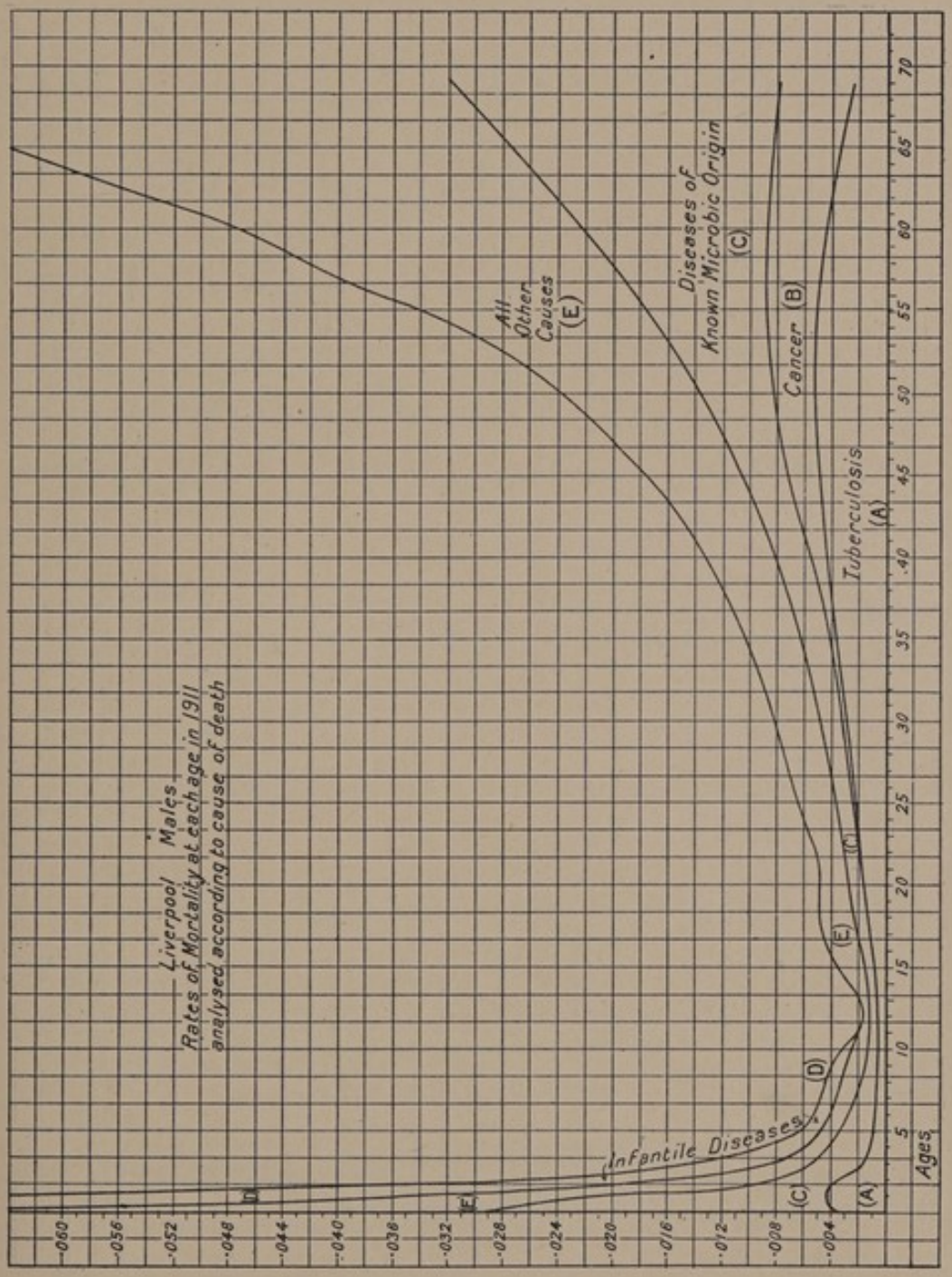


Diagram 19.

A, B, C, and D, are in the nature of preventable diseases. If we ever succeed, and I trust we may, in entirely eradicating the diseases included in groups A, B, C, and D,

there can be no doubt that we shall have added many years to the working life of the community, but it is, of course,

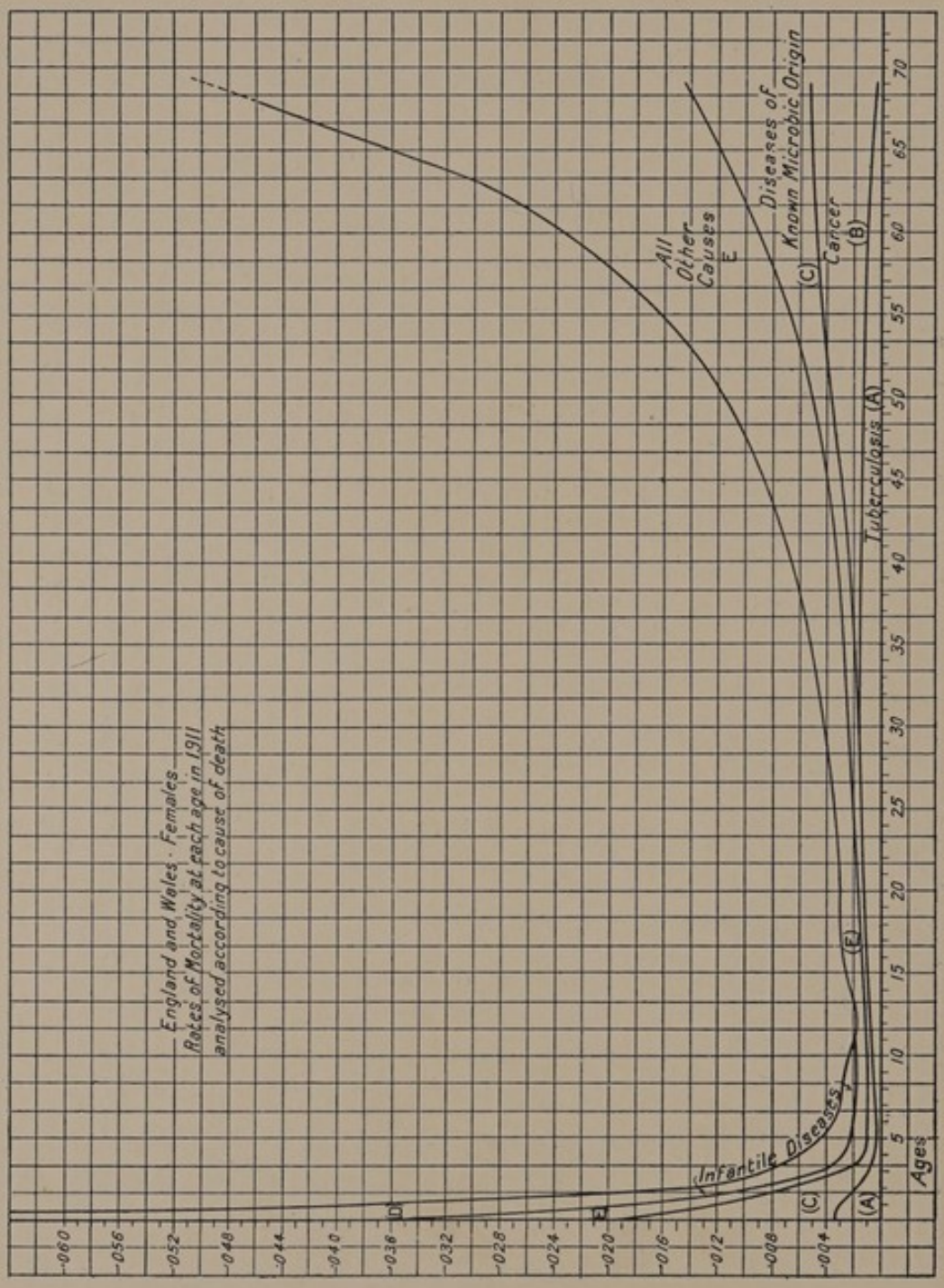


Diagram 20.

impossible to predict what the rate of mortality would then be. We may reasonably suppose that a healthier nation would be capable of greater resistance to other

diseases, but on the other hand new diseases may be developed.

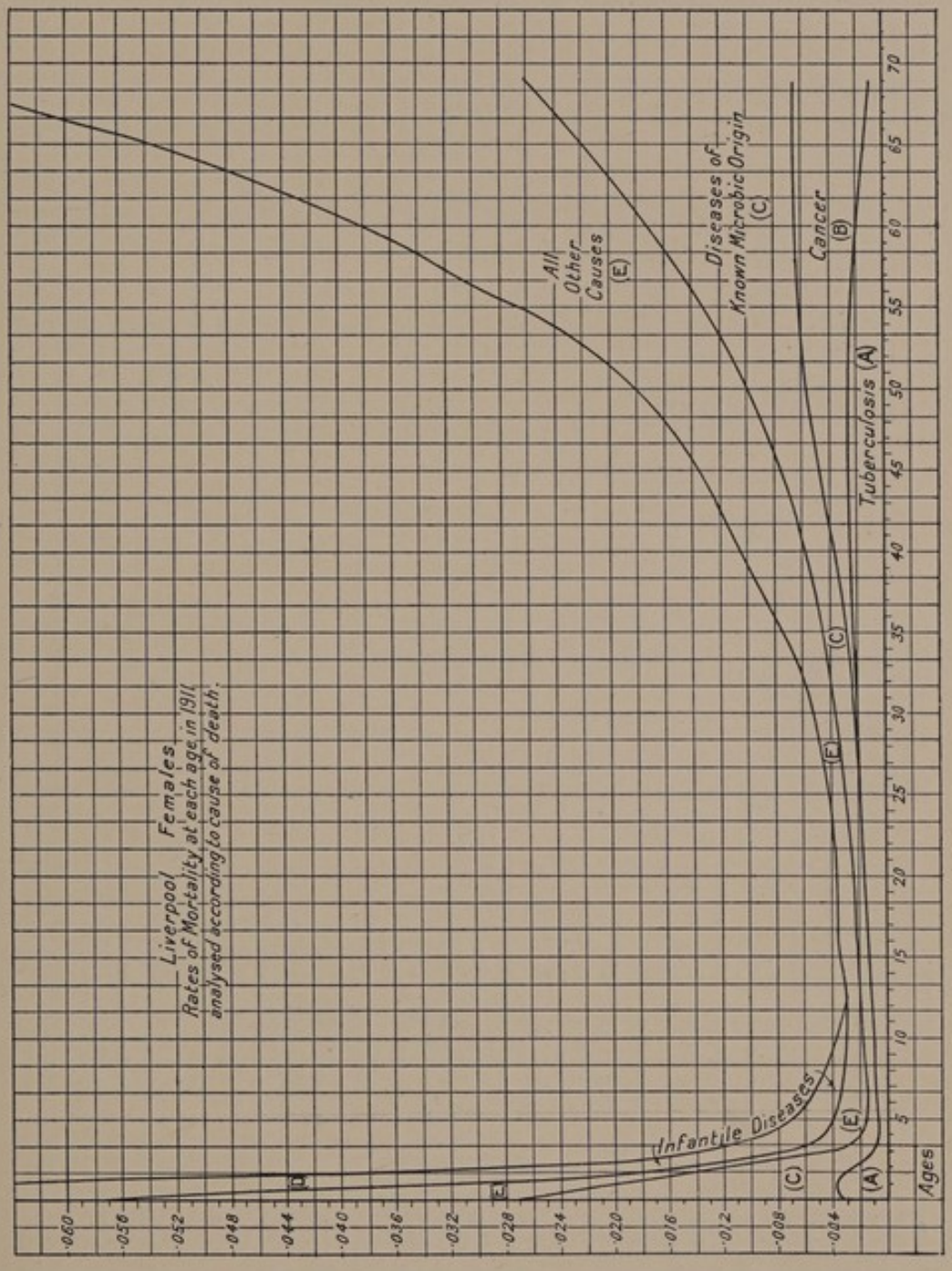


Diagram 21.

Quite apart, however, from any uncertainty as to the eventual future rates of mortality, the great fact presented is that hundreds of thousands of deaths occur yearly in

this country which could be prevented. If I could but succeed in impressing this great fact upon the nation at large, I believe that sanitary reform and the improvement

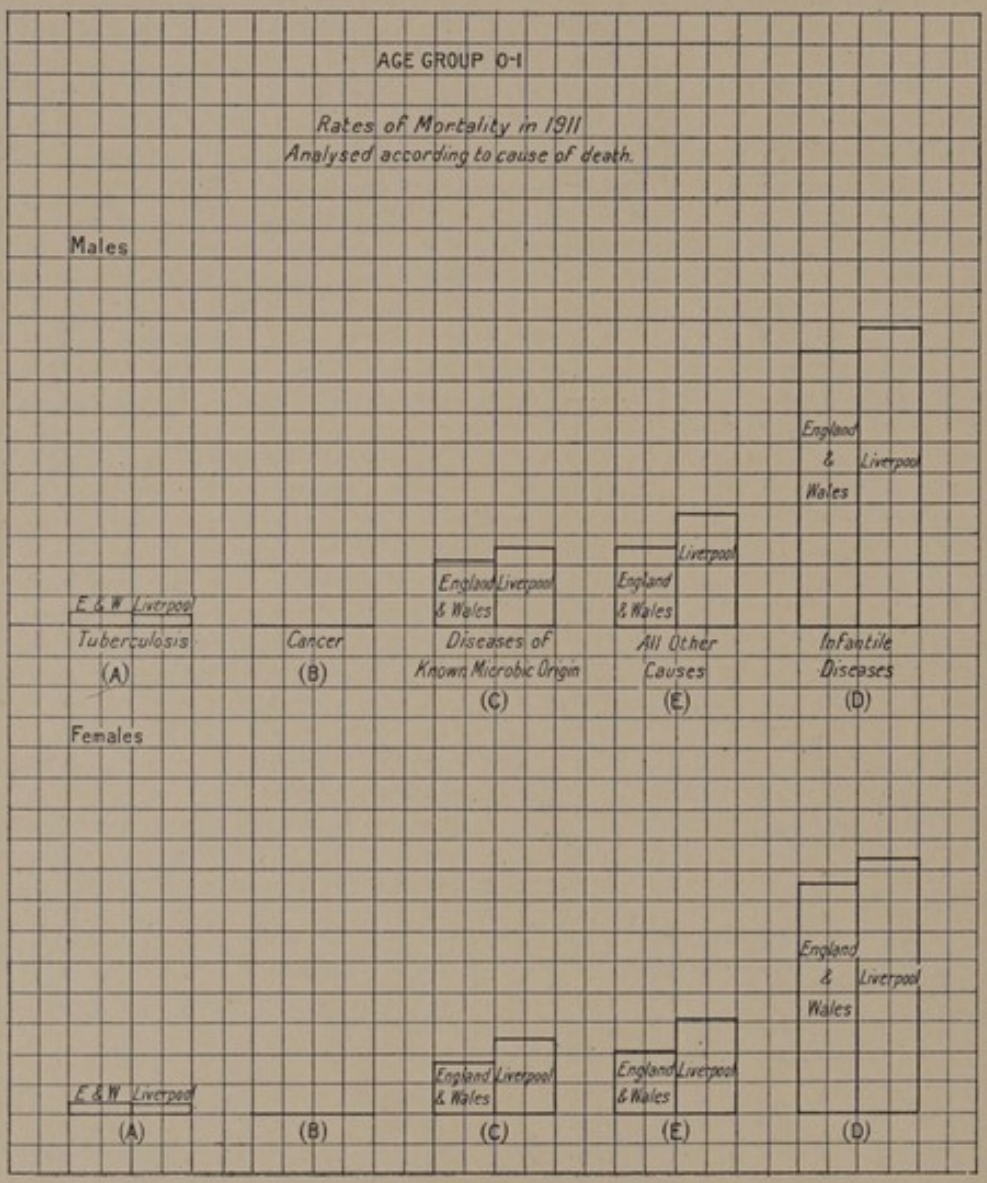


Diagram 22.

of the public health would be recognised as a matter of far greater national importance than the majority of political and other questions which attract such constant public attention.

The analysis of the death rates in a manner such as I

have explained enables each district to see the extent of the waste in its own case and the ages at which this waste occurs, thus enabling anyone to bring the matter quite clearly before the public notice.

I have referred to the Liverpool rates of mortality for

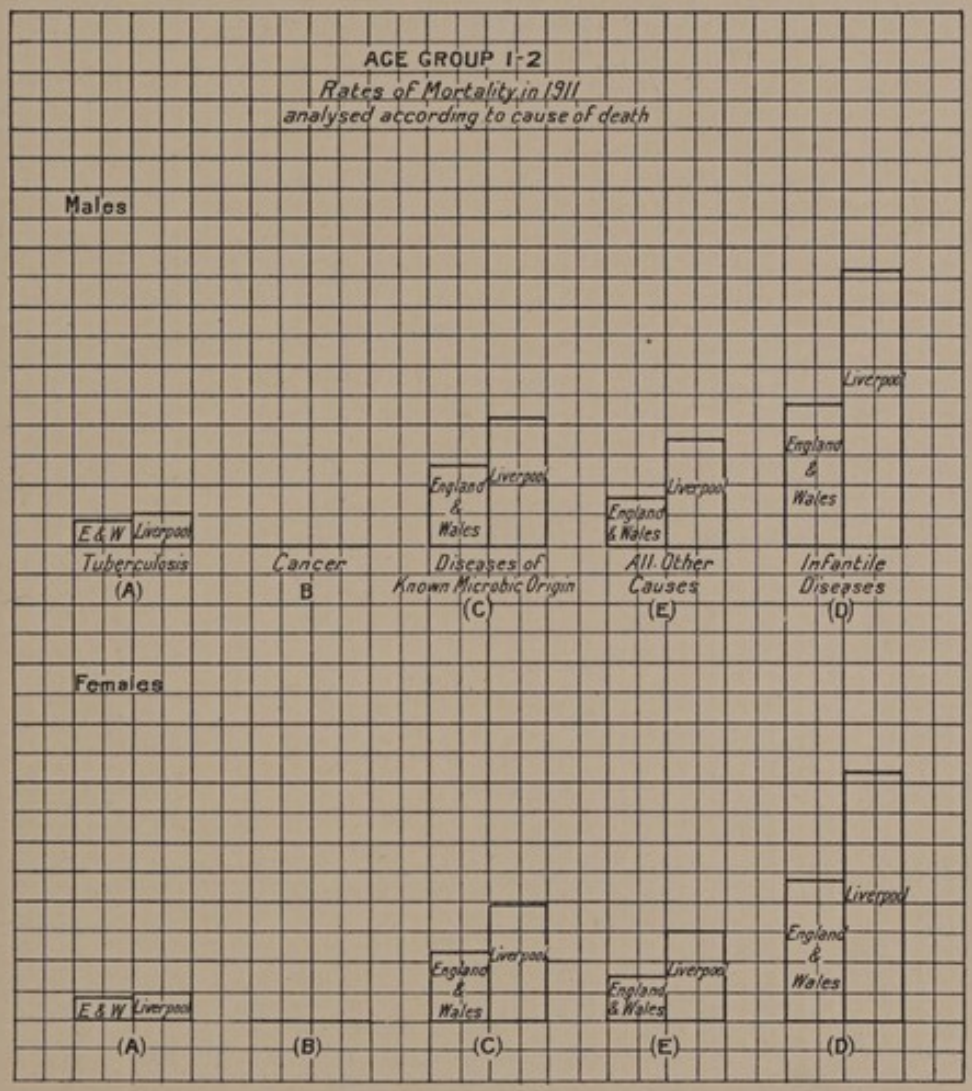


Diagram 23.

the sole reason that I delivered my lectures in Liverpool, and my desire is to show how the amount of preventable disease in any district can be detected. I am well aware of the enormous strides which have been made in sanitary reform in Liverpool, and the peculiar difficulties to

which this great city is subject. In using the tables of analysed mortality each year, the progress which is being made will be shown beyond contradiction, and to my mind, once it is exhibited in this graphic form, the effect on

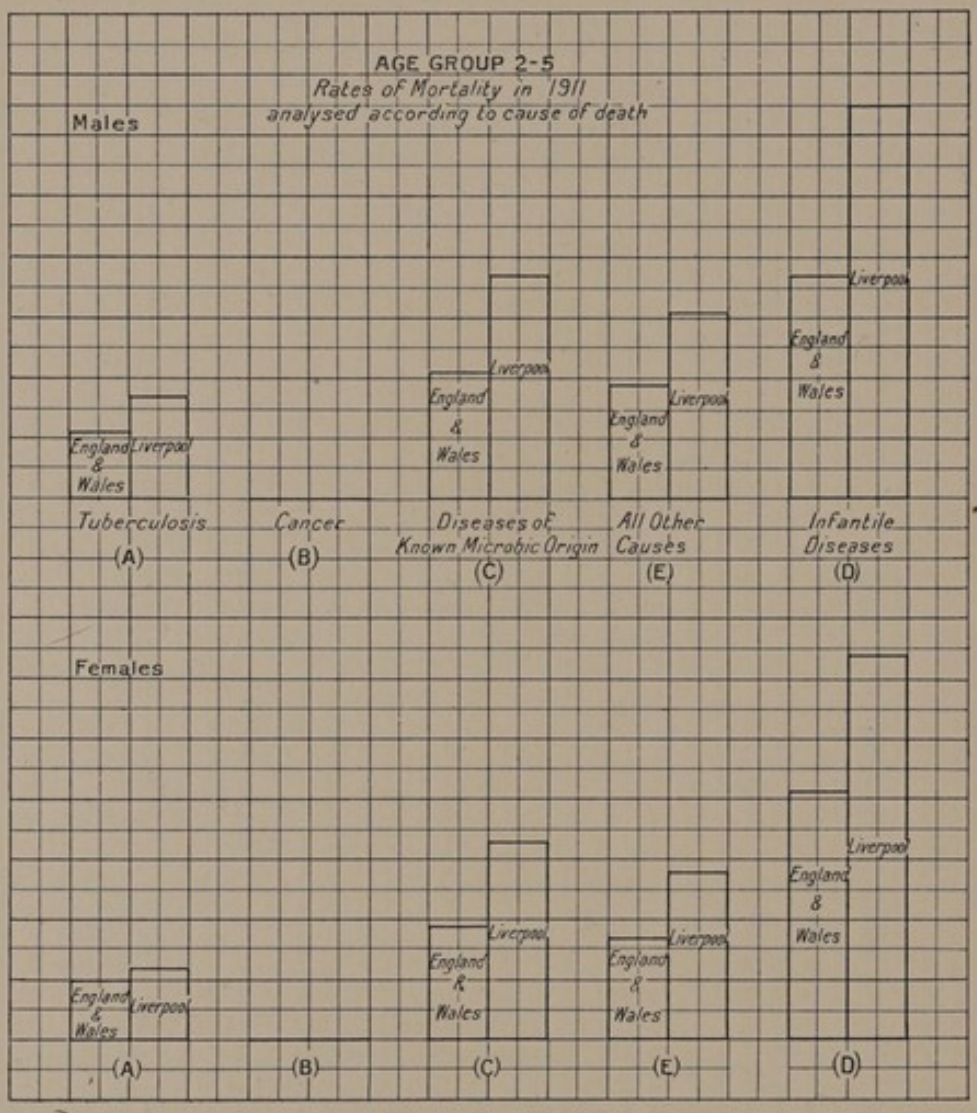


Diagram 24.

public opinion will be such that the remedy must inevitably follow. I say public opinion deliberately, for, without this backing, the efforts of the medical officer are more or less unavailing.

In the diagrams on pp. 86, 87 are shown the analysed

rates of mortality for females for England and Wales and for Liverpool.

Now I should like to show the analysed results for England and Wales and Liverpool in a somewhat different form.

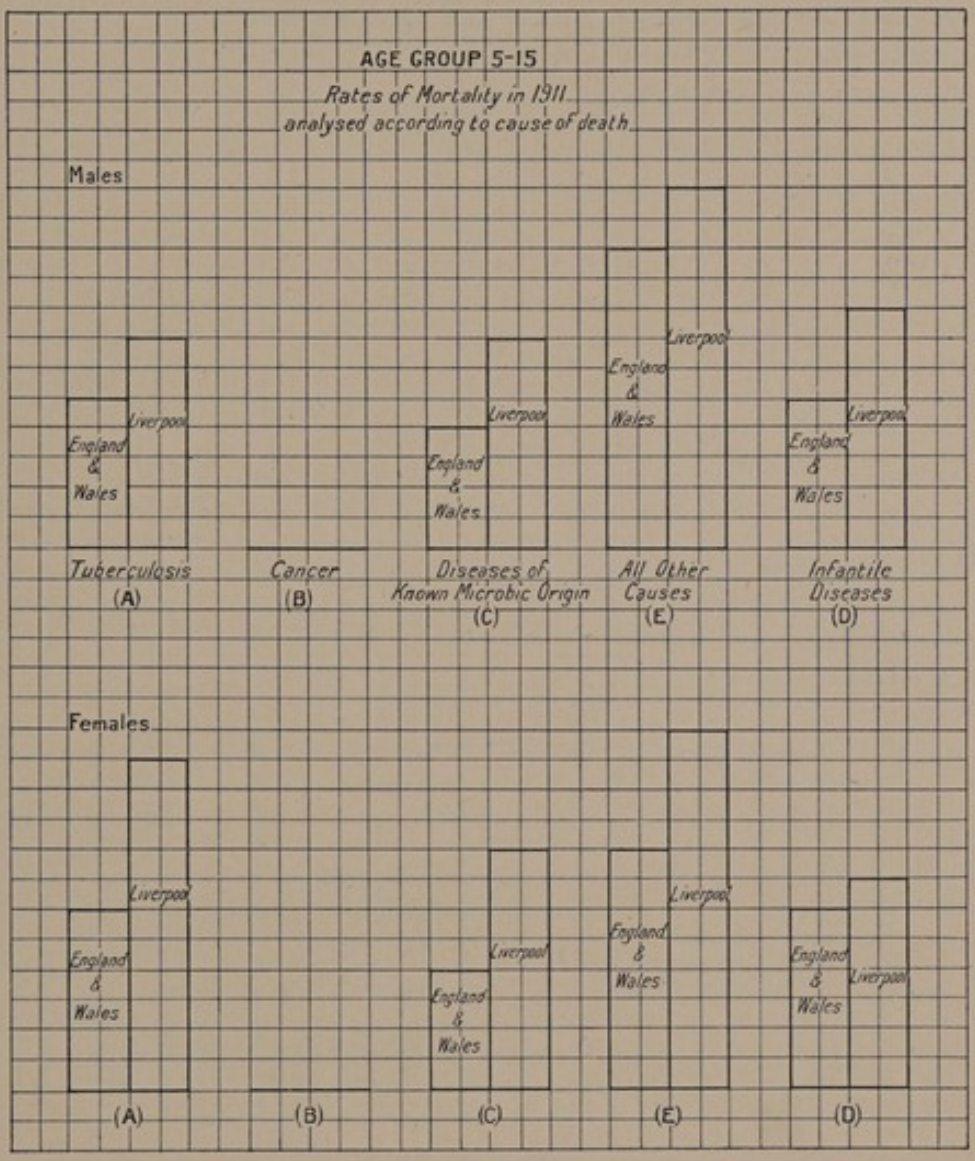


Diagram 25.

In the diagrams on pp. 88 to 94 are represented the mortality for the age-groups 0—1, 1—2, 2—5, 5—15, 15—25, 25—45, 45—65, for Liverpool and England and Wales, under the five headings as set out above.

It will be seen that there is comparatively little difference for age 0, so that we may suppose that the children born in Liverpool are average healthy babies.

In age-group 1—2 (p. 89) the divergence has increased,

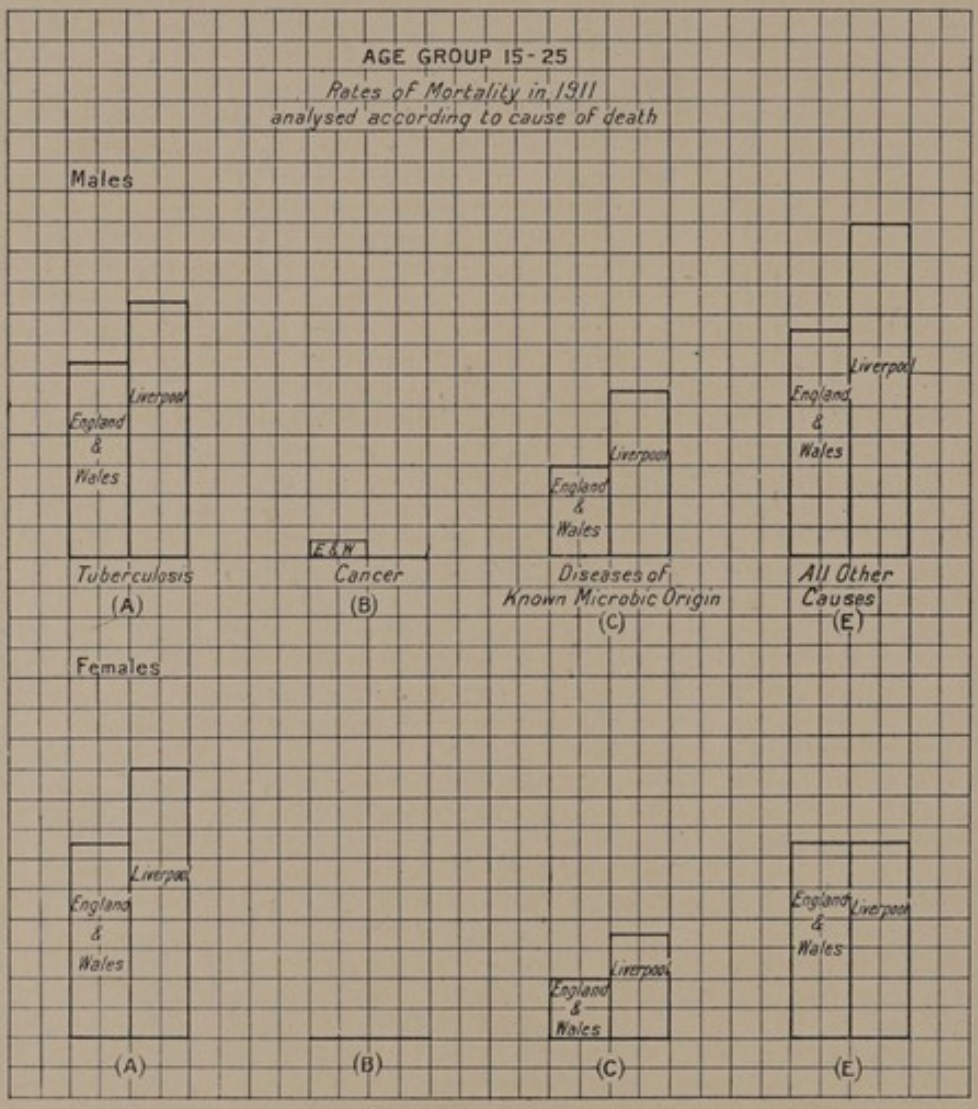


Diagram 26.

more particularly under the heading D, viz., Infantile diseases.

At ages 2—5, tuberculosis and diseases of microbic origin are already assuming high proportions. The excess in the case of tuberculosis amongst males is more than half

as much again as for England and Wales, although only 20 per cent. higher in the case of females. The number of deaths involved, however, is comparatively small. The

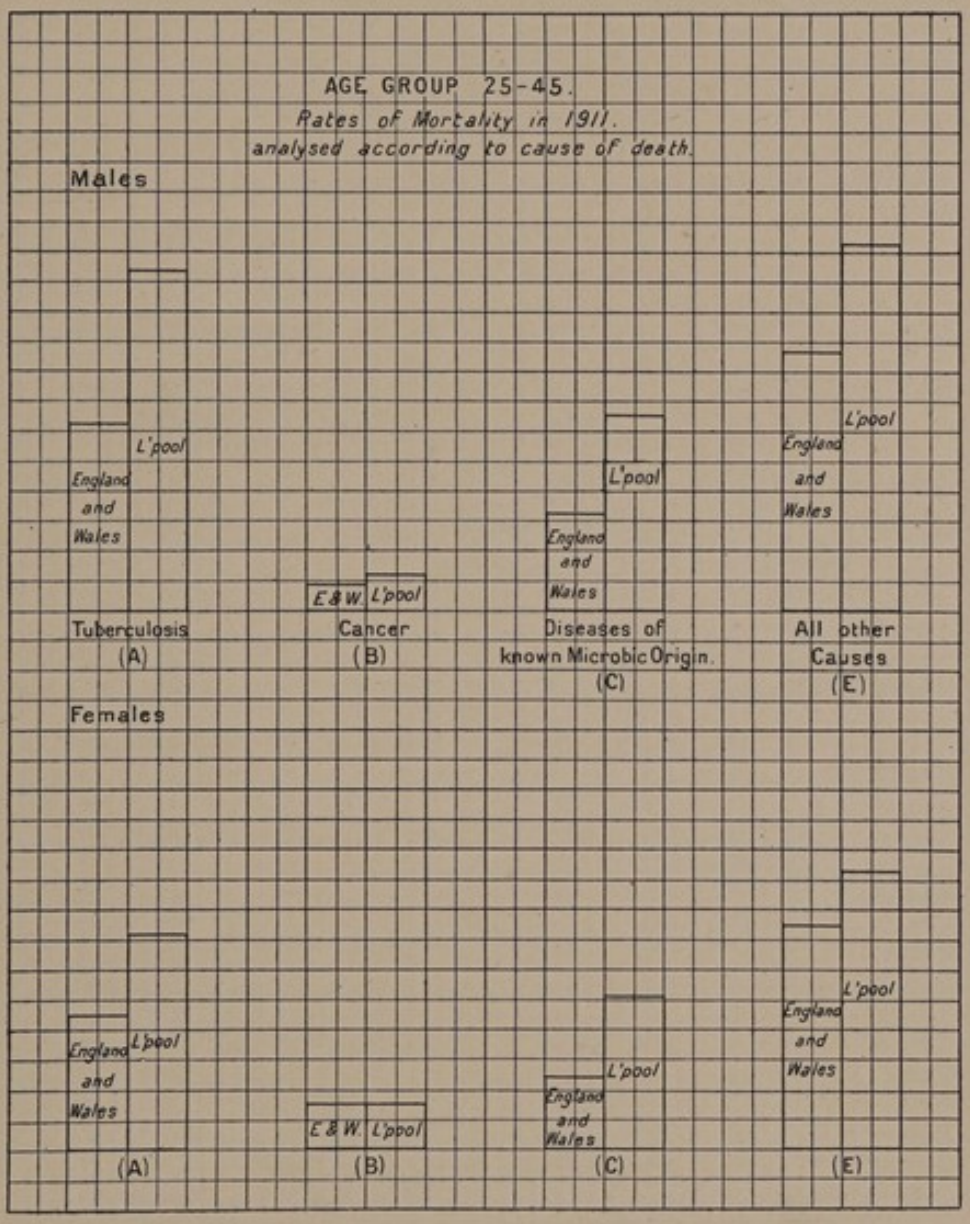


Diagram 27.

most remarkable feature is, I think, the excess in infantile complaints, which shows an excess of 76 per cent. for males and 56 per cent. for females (206 and 217 deaths respectively).

For the age-group 5—15, tuberculosis and other microbic diseases amongst females show an excess of nearly 100 per cent. The same diseases are responsible

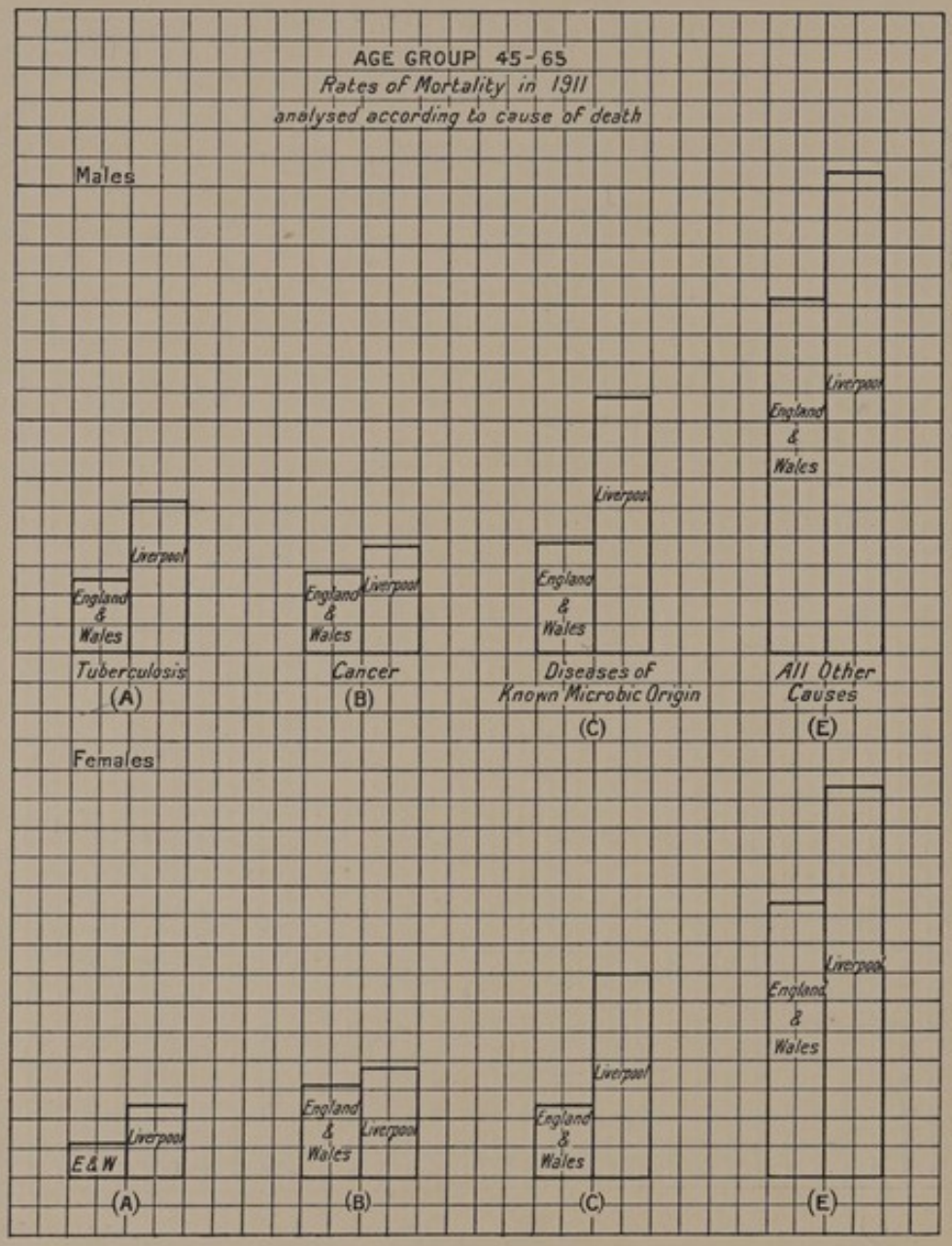


Diagram 28.

for the whole of the excess in the case of females for the age-group 15—25.

For ages 25—45, groups A and C in the case of females

still show a very marked excess, the number of deaths involved being 472, and the mortality rates being nearly double those for England and Wales. In the case of males the excess rate is still more marked, the number of deaths being 636.

For age-group 45—65, the death rate from tuberculosis is double that of England and Wales for both males and females. The outstanding feature, however, is group C (other microbic diseases), which shows an excess of 132 per cent. for males and 180 per cent. for females (442 male deaths, and 380 female deaths).

It must be clearly understood that in all these figures corrections have been made for deaths in hospitals, etc. Those brought in from other districts have been excluded, whilst those sent to other districts have been included.

The honour conferred upon me in being asked to deliver the Chadwick lectures was greatly enhanced by the fact that we have now started on a new era, in which we are able to obtain readily the practical details of the census returns. I am well aware that to the ordinary person, this does not seem to be any matter of great importance, and one object of my lectures was to explain how vital a matter it is to all those who are endeavouring to improve the public health of this great nation. Am I too sanguine in hoping that now we have all the necessary statistics, there may be at least one person in each important centre who will periodically construct tables of mortality for his own district on some such lines as those which I have described, showing the analysed mortality rates referring to the various principal diseases ? If this is done, I am confident that it must have beneficial results. The progress which is being made will be clearly denoted. There will no longer be any excuse for acting in ignorance, since the table will show exactly what is

happening, so that all conscientious workers for sanitary reform will be able to discover at once the direction in which it is most desirable to concentrate attention.

Year by year they will be able to trace the extent to which the rates of mortality due to various causes are falling, and not content with partial success, they will strive towards that ideal which we should ever bear in mind, viz., the complete elimination of all preventable disease.

APPENDIX

A METHOD OF CONSTRUCTING A MORTALITY TABLE

The Preparation of Analysed Tables.

The estimated population of England and Wales, and of each of the principal areas, as at the middle of the year 1911, is published in five-yearly age-groups up to age 25, then in ten-yearly groups up to age 85, with a final group for ages 85 and upwards.

The deaths are published in five-yearly age-groups up to age 85, with a final group for ages 85 and upwards.

In order to construct a mortality table, the numbers living and dying are required at *each* age, instead of in groups of ages, and it is necessary, therefore, to make use of some form of mathematical interpolation by means of which the numbers for each age can be estimated from the grouped numbers, which are given by the Registrar-General.

The object of this Appendix is not to explain the theory of interpolation or graduation, but merely to enable anyone to form a mortality table on the lines suggested in the foregoing Chapter.

The method adopted is that known as "Osculatory Interpolation." It has been most clearly explained by Dr. T. B. Sprague (see *Journal of the Institute of Actuaries*, Vol. 22, p. 282), Herr Karup (see Second International Actuarial Congress Transactions, p. 82), and Mr. G. King

(see *Journal of the Institute of Actuaries*, Vol. 41, p. 530).

For those who are interested in higher mathematics, I strongly recommend a perusal of Mr. Geo. King's most interesting paper, but I do not consider it within the scope of this Appendix to attempt any full demonstration. I think, however, that it may be advisable to give the formulæ employed, and to make some few comments thereon, but for those who merely wish to undertake the work of constructing a mortality table in the manner here suggested, it is not absolutely necessary that they should understand these preliminary explanations. In other words, I have given the details of the work at such length that I believe it will be possible for anyone to do the whole of the work without any mathematical appreciation of the reason for the steps employed.

The symbol T_x is used to denote the whole of the population living at a particular age x and all higher ages. Thus, T_{20} represents the numbers living at ages 20, 21, 22, and so on to the oldest age attained.

It will be seen that the Registrar-General's report supplies the data for obtaining T_5, T_{10}, T_{15}, T_{20}, T_{25}, T_{35}, T_{45}, T_{55}, T_{65}, T_{75}, and T_{85} by merely summing the numbers given in the report, but as the values of T_{30}, T_{40}, T_{50}, T_{60}, and T_{70} are also required, these must be obtained by interpolation. It is possible that in future reports the numbers will be given in five-yearly age-groups throughout and in such circumstances this preliminary interpolation will be obviated. Although this may sacrifice some of the regularity of the rates obtained, it will save a certain amount of work and simplify the method.

It will be noticed that the interpolated value has been obtained for T_{20}, although this can be obtained direct. The reason for this is to obtain a smoother progression.

The value of T_{10} used, however, is the original value, as it is impossible to obtain an interpolated value by the application of the formula.

The method used for obtaining the values of T_{20}, T_{30}, T_{40}, T_{50}, T_{60} and T_{70} is a well-known third difference equation, which may be represented as follows :—

$$T_{20} = \tfrac{1}{16}\{10\,(T_{15} + T_{25}) - (T_5 + T_{15} + T_{25} + T_{35})\}$$
$$T_{30} = \tfrac{1}{16}\{10\,(T_{25} + T_{35}) - (T_{15} + T_{25} + T_{35} + T_{45})\}$$
$$T_{40} = \tfrac{1}{16}\{10\,(T_{35} + T_{45}) - (T_{25} + T_{35} + T_{45} + T_{55})\}$$

and so on.

The *rationale* of this formula can be readily seen by examining a particular case. Thus, for obtaining T_{20}, we have taken ten times T_{15} and ten times T_{25}, and deducted T_5, T_{15}, T_{25}, and T_{35}. In other words, we have taken nine times T_{15} and nine times T_{25}, and deducted T_5 and T_{35}. This gives us sixteen values of T, and we have, therefore, divided the result by 16. As would naturally be expected, the greatest weight has been given to the two terms nearest to the interpolated values required.

Having performed the necessary arithmetical work, as explained in the method of construction which follows, we then have a complete series of the values of T_x for each quinquennial age from 0—75. To these values the formula of osculatory interpolation has been applied to obtain the values of T_x for the intermediate ages. For this purpose we require four formulæ, *i.e.*, one for each age between the two quinquennial known values. These formulæ, which apply to each set of four intermediate ages throughout the table, are as follows :—

$$T_{x+1} = (\cdot 912\,T_x + \cdot 168\,T_{x+5}) - (\cdot 064\,T_{x-5} + \cdot 016\,T_{x+10})$$
$$T_{x+2} = (\cdot 696\,T_x + \cdot 424\,T_{x+5}) - (\cdot 072\,T_{x-5} + \cdot 048\,T_{x+10})$$
$$T_{x+3} = (\cdot 424\,T_x + \cdot 696\,T_{x+5}) - (\cdot 048\,T_{x-5} + \cdot 072\,T_{x+10})$$
$$T_{x+4} = (\cdot 168\,T_x + \cdot 912\,T_{x+5}) - (\cdot 016\,T_{x-5} + \cdot 064\,T_{x+10})$$

Applying these formulæ to particular ages we have :—

$$T_{11} = (\cdot 912\, T_{10} + \cdot 168\, T_{15}) - (\cdot 064\, T_5 + \cdot 016\, T_{20})$$
$$T_{12} = (\cdot 696\, T_{10} + \cdot 424\, T_{15}) - (\cdot 072\, T_5 + \cdot 048\, T_{20})$$
$$T_{13} = (\cdot 424\, T_{10} + \cdot 696\, T_{15}) - (\cdot 048\, T_5 + \cdot 072\, T_{20})$$
$$T_{14} = (\cdot 168\, T_{10} + \cdot 912\, T_{15}) - (\cdot 016\, T_5 + \cdot 064\, T_{20})$$

For the next four ages, we have :—

$$T_{16} = (\cdot 912\, T_{15} + \cdot 168\, T_{20}) - (\cdot 064\, T_{10} + \cdot 016\, T_{25})$$
$$T_{17} = (\cdot 696\, T_{15} + \cdot 424\, T_{20}) - (\cdot 072\, T_{10} + \cdot 048\, T_{25})$$
$$T_{18} = (\cdot 424\, T_{15} + \cdot 696\, T_{20}) - (\cdot 048\, T_{10} + \cdot 072\, T_{25})$$
$$T_{19} = (\cdot 168\, T_{15} + \cdot 912\, T_{20}) - (\cdot 016\, T_{10} + \cdot 064\, T_{25})$$

and so on.

It will be seen that T_{11} is built up by taking varying proportions of T_5, T_{10}, T_{15} and T_{20} ; the greatest weight is given to T_{10}, which is nearest to T_{11}, a smaller weight being given to T_{15}, a still smaller weight to T_5, while the smallest weight is given to T_{20}, which is the most remote from T_{11}.

It will also be noticed that the sum of the coefficients in each case equals unity, thus for T_{11} we have $(\cdot 912 + \cdot 168) - (\cdot 064 + \cdot 016) = 1$, and for T_{12} $(\cdot 696 + \cdot 424) - (\cdot 072 + \cdot 048) = 1$.

The formulæ given above were obtained by translating Mr. King's third difference formulæ (to which I have already referred) into terms of the original functions. This translation is somewhat similar to the conversion of the ordinary finite difference interpolation formula into the well-known formula of La Grange.

Method of Construction.

In order to explain the *modus operandi*, it will be convenient to take as an example the male population of England and Wales as given by the Registrar-General in his seventy-fourth annual report.

The first operation is to extract the figures from the Registrar-General's return for the various age-groups 5—10, 10—15, 15—20, 20—25, 25—35, 35—45, 85 and upwards, as set out in column (1) of Schedule A, given on p. 114.

The second operation is to combine the first and second groups and the third and fourth groups respectively, so as to have regular groups each embracing ten ages, and then set these figures out for all the groups in column (2) of Schedule A.

The third operation is to obtain the total population living at any particular age and upwards, and place the results against the corresponding ages in column (3). It is convenient to have a symbol, T_x, to represent these results.

As already explained, the figures given by the Registrar-General in his final age-group are for ages 85 and upwards, viz., 22,775 ; and, therefore, we have merely to copy these into column (3). In symbols, $T_{85} = 22{,}775$. The male population living between ages 75 and 85 is 184,307, and if this number is added to T_{85}, we obtain T_{75}, that is, 207,082.

Again, the male population living between ages 65 and 75 is 604,220, and, if this number is added to T_{75}, we obtain T_{65}, that is, 811,302.

In exactly the same manner we obtain T_{55}, that is, 1,899,115, and then T_{45}, T_{35}, T_{25}, T_{15}, and, finally, T_5, viz., 15,549,567.

The fourth operation is to obtain the figures in column (4), which are denoted by the symbols at the head of the column. This operation merely consists of adding successive groups in column (3) and placing the results in column (4). Thus we add T_{15} and T_{25}, that is, 11,945,199 and 8,779,456, and place the result, viz., 20,724,655, against age 20 in column (4).

The fifth operation is to obtain the figures for column (5) in accordance with the symbols set out at the head of the column. Thus we sum the first four groups of figures in column (3), viz., 15,549,567 + 11,945,199 + 8,779,456 + 5,940,302, and place the result, viz., 42,214,524, opposite age 20 in column (5).

The sixth operation is to obtain the figures for column (6), which we do by multiplying the number against each age in column (4) by 10, and deducting from the result the number against the corresponding age in column (5). Thus at age 20 we have :—

Ten times the number in column (4)	= 207,246,550
The number in column (5)	= 42,214,524
By deduction	165,032,026

The seventh operation, by means of which we obtain the figures in column (7), merely consists of dividing the number against each age in column (6) by 16, and placing the result in column (7).

It will be noticed that in column (3) are given values of T_5, T_{15}, T_{25}, T_{35}, etc., and in column (7) values of T_{20}, T_{30}, T_{40}, etc., so that we now have values of T_{15}, T_{20}, T_{25}, T_{30}, and so on at quinquennial intervals up to age 75. We also have the values of T_5 and T_{85}.

The succeeding operations are shown in full in Schedule B. It is only necessary to state that in column (2), T_{10}, which has not previously been used, must now be obtained by adding the numbers for age groups 10 to 15 in Schedule A, column (1), to T_{15}, given in column (3), Schedule A.

In column (9) of Schedule B are given the final results obtained, which represent the graduated numbers of the male population at each age from 10 to 69 inclusive.

I am quite aware that this method for constructing a

mortality table involves a somewhat considerable amount of arithmetical work, but it has the advantage of being confined to work of the very simplest kind. The factors for multiplication in columns (2), (3), (5), and (6) will remain unchanged whatever table of mortality is being constructed, and moreover the figures in columns (3) and (6) have been obtained in columns (2) and (5). Thus, taking column (2), for ages 11, 12, 13, and 14, the factors, viz., ·912, ·696, ·424, and ·168, would still be used if we were constructing a table of female mortality, but in that case the values of T_x would, of course, be different.

The next operation is to obtain the graduated numbers of death at each age. The deaths are given in the Registrar-General's report for quinquennial age-groups from 5 to 85, and it is not absolutely necessary in this case to prepare a preliminary schedule similar to Schedule A. If this is not done, however, it will be found that the resulting rates of mortality will exhibit some irregularity. It is advisable, therefore, that the deaths should be first combined in the ten-yearly age-groups 5—14, 15—24, 25—34, 35—44, 45—54, 55—64, 65—74, 75—84, and 85 and upwards. Schedule A for the deaths, therefore, will be in precisely the same form as that for the living. In the first column will be the deaths in five-yearly age-groups as given in the Registrar-General's report, starting with group 5—9.

In the second column these numbers will be combined to form ten-yearly age-groups. The other columns will be completed in precisely the same manner as that already explained at length for the living.

Schedule B for the deaths will be in exactly the same form as Schedule B for the living. The interpolated values of T_x for the deaths as obtained in Schedule A are entered in column (1) of Schedule B, and the other columns

are completed in exactly the same way as the corresponding columns for the living, the multiplier shown against each age in Schedule B of the living being used in precisely the same manner.

We have now obtained the numbers living at each age from 10 to 69 inclusive, and also the deaths at the corresponding ages.

The numbers living, however, do not refer to the exact ages, but to mean ages, and in order to obtain the rates of mortality it is, therefore, necessary to make use of the following relationship :—

$$\text{Rate of mortality per unit at age } x = q_x = \frac{2\,d_x}{2\,\mathrm{L}_x + d_x},$$

where L_x represents the number living at the mean age x as given in the last column of Schedule B of the living, and d_x represents the numbers dying as shown in the last column of the corresponding schedule for deaths.

The actual work of obtaining the values of q_x is given in Schedule C, and it will be noticed that in the last column are given the values of p_x, that is, the probability of living for one year at age x.

The next operation is to calculate the rates of mortality for males aged 0—4. We must first obtain from the Registrar-General's returns the male births during the year for which the rates are to be obtained, and also for the five previous years. As in this case we are obtaining the rates for 1911, we must obtain the births for the years 1906—1911. These are set out in column (2) of Schedule D.

The next operation is to take the figures in column (2) and put them in groups of two, as shown in column (3). Thus, against 1911 we put the births for 1911 and 1910, that is, 448,933 + 457,266 = 906,199.

In column (4) are set out the results obtained by

dividing the figures in column (3) by 2, that is to say, we have the mean of two years' births which we may assume for the purposes of our calculations took place on the central date of the two years, that is, on January 1st.

Thus, 453,099 is the mean of the births for 1910 to 1911, and may be considered as representing a number of children all born on January 1st, 1911, and being those amongst whom, on the average, the deaths registered in 1911 between ages 0 and 1, that is, 63,874, as stated in column (11), have occurred. Similarly, the mean of the births in 1909 and 1910, viz., 461,864, in column (4), may be assumed to have occurred on the average on January 1st, 1910, and, therefore, if we deduct from these the deaths at age 0 to 1 in 1910, viz., 53,155, in column (5), we shall have approximately the survivors at exact age 1 on January 1st, 1911, that is, 408,709, in column (10), amongst whom the deaths between ages 1 and 2, viz., 16,326, in column (11), occurred during the year 1911.

Again, 472,436, in column (4), is the number of births which took place on the average on January 1st, 1909, and, deducting from these the deaths between ages 0 and 1 in 1909, viz., 56,026, in column (5), and the deaths between ages 1 and 2 in 1910, viz., 13,251, in column (6), we have 403,159, which is approximately the number of survivors at exact age 2, amongst whom the deaths between ages 2 and 3, viz., 5,822, in column (11), occurred during the year 1911.

The assumed number of births on January 1st, 1908, is 473,066, in column (4), and from this we deduct 63,594 + 14,146 + 5,020, that is, the deaths between ages 0 and 1 in 1908, the deaths between ages 1 and 2 in 1909, and the deaths between ages 2 and 3 in 1910, and thus obtain 473,066 — 82,760 = 390,306, in column (10), which is the assumed number of survivors at age 3 on

January 1st, 1911, amongst whom the deaths between ages 3 and 4 in 1911, viz., 3,449, in column (11), are assumed to have occurred.

The assumed number of births on January 1st, 1907, is 472,333, in column (4), and from this we deduct the deaths between ages 0 and 1 in 1907, viz., 60,926, the deaths between ages 1 and 2 in 1908, viz., 14,895, the deaths between ages 2 and 3 in 1909, viz., 5,941, and the deaths between ages 3 and 4 in 1910, viz., 2,950. That is to say, we deduct 84,712, in column (9), and so obtain 387,621, in column (10), *i.e.*, the number of the assumed survivors at exact age 4 on January 1st, 1911, amongst whom the 2,386 deaths between ages 4 and 5, in column (11), are assumed to have occurred in 1911.

With this explanation, the figures in columns (5), (6), (7), (8), (9), (10), and (11) will, I think, be easily understood.

Column (12) shows the results of dividing the figures in column (11) by those in column (10), and represents the rates of mortality (the symbol for which is q_x) for ages 0 to 4. That is to say, $q_0 = \cdot14097$, $q_1 = \cdot03995$, $q_2 = \cdot01444$, $q_3 = \cdot00884$, and $q_4 = \cdot00616$.

The method of obtaining the rates of mortality amongst infants is due to Professor Pell, of the University of Sydney, and is fully described on p. 264, in Vol. 21, of the *Journal of the Institute of Actuaries*.

There now only remain to be found the rates of mortality for ages 5, 6, 7, 8, and 9. These, I suggest, should be obtained by means of what is known as graphic graduation. A piece of specially cross-ruled paper should be used, and the values of q_x already obtained for ages 0 to 4 and 10 to 69 should be plotted out in the same manner as shown in the various diagrams in the preceding pages. When these values have been plotted out, the

result will be a curved line with a break at the five ages 5 to 9.

The general progression of the curve must be observed, and the break filled in so as to join up the curved line. The values of q_5, q_6, q_7, q_8 and q_9 can then be read off.

In Schedule E, column (4), are given all values of q_x from age 0 to age 69. In column (3) the values of p_x are set out, these having been obtained from the relationship $p_x = 1 - q_x$.

In column (1) of Schedule E there are set out the values usually referred to as the life column. This is obtained by assuming 100,000 births, and ascertaining the number of survivors at each successive age, by multiplying by the corresponding values of p_x. This column of figures is useful for many purposes, but it will at once be noticed that it enables us to see at a glance what is the probability of living from age 0 to any other age up to age 69. Thus, the probability of living from age 0 to age 50 is ·64554.

In Schedule F is given the corresponding mortality table for females in England and Wales in 1911.

In Schedules G and H are given male and female mortality tables for the city of Liverpool in the year 1911.

Construction of Analysed Tables.

Having obtained all the rates of mortality from age 0 to age 69, and having set them out in graphic form in the manner indicated, we now proceed to analyse these rates by dividing them into the five divisions referred to in Chapter VI., viz. :—

A. Tuberculosis, including pulmonary tuberculosis, tuberculous meningitis, and other tuberculous diseases.

B. Cancer.

C. Other diseases of known microbic origin.

D. Infantile complaints. This group is confined to ages under 15, after which it is included in Group E.

E. All other causes of death.

In order to explain the method of procedure, it will be convenient to confine the description to the analysis of the rates of mortality amongst males in England and Wales during 1911.

On p. 313 of the Registrar-General's report will be found the numbers of deaths occurring from various diseases in different age-groups.

Our first division, A, consists of the following causes as set out by the Registrar-General :—

Cause 9. Pulmonary tuberculosis.
,, 10. Tuberculous meningitis.
,, 11. Other tuberculous diseases.

Division B consists of :—

Cause 12. Cancer, malignant disease.

Division C consists of :—

Cause 1. Enteric fever.
,, 2. Small-pox.
,, 7. Influenza.
,, 8. Erysipelas.
,, 13. Rheumatic fever.
,, 16. Bronchitis.
,, 17. Pneumonia (all forms).
,, 18. Other respiratory diseases.
,, 23. Puerperal fever.

Division D consists of :—

Cause 3. Measles.
,, 4. Scarlet fever.
,, 5. Whooping cough.
,, 6. Diphtheria and croup.
,, 19. Diarrhœa, etc.
,, 25. Congenital debility, etc.

Division E consists of the diseases mentioned in Division D after age 15 combined with :—

Cause 14. Meningitis.
,, 15. Organic heart disease.
,, 20. Appendicitis and typhlitis.
,, 21. Cirrhosis of liver.
,, 21A. Alcoholism.
,, 22. Nephritis and Bright's disease.
,, 24. Parturition, apart from puerperal fever.
,, 26. Violence, apart from suicide.
,, 27. Suicide.
,, 28. Other defined diseases.
,, 29. Causes ill-defined or unknown.

The deaths occurring from each of these thirty causes are given for age-groups 0—1, 1—2, 2—5, 5—15, 15—25, 25—45, and 45—65.

Dealing first with age-group 0—1, it will be found that the following figures are given on p. 313 of the Registrar-General's report.

Group A	Cause 9	216	deaths.
	,, 10	600	,,
	,, 11	1,047	,,
	Total	1,863	,,
Group B	Cause 12	13	,,
Group C	Cause 1	3	deaths.
	,, 2	1	,,
	,, 7	120	,,
	,, 8	63	,,
	,, 13	5	,,
	,, 16	4,083	,,
	,, 17	4,994	,,
	,, 18	353	,,
	,, 23	*nil*	,,
	Total	9,622	,,

Group D	Cause	3	1,527 deaths.
	,,	4	42 ,,
	,,	5	1,676 ,,
	,,	6	128 ,,
	,,	19	17,552 ,,
	,,	25	19,691 ,,
		Total	40,616 ,,

Group E	Cause	14	858 deaths.
	,,	15	8 ,,
	,,	20	2 ,,
	,,	21	4 ,,
	,,	21A	*nil* ,,
	,,	22	74 ,,
	,,	24	*nil* ,,
	,,	26	847 ,,
	,,	27	*nil* ,,
	,,	28	9,832 ,,
	,,	29	135 ,,
		Total	11,760 ,,

The totals given above appear in column (1) of Schedule I, and it will be seen that the deaths from all thirty causes amounted to 63,874.

In column (3) of Schedule I, the rates of mortality from all causes is given, viz., ·1410, which is the rate shown against age 0 in Schedule E.

In order to obtain the rate of mortality at age 0 from the causes in Group A, we have the following relationship :—

$$\left(\begin{matrix}\text{Rate of mortality}\\ \text{from all causes}\end{matrix}\right) \times \frac{\text{Group A deaths}}{\text{Total deaths}} = \left(\begin{matrix}\text{Rate of mortality from}\\ \text{Group A causes}\end{matrix}\right).$$

Translating this into figures we have—

$$\cdot1410 \times \frac{1863}{63874} = \cdot0041 = \left\{\begin{matrix}\text{Rate of mortality per unit}\\ \text{from Group A causes.}\end{matrix}\right.$$

In the same way we have—

$$\cdot1410 \times \frac{9622}{63874} = \cdot0212 = \left\{\begin{matrix}\text{Rate of mortality per unit}\\ \text{from Group C causes.}\end{matrix}\right.$$

$$\cdot 1410 \times \frac{40616}{63874} = \cdot 0897 = \left\{\begin{array}{l}\text{Rate of mortality per unit}\\ \text{from Group D causes.}\end{array}\right.$$

$$\cdot 1410 \times \frac{11760}{63874} = \cdot 0260 = \left\{\begin{array}{l}\text{Rate of mortality per unit}\\ \text{from Group E causes.}\end{array}\right.$$

It will be noticed that in Schedule I, column (3), the rate of mortality for Group B causes is given as *nil*, the reason for this being that the number of deaths is so insignificant that the rate shown is less than ·5 per 10,000.

Precisely the same method is used for age-group 1—2, the figures for which are given in Schedule K.

The first two age-groups consist of single ages, but the third group, viz., 2—5, consists of three ages, and here it will be found that the rate of mortality from all causes is taken as the central age of the group, viz., age 3.

By reference to Schedule E, it will be seen that $q_3 = \cdot 0088$. We now assume that the following relationship holds good :—

$$\left(\begin{array}{c}\text{Rate of mortality}\\ \text{from all causes}\\ \text{at age 3}\end{array}\right) \times \frac{\text{Group A deaths at ages 2—5}}{\text{Total deaths at ages 2—5}} = \left(\begin{array}{c}\text{Rate of mortality}\\ \text{from Group A}\\ \text{causes at age 3}\end{array}\right).$$

By reference to Schedule L, column (3), it will be seen that :—

Rate of mortality at age 3 for			Group A	causes	= ·0011
,,	,,	,,	B	,,	= *nil*
,,	,,	,,	C	,,	= ·0021
,,	,,	,,	D	,,	= ·0037
,,	,,	,,	E	,,	= ·0019

One example will suffice to show how these rates were obtained, thus :—

$$\cdot 0088 \times \frac{1520}{11657} = \cdot 0011.$$

The next age-group given by the Registrar-General is for ages 5—15, that is, ten ages. The central age of this group is $9\frac{1}{2}$, but for all practical purposes it will be sufficient to deal with the mortality rate as at age 10.

From Schedule E it will be seen that the rate of mortality from all causes at age 10 is ·0024.

The Registrar-General gives the total number of deaths for this age-group from all causes as 9,985. The numbers of deaths for the five separate groups A, B, C, D and E are given in Schedule M, column (1), and the rates of mortality in column (3) have been obtained in precisely the same manner as those in Schedule L.

The rates of mortality, as given in column (3) of Schedules N, O and P, have all been obtained in the manner already explained, the central ages having been taken as 20, 35, and 55, respectively.

In Diagram 18 it will be seen that separate curves have been drawn for each group of causes, A, B, C, D and E. In order to obtain these, the points for ages 0, 1, 3, 10, 20, 35 and 55 were plotted out and a freehand curve drawn passing through these points, so as to indicate the general nature of the mortality rates.

In column (2) of Schedules I to P the deaths amongst males in Liverpool during 1911 for the five groups of causes A, B, C, D and E are set out. These figures were obtained from p. 357 of the Registrar-General's report, and were dealt with in the same manner as above explained in reference to the figures for England and Wales.

In column (4) of Schedules I to P the rates of mortality from the separate causes are set out, and in column (5) are given the ratios of the Liverpool rates to those for England and Wales.

The figures relating to females, which are given on the lower half of each Schedule I to P, as well as the graphs in Diagrams 24 and 25, were obtained in precisely the same manner as in the case of males.

The methods suggested for sub-dividing the total

rates of mortality from all causes into their component parts, as indicated by the five groups A, B, C, D and E, may be open to some theoretical objections. After careful investigation, however, I am convinced that the rates obtained so closely approximate to those which would be obtained by more elaborate methods, that I have no hesitation in recommending their use for the suggested purposes of comparison.

Schedule A.

England and Wales. Population, Males, 1911.

x	Population living in age-groups. Taken from Page 4 of Registrar-General's Report. (1)	Population in ten-yearly age-groups. (2)	T_x. (3)	$T_{x-5} + T_{x+5}$. (4)	$T_{x-15} + T_{x-5} + T_{x+5} + T_{x+15}$. (5)	$10 \times$ Col. 4 $-$ Col. 5. (6)	Col. 6 $\times \frac{1}{16} = T_x$. (7)
5	1,852,192	3,604,368	15,549,567				
10	1,752,176						
15	1,659,169	3,165,743	11,945,199				
20	1,506,574			20,724,655	42,214,524	165,032,026	10,314,502
25	2,839,154	2,839,154	8,779,456				
30				14,719,758	30,262,710	116,934,870	7,308,429
35	2,342,549	2,342,549	5,940,302				
40				9,538,055	20,216,626	75,163,924	4,697,745
45	1,698,638	1,698,638	3,597,753				
50				5,496,868	12,248,472	42,720,208	2,670,013
55	1,087,813	1,087,813	1,899,115				
60				2,710,417	6,515,252	20,588,918	1,286,807
65	604,220	604,220	811,302				
70				1,018,384	2,940,274	7,243,566	452,723
75	184,307	184,307	207,082				
80				229,857			
85	22,775	22,775	22,775				
90							
95							
100							

Schedule B.

England and Wales. Estimated Male Population at 30th June, 1911.

Age x.	T_x Population aged x and over. (1)	(2)	(3)	Col. (2) + Col. (3). (4)	(5)	(6)	Col. (5) + Col. (6). (7)	T_x Col. (4) − Col. (7). (8)	$L_x = T_x - T_{x+1}$ Population living between ages x and $(x+1)$. (9)	Age x.
5	15,549,567									5
6										6
7										7
8										8
9										9
10	13,697,375							13,697,375	358,780	10
11		$T_{10} \times \cdot912 = 12,492,006$	$T_{15} \times \cdot168 = 2,006,793$	14,498,799	$T_5 \times \cdot064 = 995,172$	$T_{20} \times \cdot016 = 165,032$	1,160,204	13,338,595	355,123	11
12		$T_{10} \times \cdot696 = 9,533,373$	$T_{15} \times \cdot424 = 5,064,764$	14,598,137	$T_5 \times \cdot072 = 1,119,569$	$T_{20} \times \cdot048 = 495,096$	1,614,665	12,983,472	350,949	12
13		$T_{10} \times \cdot424 = 5,807,687$	$T_{15} \times \cdot696 = 8,313,859$	14,121,546	$T_5 \times \cdot048 = 746,379$	$T_{20} \times \cdot072 = 742,644$	1,489,023	12,632,523	346,264	13
14		$T_{10} \times \cdot168 = 2,301,159$	$T_{15} \times \cdot912 = 10,894,021$	13,195,180	$T_5 \times \cdot016 = 248,793$	$T_{20} \times \cdot064 = 660,128$	908,921	12,286,259	341,060	14
15	11,945,199							11,945,199	335,445	15
16		$T_{15} \times \cdot912 = 10,894,021$	$T_{20} \times \cdot168 = 1,732,836$	12,626,857	$T_{10} \times \cdot064 = 876,632$	$T_{25} \times \cdot016 = 140,471$	1,017,103	11,609,754	330,171	16
17		$T_{15} \times \cdot696 = 8,313,859$	$T_{20} \times \cdot424 = 4,373,349$	12,687,208	$T_{10} \times \cdot072 = 986,211$	$T_{25} \times \cdot048 = 421,414$	1,407,625	11,279,583	325,521	17
18		$T_{15} \times \cdot424 = 5,064,764$	$T_{20} \times \cdot696 = 7,178,893$	12,243,657	$T_{10} \times \cdot048 = 657,474$	$T_{25} \times \cdot072 = 632,121$	1,289,595	10,954,062	321,486	18
19		$T_{15} \times \cdot168 = 2,006,793$	$T_{20} \times \cdot912 = 9,406,826$	11,413,619	$T_{10} \times \cdot016 = 219,158$	$T_{25} \times \cdot064 = 561,885$	781,043	10,632,576	318,074	19
20	10,314,502							10,314,502	314,155	20
21		$T_{20} \times \cdot912 = 9,406,826$	$T_{25} \times \cdot168 = 1,474,949$	10,881,775	$T_{15} \times \cdot064 = 764,493$	$T_{30} \times \cdot016 = 116,935$	881,428	10,000,347	309,824	21
22		$T_{20} \times \cdot696 = 7,178,893$	$T_{25} \times \cdot424 = 3,722,489$	10,901,382	$T_{15} \times \cdot072 = 860,054$	$T_{30} \times \cdot048 = 350,805$	1,210,859	9,690,523	306,250	22
23		$T_{20} \times \cdot424 = 4,373,349$	$T_{25} \times \cdot696 = 6,110,501$	10,483,850	$T_{15} \times \cdot048 = 573,370$	$T_{30} \times \cdot072 = 526,207$	1,099,577	9,384,273	303,435	23
24		$T_{20} \times \cdot168 = 1,732,836$	$T_{25} \times \cdot912 = 8,006,864$	9,739,700	$T_{15} \times \cdot016 = 191,123$	$T_{30} \times \cdot064 = 467,739$	658,862	9,080,838	301,382	24
25	8,779,456							8,779,456	299,949	25
26		$T_{25} \times \cdot912 = 8,006,864$	$T_{30} \times \cdot168 = 1,227,816$	9,234,680	$T_{20} \times \cdot064 = 660,128$	$T_{35} \times \cdot016 = 95,045$	755,173	8,479,507	298,010	26
27		$T_{25} \times \cdot696 = 6,110,501$	$T_{30} \times \cdot424 = 3,098,774$	9,209,275	$T_{20} \times \cdot072 = 742,644$	$T_{35} \times \cdot048 = 285,134$	1,027,778	8,181,497	295,139	27
28		$T_{25} \times \cdot424 = 3,722,489$	$T_{30} \times \cdot696 = 5,086,667$	8,809,156	$T_{20} \times \cdot048 = 495,096$	$T_{35} \times \cdot072 = 427,702$	922,798	7,886,358	291,333	28
29		$T_{25} \times \cdot168 = 1,474,949$	$T_{30} \times \cdot912 = 6,665,287$	8,140,236	$T_{20} \times \cdot016 = 165,032$	$T_{35} \times \cdot064 = 380,179$	545,211	7,595,025	286,596	29
30	7,308,429							7,308,429	282,220	30
31		$T_{30} \times \cdot912 = 6,665,287$	$T_{35} \times \cdot168 = 997,971$	7,663,258	$T_{25} \times \cdot064 = 561,885$	$T_{40} \times \cdot016 = 75,164$	637,049	7,026,209	278,467	31
32		$T_{30} \times \cdot696 = 5,086,667$	$T_{35} \times \cdot424 = 2,518,688$	7,605,355	$T_{25} \times \cdot072 = 632,121$	$T_{40} \times \cdot048 = 225,492$	857,613	6,747,742	274,170	32
33		$T_{30} \times \cdot424 = 3,098,774$	$T_{35} \times \cdot696 = 4,134,450$	7,233,224	$T_{25} \times \cdot048 = 421,414$	$T_{40} \times \cdot072 = 338,238$	759,652	6,473,572	269,328	33
34		$T_{30} \times \cdot168 = 1,227,816$	$T_{35} \times \cdot912 = 5,417,555$	6,645,371	$T_{25} \times \cdot016 = 140,471$	$T_{40} \times \cdot064 = 300,656$	441,127	6,204,244	263,942	34
35	5,940,302							5,940,302	258,829	35
36		$T_{35} \times \cdot912 = 5,417,555$	$T_{40} \times \cdot168 = 789,221$	6,206,776	$T_{30} \times \cdot064 = 467,739$	$T_{45} \times \cdot016 = 57,564$	525,303	5,681,473	254,078	36
37		$T_{35} \times \cdot696 = 4,134,450$	$T_{40} \times \cdot424 = 1,991,844$	6,126,294	$T_{30} \times \cdot072 = 526,207$	$T_{45} \times \cdot048 = 172,692$	698,899	5,427,395	248,919	37
38		$T_{35} \times \cdot424 = 2,518,688$	$T_{40} \times \cdot696 = 3,269,631$	5,788,319	$T_{30} \times \cdot048 = 350,805$	$T_{45} \times \cdot072 = 259,038$	609,843	5,178,476	243,353	38
39		$T_{35} \times \cdot168 = 997,971$	$T_{40} \times \cdot912 = 4,284,343$	5,282,314	$T_{30} \times \cdot016 = 116,935$	$T_{45} \times \cdot064 = 230,256$	347,191	4,935,123	237,378	39
40	4,697,745							4,697,745	231,878	40
41		$T_{40} \times \cdot912 = 4,284,343$	$T_{45} \times \cdot168 = 604,423$	4,888,766	$T_{35} \times \cdot064 = 380,179$	$T_{50} \times \cdot016 = 42,720$	422,899	4,465,867	226,652	41
42		$T_{40} \times \cdot696 = 3,269,631$	$T_{45} \times \cdot424 = 1,525,447$	4,795,078	$T_{35} \times \cdot072 = 427,702$	$T_{50} \times \cdot048 = 128,161$	555,863	4,239,215	220,710	42
43		$T_{40} \times \cdot424 = 1,991,844$	$T_{45} \times \cdot696 = 2,504,036$	4,495,880	$T_{35} \times \cdot048 = 285,134$	$T_{50} \times \cdot072 = 192,241$	477,375	4,018,505	214,059	43
44		$T_{40} \times \cdot168 = 789,221$	$T_{45} \times \cdot912 = 3,281,151$	4,070,372	$T_{35} \times \cdot016 = 95,045$	$T_{50} \times \cdot064 = 170,881$	265,926	3,804,446	206,693	44
45	3,597,753							3,597,753	199,082	45
46		$T_{45} \times \cdot912 = 3,281,151$	$T_{50} \times \cdot168 = 448,562$	3,729,713	$T_{40} \times \cdot064 = 300,656$	$T_{55} \times \cdot016 = 30,386$	331,042	3,398,671	191,945	46
47		$T_{45} \times \cdot696 = 2,504,036$	$T_{50} \times \cdot424 = 1,132,086$	3,636,122	$T_{40} \times \cdot072 = 338,238$	$T_{55} \times \cdot048 = 91,158$	429,396	3,206,726	185,178	47
48		$T_{45} \times \cdot424 = 1,525,447$	$T_{50} \times \cdot696 = 1,858,329$	3,383,776	$T_{40} \times \cdot048 = 225,492$	$T_{55} \times \cdot072 = 136,736$	362,228	3,021,548	178,780	48
49		$T_{45} \times \cdot168 = 604,423$	$T_{50} \times \cdot912 = 2,435,052$	3,039,475	$T_{40} \times \cdot016 = 75,164$	$T_{55} \times \cdot064 = 121,543$	196,707	2,842,768	172,755	49
50	2,670,013							2,670,013	166,755	50
51		$T_{50} \times \cdot912 = 2,435,052$	$T_{55} \times \cdot168 = 319,051$	2,754,103	$T_{45} \times \cdot064 = 230,256$	$T_{60} \times \cdot016 = 20,589$	250,845	2,503,258	160,509	51
52		$T_{50} \times \cdot696 = 1,858,329$	$T_{55} \times \cdot424 = 805,225$	2,663,554	$T_{45} \times \cdot072 = 259,038$	$T_{60} \times \cdot048 = 61,767$	320,805	2,342,749	154,221	52
53		$T_{50} \times \cdot424 = 1,132,086$	$T_{55} \times \cdot696 = 1,321,784$	2,453,870	$T_{45} \times \cdot048 = 172,692$	$T_{60} \times \cdot072 = 92,650$	265,342	2,188,528	147,893	53
54		$T_{50} \times \cdot168 = 448,562$	$T_{55} \times \cdot912 = 1,731,993$	2,180,555	$T_{45} \times \cdot016 = 57,564$	$T_{60} \times \cdot064 = 82,356$	139,920	2,040,635	141,520	54
55	1,899,115							1,899,115	134,800	55
56		$T_{55} \times \cdot912 = 1,731,993$	$T_{60} \times \cdot168 = 216,184$	1,948,177	$T_{50} \times \cdot064 = 170,881$	$T_{65} \times \cdot016 = 12,981$	183,862	1,764,315	128,108	56
57		$T_{55} \times \cdot696 = 1,321,784$	$T_{60} \times \cdot424 = 545,606$	1,867,390	$T_{50} \times \cdot072 = 192,241$	$T_{65} \times \cdot048 = 38,942$	231,183	1,636,207	121,939	57
58		$T_{55} \times \cdot424 = 805,225$	$T_{60} \times \cdot696 = 895,618$	1,700,843	$T_{50} \times \cdot048 = 128,161$	$T_{65} \times \cdot072 = 58,414$	186,575	1,514,268	116,292	58
59		$T_{55} \times \cdot168 = 319,051$	$T_{60} \times \cdot912 = 1,173,568$	1,492,619	$T_{50} \times \cdot016 = 42,720$	$T_{65} \times \cdot064 = 51,923$	94,643	1,397,976	111,169	59
60	1,286,807							1,286,807	105,727	60
61		$T_{60} \times \cdot912 = 1,173,568$	$T_{65} \times \cdot168 = 136,299$	1,309,867	$T_{55} \times \cdot064 = 121,543$	$T_{70} \times \cdot016 = 7,244$	128,787	1,181,080	99,937	61
62		$T_{60} \times \cdot696 = 895,618$	$T_{65} \times \cdot424 = 343,992$	1,239,610	$T_{55} \times \cdot072 = 136,736$	$T_{70} \times \cdot048 = 21,731$	158,467	1,081,143	94,625	62
63		$T_{60} \times \cdot424 = 545,606$	$T_{65} \times \cdot696 = 564,666$	1,110,272	$T_{55} \times \cdot048 = 91,158$	$T_{70} \times \cdot072 = 32,596$	123,754	986,518	89,787	63
64		$T_{60} \times \cdot168 = 216,184$	$T_{65} \times \cdot912 = 739,907$	956,091	$T_{55} \times \cdot016 = 30,386$	$T_{70} \times \cdot064 = 28,974$	59,360	896,731	85,429	64
65	811,302							811,302	81,007	65
66		$T_{65} \times \cdot912 = 739,907$	$T_{70} \times \cdot168 = 76,057$	815,964	$T_{60} \times \cdot064 = 82,356$	$T_{75} \times \cdot016 = 3,313$	85,669	730,295	76,264	66
67		$T_{65} \times \cdot696 = 564,666$	$T_{70} \times \cdot424 = 191,955$	756,621	$T_{60} \times \cdot072 = 92,650$	$T_{75} \times \cdot048 = 9,940$	102,590	654,031	71,621	67
68		$T_{65} \times \cdot424 = 343,992$	$T_{70} \times \cdot696 = 315,095$	659,087	$T_{60} \times \cdot048 = 61,767$	$T_{75} \times \cdot072 = 14,910$	76,677	582,410	67,071	68
69		$T_{65} \times \cdot168 = 136,299$	$T_{70} \times \cdot912 = 412,883$	549,182	$T_{60} \times \cdot016 = 20,589$	$T_{75} \times \cdot064 = 13,254$	33,843	515,339	62,616	69
70	452,723									
71		$T_{70} \times \cdot912 = 412,883$			$T_{65} \times \cdot064 = 51,923$					
72		$T_{70} \times \cdot696 = 315,095$			$T_{65} \times \cdot072 = 58,414$					
73		$T_{70} \times \cdot424 = 191,955$			$T_{65} \times \cdot048 = 38,942$					
74		$T_{70} \times \cdot168 = 76,057$			$T_{65} \times \cdot016 = 12,981$					
75	207,082									
76					$T_{70} \times \cdot064 = 23,974$					
77					$T_{70} \times \cdot072 = 32,596$					
78					$T_{70} \times \cdot048 = 21,731$					
79					$T_{70} \times \cdot016 = 7,244$					
80										
81					$T_{75} \times \cdot064 = 13,254$					
82					$T_{75} \times \cdot072 = 14,910$					
83					$T_{75} \times \cdot048 = 9,940$					
84					$T_{75} \times \cdot016 = 3,313$					

| | | |

Schedule C.

England and Wales. Estimated Male Population at 30th June, 1911.

x.	$2\,L_x$. (1)	d_x. (2)	$2\,L_x + d_x$. (3)	$2\,d_x$. (4)	$\frac{\text{Col. 4}}{\text{Col. 3}} = \frac{2\,d_x}{2\,L_x + d_x} = q_x$. (5)	$p_x = 1 - q_x$. (6)	x.
0						·8590	0
1						·9600	1
2						·9856	2
3						·9912	3
4						·9938	4
5						·9954	5
6						·9961	6
7						·9966	7
8						·9970	8
9						·9973	9
10	717,560	870	718,430	1,740	·0024	·9976	10
11	710,246	697	710,943	1,394	·0020	·9980	11
12	701,898	610	702,508	1,220	·0017	·9983	12
13	692,528	637	693,165	1,274	·0018	·9982	13
14	682,120	770	682,890	1,540	·0023	·9977	14
15	670,890	922	671,812	1,844	·0027	·9973	15
16	660,342	1,004	661,346	2,008	·0030	·9970	16
17	651,042	1,058	652,100	2,116	·0032	·9968	17
18	642,972	1,086	644,058	2,172	·0034	·9966	18
19	636,148	1,091	637,239	2,182	·0034	·9966	19
20	628,310	1,089	629,399	2,178	·0035	·9965	20
21	619,648	1,103	620,751	2,206	·0036	·9964	21
22	612,500	1,127	613,627	2,254	·0037	·9963	22
23	606,870	1,160	608,030	2,320	·0038	·9962	23
24	602,764	1,200	603,964	2,400	·0040	·9960	24
25	599,898	1,239	601,137	2,478	·0041	·9959	25
26	596,020	1,271	597,291	2,542	·0043	·9957	26
27	590,278	1,308	591,586	2,616	·0044	·9956	27
28	582,666	1,347	584,013	2,694	·0046	·9954	28
29	573,192	1,390	574,582	2,780	·0048	·9952	29
30	564,440	1,429	565,869	2,858	·0051	·9949	30
31	556,934	1,468	558,402	2,936	·0053	·9947	31
32	548,340	1,508	549,848	3,016	·0055	·9945	32
33	538,656	1,557	540,213	3,114	·0058	·9942	33
34	527,884	1,610	529,494	3,220	·0061	·9939	34
35	517,658	1,662	519,320	3,324	·0064	·9936	35
36	508,156	1,709	509,865	3,418	·0067	·9933	36
37	497,838	1,759	499,597	3,518	·0070	·9930	37
38	486,706	1,812	488,518	3,624	·0074	·9926	38
39	474,756	1,870	476,626	3,740	·0078	·9922	39
40	463,756	1,923	465,679	3,846	·0083	·9917	40
41	453,304	1,976	455,280	3,952	·0087	·9913	41
42	441,420	2,030	443,450	4,060	·0092	·9908	42
43	428,118	2,089	430,207	4,178	·0097	·9903	43
44	413,386	2,153	415,539	4,306	·0104	·9896	44

SCHEDULE C—*continued.*

x.	$2\,L_x$. (1)	d_x. (2)	$2\,L_x + d_x$. (3)	$2\,d_x$. (4)	$\frac{\text{Col. 4} - \text{Col. 3}}{2d_x} = \frac{d_x}{2\,L_x + d_x} = q_x$. (5)	$p_x = 1 - q_x$. (6)	x.
45	398,164	2,211	400,375	4,422	·0110	·9890	45
46	383,890	2,270	386,160	4,540	·0118	·9882	46
47	370,356	2,333	372,689	4,666	·0125	·9875	47
48	357,560	2,395	359,955	4,790	·0133	·9867	48
49	345,510	2,465	347,975	4,930	·0142	·9858	49
50	333,510	2,529	336,039	5,058	·0151	·9849	50
51	321,018	2,590	323,608	5,180	·0160	·9840	51
52	308,442	2,658	311,100	5,316	·0171	·9829	52
53	295,786	2,735	298,521	5,470	·0183	·9817	53
54	283,040	2,817	285,857	5,634	·0197	·9803	54
55	269,600	2,905	272,505	5,810	·0213	·9787	55
56	256,216	2,987	259,203	5,974	·0230	·9770	56
57	243,878	3,063	246,941	6,126	·0248	·9752	57
58	232,584	3,132	235,716	6,264	·0266	·9734	58
59	222,338	3,194	225,532	6,388	·0283	·9717	59
60	211,454	3,240	214,694	6,480	·0302	·9698	60
61	199,874	3,291	203,165	6,582	·0324	·9676	61
62	189,250	3,364	192,614	6,728	·0349	·9651	62
63	179,574	3,464	183,038	6,928	·0379	·9621	63
64	170,858	3,586	174,444	7,172	·0411	·9589	64
65	162,014	3,766	165,780	7,532	·0454	·9546	65
66	152,528	3,928	156,456	7,856	·0502	·9498	66
67	143,242	4,008	147,250	8,016	·0544	·9456	67
68	134,142	4,000	138,142	8,000	·0579	·9421	68
69	125,232	3,906	129,138	7,812	·0605	·9395	69

Schedule D.

Construction of Infantile Rates of Mortality, England and Wales, Males, 1911.

Year (y).	Births in year (y). Taken from Registrar-General's Returns.	Births in year (y) + Births in year ($y-1$)	Estimated Births 1st Jan. = ½ Col. (3).	Deaths. Ages 0—1. Year (y)	Deaths. Ages 1—2. Year ($y+1$).	Deaths. Ages 2—3. Year ($y+2$).	Deaths. Ages 3—4. Year ($y+3$).	Sum of Cols. (5), (6), (7), and (8).	Estimated Survivors on 1st Jan., 1911, at age (x) Col. (4) − Col. (9).	d_x = Deaths 1911. Taken from Registrar-General's Returns.	q_x Col. 11 ÷ Col. 10.	(x).
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1911	448,933	906,199	453,099	—	—	—	—	—	453,099	63,874	·14097	0
1910	457,266	923,729	461,864	53,155	—	—	—	53,155	408,709	16,326	·03995	1
1909	466,463	944,873	472,436	56,026	13,251	—	—	69,277	403,159	5,822	·01444	2
1908	478,410	946,133	473,066	63,594	14,146	5,020	—	82,760	390,306	3,449	·00884	3
1907	467,728	944,667	472,333	60,926	14,895	5,941	2,950	84,712	387,621	2,386	·00616	4
1906	476,939											

SCHEDULE E.—ENGLAND AND WALES. 1911. MALES.

x.	l_x. (1)	d_x. (2)	p_x. (3)	q_x. (4)
0	100,000	14,100	·8590	·1410
1	85,900	3,436	·9600	·0400
2	82,464	1,187	·9856	·0144
3	81,277	716	·9912	·0088
4	80,561	499	·9938	·0062
5	80,062	368	·9954	·0046
6	79,694	311	·9961	·0039
7	79,383	270	·9966	·0034
8	79,113	238	·9970	·0030
9	78,875	212	·9973	·0027
10	78,663	189	·9976	·0024
11	78,474	157	·9980	·0020
12	78,317	133	·9983	·0017
13	78,184	141	·9982	·0018
14	78,043	180	·9977	·0023
15	77,863	210	·9973	·0027
16	77,653	233	·9970	·0030
17	77,420	248	·9968	·0032
18	77,172	262	·9966	·0034
19	76,910	261	·9966	·0034
20	76,649	269	·9965	·0035
21	76,380	275	·9964	·0036
22	76,105	281	·9963	·0037
23	75,824	288	·9962	·0038
24	75,536	303	·9960	·0040
25	75,233	308	·9959	·0041
26	74,925	322	·9957	·0043
27	74,603	328	·9956	·0044
28	74,275	342	·9954	·0046
29	73,933	355	·9952	·0048
30	73,578	375	·9949	·0051
31	73,203	388	·9947	·0053
32	72,815	401	·9945	·0055
33	72,414	420	·9942	·0058
34	71,994	439	·9939	·0061

SCHEDULE E—*continued.*

x.	l_x. (1)	d_x. (2)	p_x. (3)	q_x. (4)
35	71,555	458	·9936	·0064
36	71,097	476	·9933	·0067
37	70,621	494	·9930	·0070
38	70,127	519	·9926	·0074
39	69,608	543	·9922	·0078
40	69,065	574	·9917	·0083
41	68,491	595	·9913	·0087
42	67,896	625	·9908	·0092
43	67,271	653	·9903	·0097
44	66,618	692	·9896	·0104
45	65,926	726	·9890	·0110
46	65,200	769	·9882	·0118
47	64,431	805	·9875	·0125
48	63,626	847	·9867	·0133
49	62,779	891	·9858	·0142
50	61,888	935	·9849	·0151
51	60,953	975	·9840	·0160
52	59,978	1,025	·9829	·0171
53	58,953	1,079	·9817	·0183
54	57,874	1,140	·9803	·0197
55	56,734	1,209	·9787	·0213
56	55,525	1,277	·9770	·0230
57	54,248	1,345	·9752	·0248
58	52,903	1,407	·9734	·0266
59	51,496	1,458	·9717	·0283
60	50,038	1,511	·9698	·0302
61	48,527	1,572	·9676	·0324
62	46,955	1,639	·9651	·0349
63	45,316	1,717	·9621	·0379
64	43,599	1,792	·9589	·0411
65	41,807	1,898	·9546	·0454
66	39,909	2,004	·9498	·0502
67	37,905	2,062	·9456	·0544
68	35,843	2,075	·9421	·0579
69	33,768	2,043	·9395	·0605

SCHEDULE F.—ENGLAND AND WALES. 1911. FEMALES.

x.	l_x. (1)	d_x. (2)	p_x. (3)	q_x. (4)
0	100,000	11,640	·8836	·1164
1	88,360	3,313	·9625	·0375
2	85,047	1,225	·9856	·0144
3	83,822	729	·9913	·0087
4	83,093	499	·9940	·0060
5	82,594	372	·9955	·0045
6	82,222	287	·9965	·0035
7	81,935	246	·9970	·0030
8	81,689	229	·9972	·0028
9	81,460	212	·9974	·0026
10	81,248	195	·9976	·0024
11	81,053	162	·9980	·0020
12	80,891	145	·9982	·0018
13	80,746	154	·9981	·0019
14	80,592	177	·9978	·0022
15	80,415	201	·9975	·0025
16	80,214	217	·9973	·0027
17	79,997	232	·9971	·0029
18	79,765	231	·9971	·0029
19	79,534	239	·9970	·0030
20	79,295	238	·9970	·0030
21	79,057	237	·9970	·0030
22	78,820	244	·9969	·0031
23	78,576	252	·9968	·0032
24	78,324	258	·9967	·0033
25	78,066	273	·9965	·0035
26	77,793	280	·9964	·0036
27	77,513	287	·9963	·0037
28	77,226	301	·9961	·0039
29	76,925	308	·9960	·0040
30	76,617	322	·9958	·0042
31	76,295	328	·9957	·0043
32	75,967	342	·9955	·0045
33	75,625	355	·9953	·0047
34	75,270	376	·9950	·0050

SCHEDULE F—*continued.*

x.	l_x. (1)	d_x. (2)	p_x. (3)	q_x. (4)
35	74,894	397	·9947	·0053
36	74,497	410	·9945	·0055
37	74,087	430	·9942	·0058
38	73,657	449	·9939	·0061
39	73,208	469	·9936	·0064
40	72,739	487	·9933	·0067
41	72,252	513	·9929	·0071
42	71,739	531	·9926	·0074
43	71,208	555	·9922	·0078
44	70,653	580	·9918	·0082
45	70,073	609	·9913	·0087
46	69,464	632	·9909	·0091
47	68,832	668	·9903	·0097
48	68,164	695	·9898	·0102
49	67,469	742	·9890	·0110
50	66,727	781	·9883	·0117
51	65,946	818	·9876	·0124
52	65,128	860	·9868	·0132
53	64,268	906	·9859	·0141
54	63,362	963	·9848	·0152
55	62,399	1,017	·9837	·0163
56	61,382	1,074	·9825	·0175
57	60,308	1,134	·9812	·0188
58	59,174	1,201	·9797	·0203
59	57,973	1,270	·9781	·0219
60	56,703	1,327	·9766	·0234
61	55,376	1,395	·9748	·0252
62	53,981	1,474	·9727	·0273
63	52,507	1,564	·9702	·0298
64	50,943	1,666	·9673	·0327
65	49,277	1,789	·9637	·0363
66	47,488	1,900	·9600	·0400
67	45,588	1,974	·9567	·0433
68	43,614	2,015	·9538	·0462
69	41,599	2,021	·9514	·0486

SCHEDULE G.—LIVERPOOL. 1911. MALES.

x.	l_x. (1)	d_x. (2)	p_x. (3)	q_x. (4)
0	100,000	16,350	·8365	·1635
1	83,650	6,098	·9271	·0729
2	77,552	2,024	·9739	·0261
3	75,528	1,133	·9850	·0150
4	74,395	685	·9908	·0092
5	73,710	457	·9938	·0062
6	73,253	388	·9947	·0053
7	72,865	350	·9952	·0048
8	72,515	326	·9955	·0045
9	72,189	289	·9960	·0040
10	71,900	237	·9967	·0033
11	71,663	158	·9978	·0022
12	71,505	121	·9983	·0017
13	71,384	136	·9981	·0019
14	71,248	192	·9973	·0027
15	71,056	256	·9964	·0036
16	70,800	297	·9958	·0042
17	70,503	325	·9954	·0046
18	70,178	344	·9951	·0049
19	69,834	342	·9951	·0049
20	69,492	347	·9950	·0050
21	69,145	353	·9949	·0051
22	68,792	364	·9947	·0053
23	68,428	390	·9943	·0057
24	68,038	415	·9939	·0061
25	67,623	440	·9935	·0065
26	67,183	464	·9931	·0069
27	66,719	480	·9928	·0072
28	66,239	503	·9924	·0076
29	65,736	526	·9920	·0080
30	65,210	541	·9917	·0083
31	64,669	563	·9913	·0087
32	64,106	583	·9909	·0091
33	63,523	604	·9905	·0095
34	62,919	629	·9900	·0100

SCHEDULE G—*continued.*

x.	l_x. (1)	d_x. (2)	p_x. (3)	q_x. (4)
35	62,290	654	·9895	·0105
36	61,636	678	·9890	·0110
37	60,958	707	·9884	·0116
38	60,251	735	·9878	·0122
39	59,516	762	·9872	·0128
40	58,754	787	·9866	·0134
41	57,967	824	·9858	·0142
42	57,143	851	·9851	·0149
43	56,292	884	·9843	·0157
44	55,408	925	·9833	·0167
45	54,483	975	·9821	·0179
46	53,508	1,022	·9809	·0191
47	52,486	1,061	·9798	·0202
48	51,425	1,105	·9785	·0215
49	50,320	1,147	·9772	·0228
50	49,173	1,186	·9759	·0241
51	47,987	1,228	·9744	·0256
52	46,759	1,281	·9726	·0274
53	45,478	1,337	·9706	·0294
54	44,141	1,395	·9684	·0316
55	42,746	1,466	·9657	·0343
56	41,280	1,540	·9627	·0373
57	39,740	1,594	·9599	·0401
58	38,146	1,625	·9574	·0426
59	36,521	1,636	·9552	·0448
60	34,885	1,650	·9527	·0473
61	33,235	1,682	·9494	·0506
62	31,553	1,710	·9458	·0542
63	29,843	1,716	·9425	·0575
64	28,127	1,718	·9389	·0611
65	26,409	1,751	·9337	·0663
66	24,658	1,780	·9278	·0722
67	22,878	1,771	·9226	·0774
68	21,107	1,723	·9184	·0816
69	19,384	1,628	·9160	·0840

— SCHEDULE H.—LIVERPOOL. 1911. FEMALES.

x.	l_x. (1)	d_x. (2)	p_x. (3)	q_x. (4)
0	100,000	14,270	·8573	·1427
1	85,730	5,590	·9348	·0652
2	80,140	2,155	·9731	·0269
3	77,985	1,069	·9863	·0137
4	76,916	700	·9909	·0091
5	76,216	533	·9930	·0070
6	75,683	447	·9941	·0059
7	75,236	391	·9948	·0052
8	74,845	352	·9953	·0047
9	74,493	313	·9958	·0042
10	74,180	281	·9962	·0038
11	73,899	252	·9966	·0034
12	73,647	235	·9968	·0032
13	73,412	228	·9969	·0031
14	73,184	242	·9967	·0033
15	72,942	255	·9965	·0035
16	72,687	261	·9964	·0036
17	72,426	261	·9964	·0036
18	72,165	267	·9963	·0037
19	71,898	273	·9962	·0038
20	71,625	273	·9962	·0038
21	71,352	270	·9962	·0038
22	71,082	278	·9961	·0039
23	70,804	283	·9960	·0040
24	70,521	303	·9957	·0043
25	70,218	302	·9957	·0043
26	69,916	315	·9955	·0045
27	69,601	327	·9953	·0047
28	69,274	340	·9951	·0049
29	68,934	358	·9948	·0052
30	68,576	370	·9946	·0054
31	68,206	382	·9944	·0056
32	67,824	407	·9940	·0060
33	67,417	432	·9936	·0064
34	66,985	469	·9930	·0070

SCHEDULE H—*continued.*

x.	l_x. (1)	d_x. (2)	p_x. (3)	q_x. (4)
35	66,516	512	·9923	·0077
36	66,004	554	·9916	·0084
37	65,450	589	·9910	·0090
38	64,861	616	·9905	·0095
39	64,245	643	·9900	·0100
40	63,602	674	·9894	·0106
41	62,928	705	·9888	·0112
42	62,223	734	·9882	·0118
43	61,489	763	·9876	·0124
44	60,726	789	·9870	·0130
45	59,937	821	·9863	·0137
46	59,116	845	·9857	·0143
47	58,271	886	·9848	·0152
48	57,385	930	·9838	·0162
49	56,455	971	·9828	·0172
50	55,484	1,015	·9817	·0183
51	54,469	1,062	·9805	·0195
52	53,407	1,117	·9791	·0209
53	52,290	1,176	·9775	·0225
54	51,114	1,242	·9757	·0243
55	49,872	1,332	·9733	·0267
56	48,540	1,412	·9709	·0291
57	47,128	1,485	·9685	·0315
58	45,643	1,533	·9664	·0336
59	44,110	1,571	·9644	·0356
60	42,539	1,612	·9621	·0379
61	40,927	1,670	·9592	·0408
62	39,257	1,723	·9561	·0439
63	37,534	1,760	·9531	·0469
64	35,774	1,782	·9502	·0498
65	33,992	1,819	·9465	·0535
66	32,173	1,859	·9422	·0578
67	30,314	1,861	·9386	·0614
68	28,453	1,836	·9355	·0645
69	26,617	1,786	·9329	·0671

Schedule I.

Comparative Table of Analysed Rates of Mortality.

Age-group 0—1.

Males.

Cause of Death.	Number of Deaths at age 0—1.		Rate of Mortality per 10,000.		Rate of Mortality Liverpool ÷ Rate of Mortality England and Wales
	England and Wales. (1)	Liverpool. (2)	England and Wales. (3)	Liverpool. (4)	(5)
Tuberculosis . .	1,863	41	41	35	·85
Cancer . . .	13				
Other microbic diseases	9,622	302	212	259	1·22
Infantile diseases .	40,616	1,136	897	976	1·09
All other causes . .	11,760	425	260	365	1·40
All causes . . .	63,874	1,904	1,410	1,635	1·16

Females.

Tuberculosis . .	1,490	36	34	32	·94
Cancer . . .	9				
Other microbic diseases	7,393	274	170	247	1·45
Infantile diseases .	32,984	928	757	836	1·10
All other causes . .	8,850	347	203	312	1·54
All causes . . .	50,726	1,585	1,164	1,427	1·23

Schedule K.

Comparative Table of Analysed Rates of Mortality.

Age-group 1—2.

Males.

Cause of Death.	Number of Deaths at age 1—2.		Rate of Mortality per 10,000.		Rate of Mortality Liverpool ÷ Rate of Mortality England and Wales.
	England and Wales. (1)	Liverpool. (2)	England and Wales. (3)	Liverpool. (4)	(5)
Tuberculosis . .	1,422	45	35	44	1·26
Cancer . . .	10				
Other microbic diseases	4,377	173	108	171	1·58
Infantile diseases .	7,845	376	192	371	1·93
All other causes . .	2,672	145	65	143	2·20
All causes . . .	16,326	739	400	729	1·82

Females.

Tuberculosis . .	1,218	38	30	38	1·27
Cancer . . .	12	1	—	1	
Other microbic diseases	3,833	157	95	158	1·66
Infantile diseases .	7,635	331	190	334	1·76
All other causes . .	2,371	120	60	121	2·00
All causes . . .	15,069	647	375	652	1·74

Schedule L.

Comparative Table of Analysed Rates of Mortality.

Age-group 2—5.

Males.

Cause of Death.	Number of Deaths at ages 2—5.		Rate of Mortality per 10,000 (at age 3).		Rate of Mortality Liverpool ÷ Rate of Mortality England and Wales.
	England and Wales. (1)	Liverpool. (2)	England and Wales. (3)	Liverpool. (4)	(5)
Tuberculosis . .	1,520	53	11	17	1·55
Cancer . . .	41				
Other microbic diseases	2,717	118	21	37	1·76
Infantile diseases .	4,863	206	37	65	1·76
All other causes . .	2,516	97	19	31	1·63
All causes . . .	11,657	474	88	150	1·70

Females.

Tuberculosis . .	1,364	40	10	12	1·20
Cancer . . .	29				
Other microbic diseases	2,508	113	19	33	1·74
Infantile diseases .	5,234	217	41	64	1·56
All other causes . .	2,283	96	17	28	1·64
All causes . . .	11,418	466	87	137	1·57

Schedule M.

Comparative Table of Analysed Rates of Mortality.

Age-group 5—15.

Males.

Cause of Death.	Number of Deaths at ages 5—15.		Rate of Mortality per 10,000 (at age 10).		Rate of Mortality Liverpool ÷ Rate of Mortality England and Wales.
	England and Wales. (1)	Liverpool. (2)	England and Wales. (3)	Liverpool. (4)	(5)
Tuberculosis . .	1,903	64	5	7	1·40
Cancer . . .	90	3			
Other microbic diseases	1,550	64	4	7	1·75
Infantile diseases .	2,133	81	5	8	1·60
All other causes . .	4,309	114	10	11	1·10
All causes . . .	9,985	326	24	33	1·42

Females.

Tuberculosis . .	2,491	89	6	11	1·83
Cancer . . .	56	1			
Other microbic diseases	1,566	71	4	8	2·00
Infantile diseases .	2,349	60	6	7	1·17
All other causes . .	3,431	98	8	12	1·50
All causes . . .	9,893	319	24	38	1·58

Schedule N.

Comparative Table of Analysed Rates of Mortality.

Age-group 15—25.

Males.

Cause of Death.	Number of Deaths at ages 15—25.		Rate of Mortality per 10,000 (at age 20).		Rate of Mortality Liverpool ÷ Rate of Mortality England and Wales.
	England and Wales. (1)	Liverpool. (2)	England and Wales. (3)	Liverpool. (4)	(5)
Tuberculosis . .	4,053	106	13	17	1·33
Cancer . . .	155	2	1		
Other microbic diseases	1,709	67	6	11	1·83
All other causes . .	4,923	134	15	22	1·47
All causes . . .	10,840	309	35	50	1·43

Females.

Tuberculosis . .	4,437	127	13	18	1·38
Cancer . . .	119				
Other microbic diseases	1,492	50	4	7	1·75
All other causes .	3,928	93	13	13	1·00
All causes . . .	9,976	270	30	38	1·27

Schedule O.

Comparative Table of Analysed Rates of Mortality.

Age-group 25—45.

Males.

Cause of Death.	Number of Deaths at ages 25—45.		Rate of Mortality per 10,000 (at age 35).		Rate of Mortality Liverpool ÷ Rate of Mortality England and Wales.
	England and Wales. (1)	Liverpool. (2)	England and Wales. (3)	Liverpool. (4)	(5)
Tuberculosis . .	10,664	400	21	38	1·81
Cancer . . .	1,295	37	3	4	1·33
Other microbic diseases	5,712	236	11	22	2·00
All other causes . .	15,439	435	29	41	1·41
All causes . . .	33,110	1,108	64	105	1·64

Females.

Tuberculosis . .	8,463	278	15	24	1·60
Cancer . . .	2,585	58	5	5	1·00
Other microbic diseases	4,595	194	8	17	2·13
All other causes . .	13,907	365	25	31	1·24
All causes . . .	29,550	895	53	77	1·45

Schedule P.

Comparative Table of Analysed Rates of Mortality.

Age-group 45—65.

Males.

Cause of Death.	Number of Deaths at ages 45—65.		Rate of Mortality per 10,000 (at age 55).		Rate of Mortality Liverpool ÷ Rate of Mortality England and Wales.
	England and Wales. (1)	Liverpool. (2)	England and Wales. (3)	Liverpool. (4)	(5)
Tuberculosis . .	6,714	260	25	52	2·08
Cancer . . .	7,528	187	28	37	1·32
Other microbic diseases	10,322	442	38	88	2·32
All other causes . .	32,665	830	122	166	1·36
All causes . . .	57,229	1,719	213	343	1·61

Females.

Tuberculosis . .	3,639	138	12	25	2·08
Cancer . . .	9,485	205	32	38	1·19
Other microbic diseases	7,501	380	25	70	2·80
All other causes . .	28,248	730	94	134	1·43
All causes . . .	48,873	1,453	163	267	1·64

EXAMPLES OF THE MODE OF FILLING UP THE SCHEDULE.

CENSUS

OF

ENGLAND AND WALES,

1911.

SCHEDULE.

Prepared pursuant to the Census (Great Britain) Act, 1910.

THIS SPACE TO BE FILLED UP BY THE ENUMERATOR.

Number of Registration District

Number of Registration Sub-District

Number of Enumeration District

Name of Head of Family or Separate Occupier.

Postal Address

NOTICE.

This Schedule must be filled up and signed by, or on behalf of, the Head of the Family or other person in occupation, or in charge, of the dwelling (house, tenement or apartment).

If a house be let or sub-let to two or more occupiers each occupier of a part of the house must fill up a Schedule for his part of the house. Boarders are not to be considered as separate occupiers.

In the case of Hotels, Boarding Houses, Clubs, and other similar establishments, the Keeper, Manager, or other person in charge must fill up a Schedule with respect to all the inmates.

The Schedule will be called for on MONDAY, APRIL 3rd, by the appointed Enumerator; in order that he may not be delayed it must be ready with the answers written in the proper columns early on the morning of that day.

If the answers are incomplete or inaccurate, the Enumerator may ask any questions necessary to enable him to correct the Schedule.

If any person whose duty it is to give information refuses to do so, or wilfully gives false information as to any of the required particulars, he will be liable on conviction to a fine not exceeding FIVE POUNDS.

If the Head of the Family or other person responsible is unable to deliver the Schedule personally to the Enumerator, he may instruct another person to do so. If desired it may be put under cover.

The contents of the Schedule will be treated as strictly confidential.

BERNARD MALLET,
Registrar-General.

Approved by the Local Government Board,

JOHN BURNS,
President.

INSTRUCTIONS

For filling up the Columns headed "Profession or Occupation."

COLUMN 10.

1. DESCRIPTION OF PERSONAL OCCUPATION.—Describe the Occupation *fully* in Column 10. If more than one Occupation is followed, state that by which living is mainly earned.

2. DEALERS, SHOPKEEPERS OR SHOP ASSISTANTS as distinct from MAKERS, PRODUCERS OR REPAIRERS.—All such persons should be so described as to leave no doubt whether they are Dealers or Makers. In many cases "Tailors," "Bootmakers," "Hatters," "Watchmakers," "Goldsmiths," "Silversmiths," "Jewellers," "Chemists," "Bakers," "Seedsmen," "Florists," &c., and their Assistants are not Makers or Producers; in such cases the word "Dealer," "Shopkeeper," or "Shop Assistant" should be added to the occupational name. A person who both makes and deals should be described as "Maker," if chiefly Maker, or "Dealer," if chiefly Dealer.

3. OUT OF WORK.—If out of work or disengaged at the time of the Census, the usual *occupation* must be stated.

4. THE OCCUPATIONS OF WOMEN engaged in any business or profession, including women *regularly engaged in assisting relatives in trade or business*, must be fully stated. No entry should be made in the case of wives, daughters, or other female relatives wholly engaged in domestic duties at home.

5. CHILDREN AT SCHOOL AND STUDENTS.—For all persons over ten years of age attending school write "School," and for those attending colleges, evening schools, or other instructional classes, or receiving instruction privately, write "Student." If studying for any profession, state the profession, as "Law Student," "Medical Student," &c.

If attending school or other classes half time or part time only, write "School part time," or "Student part time."

If also engaged in any employment state the employment, as "School, Newsboy"; "School, Grocer's Errand Boy"; "School part time, Cotton Roving Frame Doffer."

6. RETIRED OR PENSIONED.—If retired or pensioned state the fact, and add former Occupation, as "Retired Farmer," "Retired Butcher," "Police Pensioner," &c. The *present occupation*, if any, of pensioners should also be stated in all cases, as "Army Pensioner, Bank Porter," &c.

7. PRIVATE MEANS.—For persons neither following nor having followed a profession or occupation, but deriving their income from private sources, or allowances, write "Private Means."

8. VAGUE OR INDEFINITE TERMS MUST NOT BE USED ALONE, such for example as Apprentice, Assistant, Canvasser, Collector, Contractor, Foreman, Inspector, Labourer, Machinist, Manager, Manufacturer, Mechanic, Milliard, Overlooker, Superintendent (*see also paragraphs a to r below*). Care should be taken that no occupational name common to different industries is used without a full and distinctive description; an Enameller should be described as a "Pottery Enameller," "Watch-dial Enameller," "Cycle Enameller," &c.; a Painter as a "Painter (Artist)," "Ship Painter," "House Painter," &c.; a Rivetter, as a "Boiler Rivetter," "Ship Plate Rivetter," "Boot Rivetter," &c.

(a) ARMY, NAVY, CIVIL SERVICE, MUNICIPAL SERVICE, &c. State the service and rank or grade.

(b) CLERGYMAN, PRIEST, MINISTER. State whether "Clergyman (Established Church)," "Roman Catholic Priest," "Wesleyan Methodist Minister," &c. Clergymen who are also Schoolmasters should be returned as Schoolmasters. In the case of Local or Occasional Preachers, the ordinary occupation only should be given.

(c) LEGAL PROFESSION. State whether "Barrister," "Solicitor," "Solicitor's Articled Clerk," "Law Clerk," &c.

(d) AGENT, BROKER, BUYER, MERCHANT, SALESMAN, COMMERCIAL TRAVELLER. State particular kind of business or trade, as "Cycle Agent," "Sugar Broker," "Coal Merchant," "Commercial Traveller, Millinery."

(e) CLERK. State whether "Bank Clerk," "Insurance Clerk," "Law Clerk," "Bookstall Clerk," "Hotel Clerk," "Railway Clerk," "Theatre Clerk," &c.

(f) ENGINEERING AND METAL TRADES. State precise branch of trade and nature of operation, as "Engineer's Pattern Maker," "Ship Fitter's Helper," "Iron Worker" is too indefinite; state whether employed at Blast Furnace, Puddling Furnace, Iron Foundry, &c.

(g) ENGINEMAN, ENGINE-DRIVER, STOKER, FIREMAN. State whether "Railway Engine Stoker," "Traction Engine Driver," "Stationary Engineman," "Gas Stoker," "Furnace Stoker at Pottering," &c.

(h) COTTON, WOOL, SILK OR OTHER TEXTILE OPERATIVE, DYER, BLEACHER, &c. State the material and the precise occupation, as "Bobbin Carrier in Cotton Spinning Room," "Silk Thrower's Piecer," "Plaiter in Cotton Finishing Works."

(i) MINER, QUARRYMAN. State kind of mine or quarry, and nature of work, as "Coal Miner, Hewer," "Colliery Horsekeeper (below ground)," "Colliery Lamp Examiner (above ground)," "Colliery Labourer (above ground)," "Copper-on in Ironstone Mine," "Driver in Stone Quarry," "Rockman in Slate Quarry."

(j) HOUSEWIFE, DOMESTIC SERVICE, &c. State whether employed in Cab, Omnibus, Domestic, or other service, as "Coachman (Domestic)," "Chauffeur (Domestic)," "Motor Bus Driver," "Tramway Motor Man."

(k) FARMER. State whether "Farmer," "Grazier," or "Farm Bailiff." Farmers' sons or other relatives assisting in the work of the farm should be returned as "Farmer's Son working on Farm," "Farmer's Brother working on Farm," "Farmer's Daughter, Dairy work," &c.

(l) FARM SERVANT. State nature of work, and indicate if mainly in charge of horses, cattle, &c., as "Horseman on Farm," "Waggoner on Farm," "Cowman on Farm," "Shepherd." A Labourer on a Farm whose work is of a general character should be described as "Farm Labourer," *not simply as a Labourer.*

(m) LABOURER, PORTER, &c. State nature of employment, as "Bricklayer's Labourer," "Dock Labourer," "Railway Contractor's Labourer," "Farm Labourer," "General Labourer," "Coal Porter," "Railway Porter," &c. The terms "*Labourer*," "*Porter*," should *never* be used alone.

(n) DOMESTIC SERVICE. State nature of service, as "Cook (Domestic)," "Housemaid (Domestic)," "Gardener (Domestic)," "Coachman (Domestic)," "Nursery Governess."

(o) SERVANTS, WAITERS, &c., IN HOTELS, CLUBS, RESTAURANTS AND BOARDING HOUSES. State nature of employment and service in which engaged, as "Hotel Cook," "Hall Porter at Club," "Hotel Waiter," "Restaurant Waitress."

(p) NURSE. State whether "Nurse (Domestic)," "Monthly Nurse," "Sick Nurse," &c.

(q) GARDENER. State whether "Gardener (Domestic)," "Market Gardener," "Jobbing Gardener," "Nurseryman," &c.

(r) COACHMAN, GROOM, MOTOR-CAR DRIVER. State whether employed in Cab, Omnibus, Domestic, or other service, as "Coachman (Domestic)," "Chauffeur (Domestic)," "Motor Bus Driver," "Tramway Motor Man."

COLUMN 11.

9. INDUSTRY OR SERVICE WITH WHICH CONNECTED.—The information asked for in this column is required in order to ascertain for each industry or service how many persons are employed therein, or in connection therewith, although following a distinct occupation. Thus, for instance, for breweries it is desired to know how many coopers, blacksmiths, bricklayers, &c., are in the direct employment of the brewery, as well as the numbers actually engaged in brewing processes. Further, it is desired to ascertain the number of persons directly employed by central or local government authorities, whether in administration or in undertakings such as tramways, gasworks, &c. Following are examples of cases in which entries should be made in Column 11 as well as in Column 10.

Column 10. Personal Occupation.	Column 11. Industry or Service with which worker is connected.	Column 10. Personal Occupation.	Column 11. Industry or Service with which worker is connected.	Column 10. Personal Occupation.	Column 11. Industry or Service with which worker is connected.	Column 10. Personal Occupation.	Column 11. Industry or Service with which worker is connected.
Blacksmith's Striker	Loco. Dept. Rly. Co.	Copper Roller Engraver	Calico Printer.	Housekeeper	Dyer.	Ship Fitter	Harbour Board.
Bricklayer	Blast Furnace.	Cotton Drawing Frame Tender.	Carpet Manufacture.	Iron Founder	General Engineer.	Solicitor	Insurance Company.
Cardboard Box Maker	Soap Manufacture.	Head Teacher	County Council.	Iron Founder	Stove Grate Maker.	Typefounder	Type Foundry.
Carter	General Carrier.	Hotel Manager	Railway Company.	Iron Founder	Clock Dial Maker.	Typefounder	General Printers.
Carter	Railway Company.	House Painter	Builder.	Lighterman	Chemical Works.	Wooden Box Maker	Glass Bottle Works.
Carter on Sewage Farm	Urban Dist. Council.	House Painter	Chemical Manufac.	Maltster's Labourer	Maltster.	Wood Sawyer	Joinery Works.
Clay Miner	Pottery Manufacture.	House Painter	Hotel Company.	Maltster's Labourer	Brewer.	Wood Sawyer	Pianoforte Works.
Coal Porter, Gasworks	Borough Council.			Railway Engine Driver	Brewer.	Wood Sawyer	Rly. Co.'s Carriage Wks.

CENSUS OF ENGLAND AND WALES, 1911.

Number of Schedule
(To be filled up by the Enumerator after collection.)

Before writing on this Schedule please read the Examples and the Instructions given on the other side of the paper, as well as the Headings of the Columns. The entries should be written in Ink.

The contents of the Schedule will be treated as confidential. Strict care will be taken that no information is disclosed with regard to individual persons. The returns are not to be used for proof of age, as in connection with Old Age Pensions, or for any other purpose than the preparation of Statistical Tables.

NAME and SURNAME of every Person, whether Member of Family, Visitor, Boarder, or Servant, who	RELATIONSHIP TO HEAD OF FAMILY	AGE (last Birthday) and SEX	PARTICULARS as to MARRIAGE				PROFESSION or OCCUPATION of PERSONS aged TEN YEARS and UPWARDS.				BIRTHPLACE of every Person.	NATIONALITY of every Person born in a Foreign Country.	INFIRMITY
			State, for each Married Woman entered on this Schedule, the Number of				Personal Occupation.	Industry or Service with which worker is connected.	Whether Employer, Worker on Own Account, or Working on Own Account.	Whether Working at Home.			
(1) passed the night of Sunday, April 2nd, 1911, in this dwelling and was alive at midnight, or	State whether "Head," "Wife," "Son," "Daughter," or other Relative, "Visitor," "Boarder," or "Servant."	For Infants under one year state the age in months as "under one month," etc.	Write "Single," "Married," "Widower," or "Widow," opposite the correct description of all persons aged 15 years and upwards.	Completed years the present Marriage has lasted. If less than one year, write "under one."	Children born alive to present Marriage (If no children born alive write "None" in column 7.)		The reply should show the precise branch of Profession, Trade, Manufacture, &c.	This question should generally be answered by stating the business carried on by the employer. If this is clearly shown in Col. 10 the question need not be answered here. No entry needed for Domestic Servants in private employments. If employed by a public body (Government, Municipal, etc.) state what body. (See Instruction 7 and Examples on back of Schedule.)	Write opposite the name of each person engaged in any Trade or Industry (1) "Employer" [that is employing persons other than domestic servants]. (2) "Worker" [that is working for an employer]. or (3) "Own Account" [that is neither employing others nor working for a [illegible]].	Write the words "At Home" opposite the name of each person carrying on Trade or Industry at Home.	(1) If born in the United Kingdom, write the name of the County, and Town or Parish. (2) If born in any other part of the British Empire, write the name of the Dependency, Colony, etc., and of the Province or State. (3) If born in a Foreign Country, write the name of the Country. (4) If born at sea, write "At Sea." Note.—In the case of persons born elsewhere than in England or Wales, state whether "Resident" or "Visitor" in this Country.	State whether :— (1) "British subject by parentage." (2) "Naturalised British subject, giving year of naturalisation. Or (3) If of foreign nationality, state whether "French," "German," "Russian," etc.	If any person included in this Schedule is :— (1) "Totally Deaf, or "Deaf and Dumb." (2) "Totally Blind." (3) "Lunatic." (4) "Imbecile," or "Feeble-minded," state the infirmity opposite that person's name, and the age at which he or she became afflicted.
No one else must be included. (For order of entering names see Examples on back of Schedule.)		Age last Birthday of Males.	Age last Birthday of Females.		Total Children Born Alive.	Children still Living.	Children who have Died.	(See Instructions 1 to 8 and Examples on back of Schedule.)					
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1															
2															
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11															
12															
13															
14															
15															

(To be Filled up by the Enumerator.)

I certify that :—
(1.) All the spaces on this Schedule are entered in the proper way as shown.
(2.) I have counted the males and females in Columns 3 and 4 separately, and have compared their sum with the total number of persons.
(3.) After making the necessary enquiries I have completed all entries on the Schedule which appeared to be defective, and have corrected such as appeared to be erroneous.

	Total.	
	Males.	Females.	Persons.

Initials of Enumerator

(To be filled up by, or on behalf of, the Head of the Family or other person in occupation, or in charge, of this dwelling.)

Write below the Number of Rooms in this Dwelling (House, Tenement, or Apartment). Count the Kitchen as a room but do not count scullery, landing, lobby, closet, bathroom; nor warehouse, office, shop.

I declare that this Schedule is correctly filled up to the best of my knowledge and belief.

Signature

Postal Address

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