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,

D 2

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
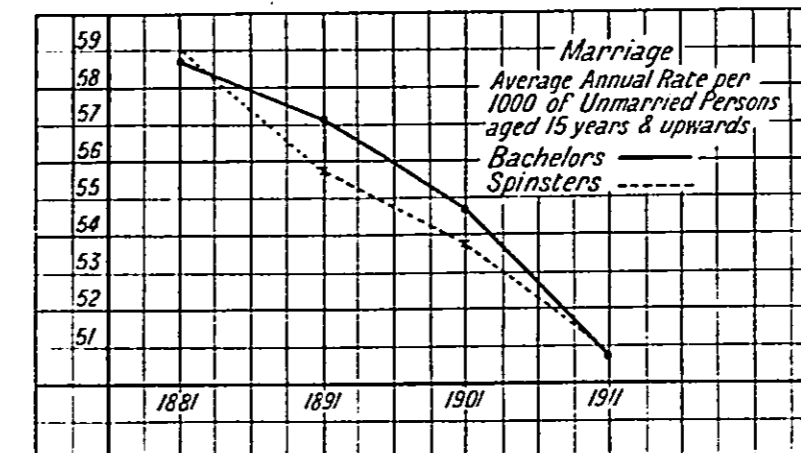

Diagram 5.

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.

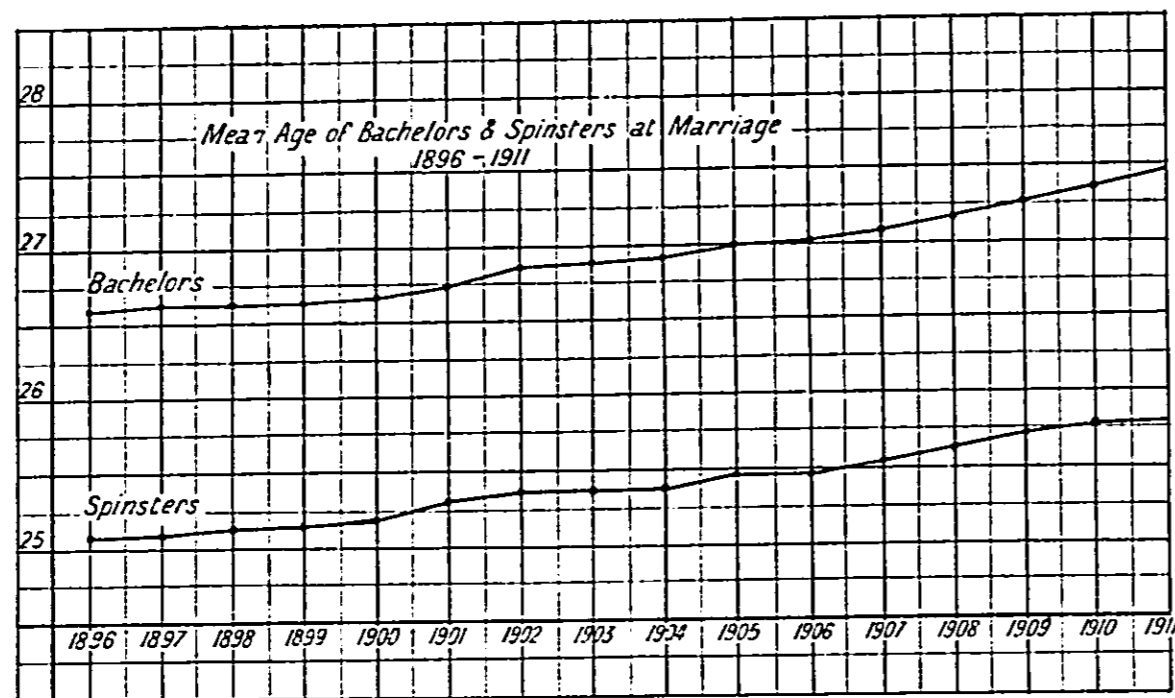| Year.	Bachelors.	Spinsters.
1896	26·59	25·08
1897	26·63	25·10
1898	26·62	25·14
1899	26·65	25·16
1900	26·68	25·23
1901	26·76	25·31
1902	26·88	25·36
1903	26·91	25·37
1904	26·93	25·37
1905	27·01	25·43
1906	27·03	25·46
1907	27·10	25·54
1908	27·19	25·63
1909	27·29	25·73
1910	27·36	25·79
1911	27·46	25·81

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
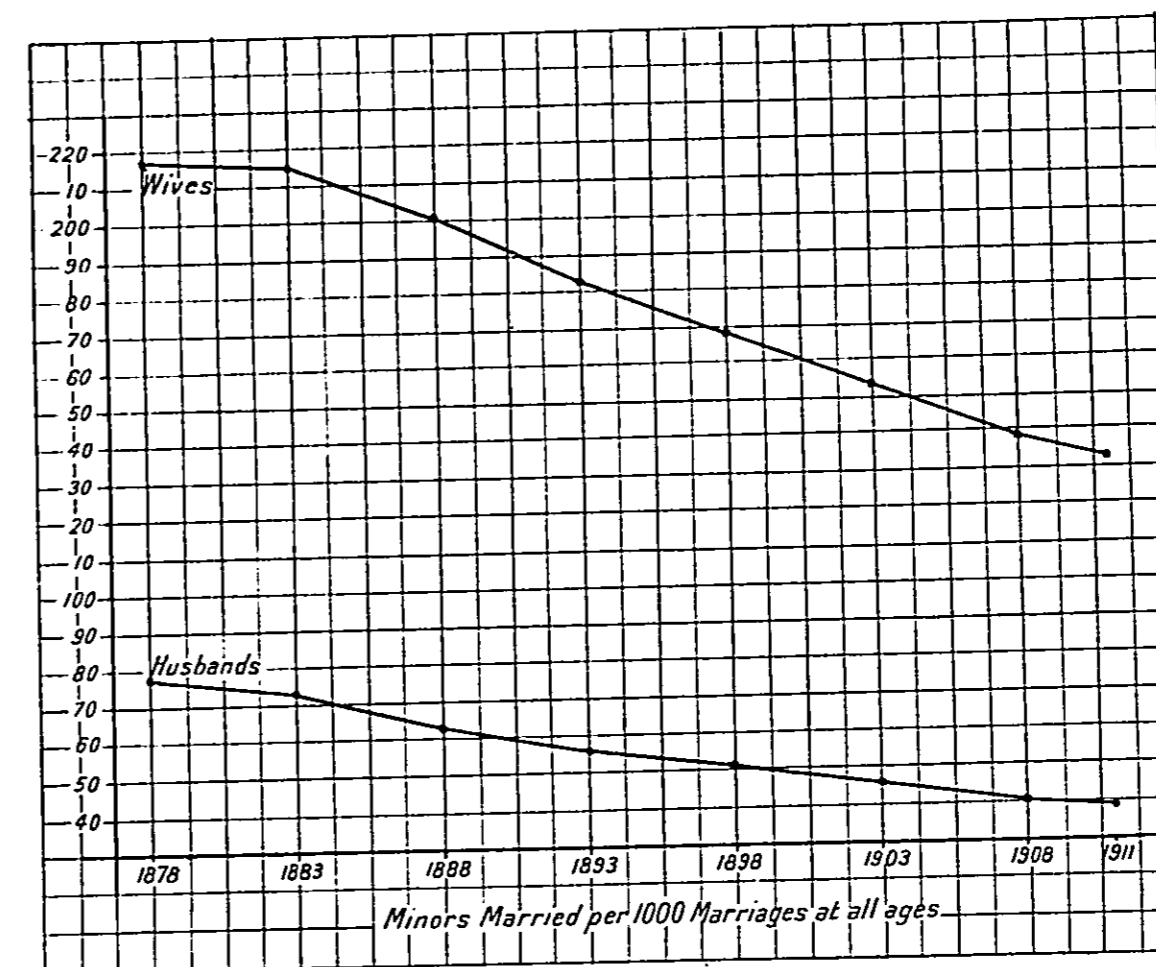
Diagram 6.

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

I. Birthrate calculated on Total Population at all ages
2. Fertility calculated on the Female Population aged 15·45 years
3. Legitimate Fertility calculated on the Married Female Population aged 15·45 years
4. Illegitimate Fertility calculated on the Unmarried & Widowed Female Population (15·45yr)

I. Rate per 1000 —
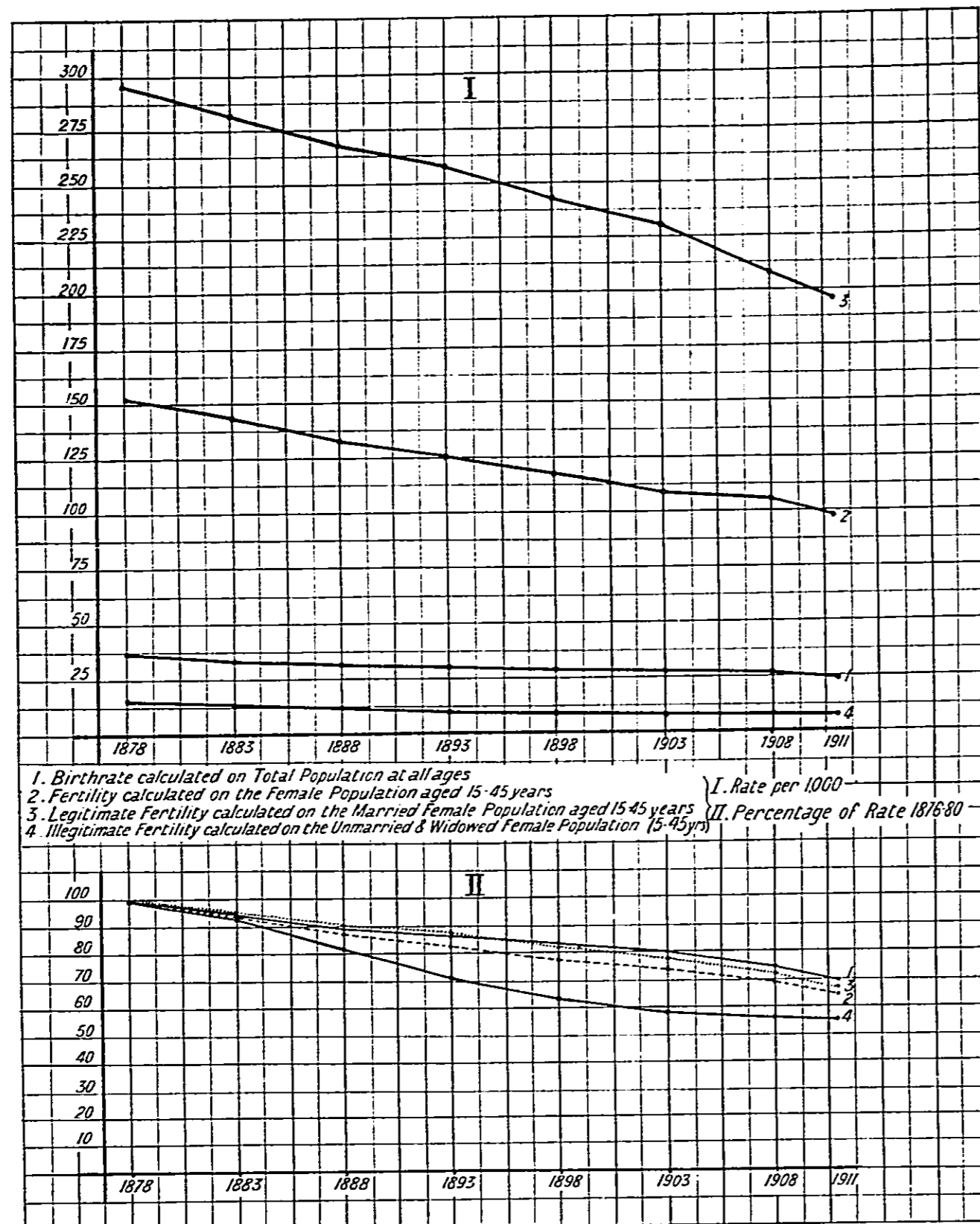II. Percentage of Rate 1876·80 —

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.

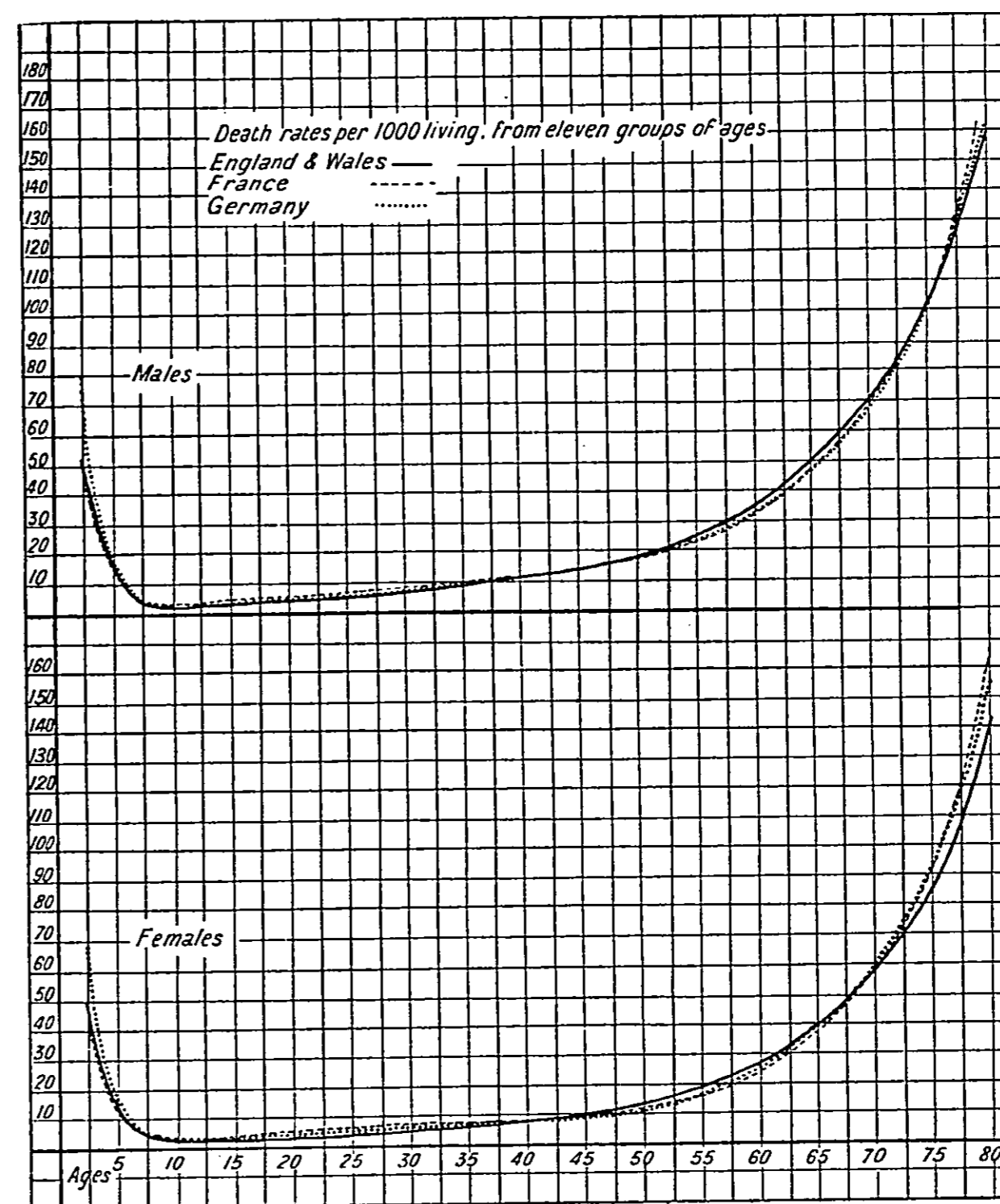higher, and between ages 35 and 45 it is 14·5 per cent. in excess.

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	18·07	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	17·09	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.

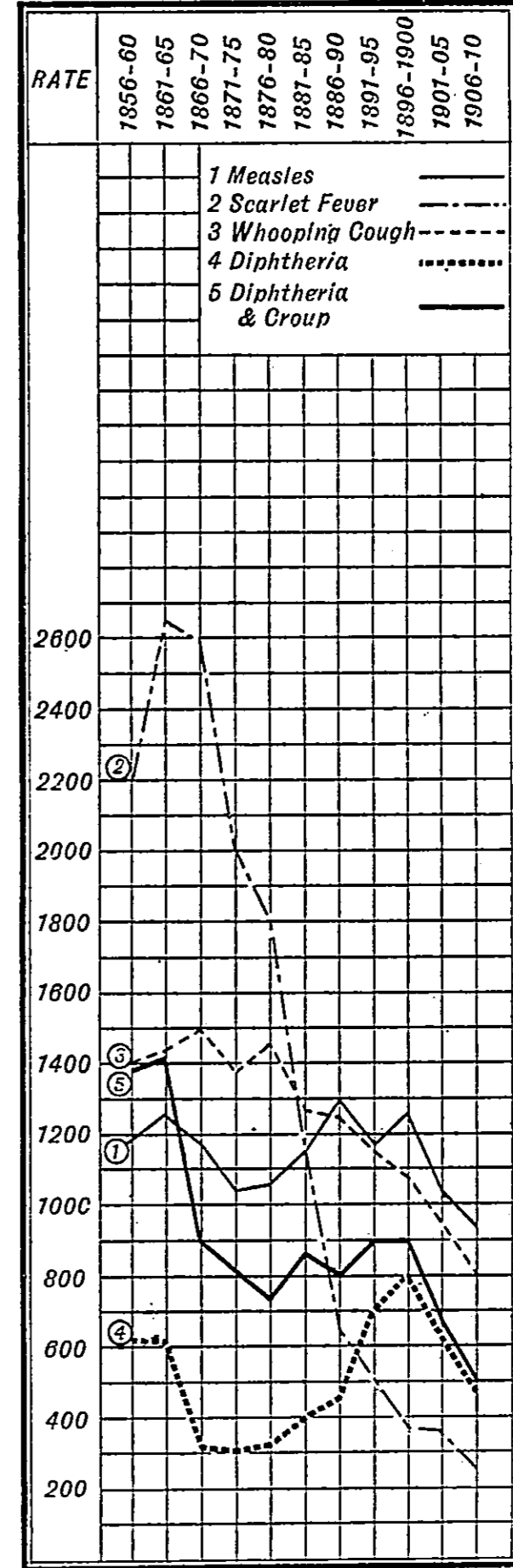AGES 0-15.
MEAN ANNUAL DEATH RATES PER MILLION LIVING.

1 Measles
2 Scarlet Fever
3 Whooping Cough
4 Diphtheria
5 Diphtheria & Croup

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