

A comparative Study of the  
Seasonal Incidence of  
Mortality in  
England etc.  
by  
E. Lewis-Fanning.

Privy Council

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A Comparative Study of the Seasonal  
Incidence of Mortality in England  
and Wales and in the United  
States of America

by

E. LEWIS FANT



LONDON  
HIS MAJESTY'S STATIONERY OFFICE

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## PREFACE

Seasonal variation of mortality has for long been a fact of common remark and a subject of speculation. When official medical statistics made it possible to measure the phenomenon, attention was mainly devoted to such questions as the influence on the death rate of abnormal cold in winter or abnormal heat in summer. Only of recent years and in a few countries have detailed data become available which relate to many diseases, cover wide areas and extend over adequate periods of time.

The present report contains a statistical analysis of data available with respect to England and Wales and to the United States of America. Consideration is also given to the figures for Germany, but this has necessarily been limited in scope owing to the fact that few of the data are published in comparable form. The broad result is that in England and Wales mortality in the winter is relatively higher and in the summer relatively lower than in the United States; but, on balance, what is lost in the winter is greater than what is gained in the summer. Indeed, when England and Wales is compared with New England alone, the summer advantage of England and Wales is reduced to about 4 per cent.

The largest contributors to the unfavourable winter balance are respiratory tuberculosis, influenza, pneumonia and bronchitis; the total excess mortality from these, in England and Wales, comes to more than 10 per cent. of the whole standardised death rate in February. In July the seasonal advantage of England and Wales depends on lower death rates attributed to diseases of the heart and to deaths from violence.

The net debit balance cannot well be due to climatic factors, considering the advantage which the insular climate of Great Britain has in its comparative freedom from the great extremes of temperature commonly experienced in continental areas such as those of Europe and North America. The explanation may more reasonably be sought in hygienic conditions. In this respect, it is to be noted that the causes of mortality which determine the unfavourable relative position in the winter are, with the possible exception of influenza, those diseases which by common consent are amenable to environmental influences and—conspicuously pneumonia and bronchitis—have long displayed great regional contrasts in mortality rates within the country.

Twenty-eight years ago, for example, in the Annual Report of the Registrar-General for 1912, the late Dr. T. H. C. Stevenson commented upon the range of mortality from pneumonia (all forms). In the county boroughs of the north of England males died at almost twice the rate experienced by males in the county boroughs of the south, and at nearly three times the rate for males in southern rural districts. "Evidently," Dr. Stevenson wrote, "pneumonia is to a

large extent a preventable disease, and the North of England has still much to learn with regard to its prevention." Again, in the Annual Report for 1925 of the Chief Medical Officer of the Ministry of Health, it is remarked that the lapse of eleven years had done little to change these relative positions. More recently there has been some slight improvement, but the mortality of the north still compares very unfavourably with that of the south. In 1937, the gross mortality from pneumonia and bronchitis in the aggregate of the northern counties (with associated county boroughs) was 29 per cent. higher than in the south-eastern division (inclusive of Greater London), and the mortality of Cheshire and Lancashire was 39.5 per cent. higher. As the Chief Medical Officer of the Ministry of Health pointed out, climate cannot be the whole explanation, for the mortality in Cumberland was much less than in Lancashire.

Hence it may be concluded that the present study contributes, from another angle, a further argument in support of the general conclusion that there is much preventable mortality in England and Wales which is not in fact prevented.

MEDICAL RESEARCH COUNCIL,  
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*18th March, 1940.*

# A COMPARATIVE STUDY OF THE SEASONAL INCIDENCE OF MORTALITY IN ENGLAND AND WALES AND IN THE UNITED STATES OF AMERICA

With a note on the data available for Germany

by

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## CONTENTS

	PAGE
I.—INTRODUCTION . . . . .	6
II.—SOURCES OF THE DATA . . . . .	8
(a) <i>England and Wales</i> . . . . .	8
(b) <i>United States of America</i> . . . . .	8
(c) <i>Germany</i> . . . . .	9
III.—STATISTICAL ANALYSIS . . . . .	11
(a) <i>Deaths</i> . . . . .	11
(b) <i>Populations</i> . . . . .	11
(c) <i>Method of analysis</i> . . . . .	12
(d) <i>Annual standardised death rates</i> . . . . .	15
(e) <i>Standardisation of monthly death rates</i> . . . . .	17
IV.—COMPARISON OF THE PRINCIPAL FEATURES OF CERTAIN DISEASES IN ENGLAND AND WALES, THE U.S.A AND NEW ENGLAND . . . . .	19
(a) <i>All causes of death</i> . . . . .	19
(b) <i>Group 1.—Diseases showing higher mortality for England         and Wales throughout the year (Winter+; Summer+).</i>	24
(c) <i>Group 2.—Diseases showing lower mortality for England         and Wales throughout the year (Winter-; Summer-).</i>	25
(d) <i>Group 3.—Diseases showing higher mortality for England         and Wales throughout the year, enhanced during the         winter (Winter++; Summer+)</i> . . . . .	30
(e) <i>Group 4.—Diseases showing lower mortality for England         and Wales throughout the year, enhanced during the         summer (Winter-; Summer--)</i> . . . . .	41
(f) <i>Group 5.—Diseases showing higher mortality for England         and Wales during the winter and lower mortality during         the summer than in the U.S.A. (Winter+; Summer-).</i>	44
V.—THE EXTENT TO WHICH INDIVIDUAL DISEASES CONTRIBUTE TO THE EXCESS OR DEFECT IN THE GENERAL MORTALITY OF ENGLAND AND WALES . . . . .	51
VI.—BRONCHITIS AND PNEUMONIA—AGE AND REGIONAL DISTRIBUTION . . . . .	60
(a) <i>England and Wales</i> . . . . .	60
(b) <i>New England</i> . . . . .	64
VII.—SUMMARY AND CONCLUSIONS . . . . .	68

## I. INTRODUCTION

The seasonal variation of mortality was explicitly mentioned in the Hippocratic writings and was frequently discussed in the pre-statistical age of modern medicine. Since the inauguration of official medical statistics by William Farr, the subject has often been the topic of official comment and, as will be seen, it is now possible to study the phenomenon in detail.

Recently, two reports of the Health Organisation of the League of Nations<sup>1</sup> contained diagrams (here reproduced as part of Diagram 1—1935–38) which aroused interest. By utilising figures which appeared in earlier publications of the same body<sup>2</sup>, the series depicted was extended to cover the years 1931 to 1938. It was shown (*a*) that while the unstandardised rate of mortality (from all causes) was higher in the large towns of England and Wales than in those of the United States of America during the winter months, it was lower in the summer; (*b*) that before 1935 the English rates were higher throughout the year than those of the large towns of Germany, but from 1935 onwards the same contrast between winter and summer appeared in this comparison as in that between England and the United States. At first sight this seemed remarkable. In spite of the frequency with which English weather receives unfavourable notice in conversation, an island climate is believed to be more equable than the continental type, and the suggestion offered itself that the apparently unfavourable winter mortality might be due to remediable conditions. That this possibility might be explored, it was necessary to undertake as complete an analysis as could be made of the constituents of the general mortality in their seasonal relations. This report contains an account of the study.

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<sup>1</sup> Weekly Epidemiological Records of the Health Section of the Secretariat, League of Nations, 17th March and 24th Nov., 1938.

<sup>2</sup> Epidemiological Reports of the Health Section of the Secretariat, League of Nations, 1931 to 1935.

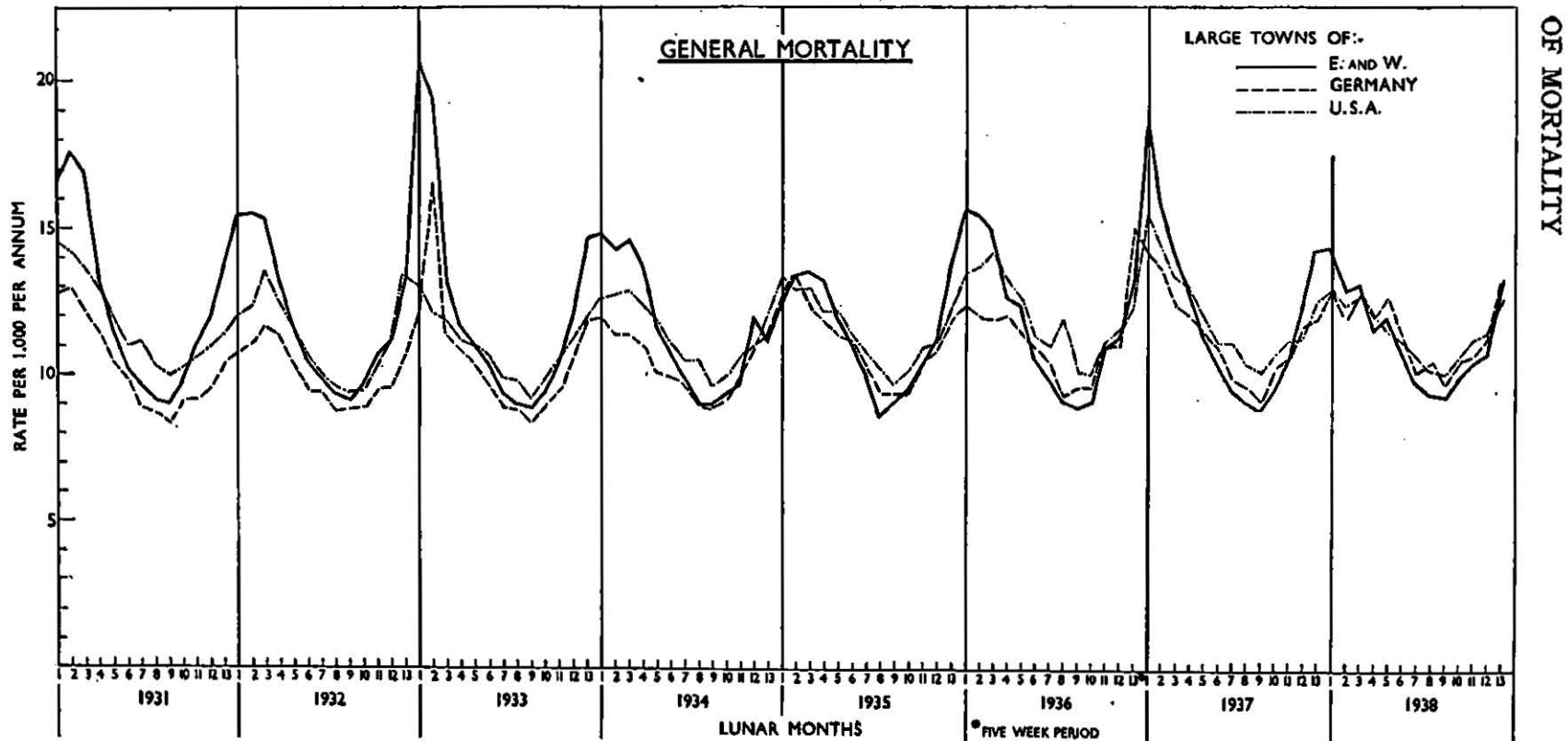


DIAGRAM 1. General mortality by four-week periods, ending approximately on the following dates in each year:—

1 : 28/I	2 : 25/II	3 : 25/III	4 : 22/IV	5 : 20/V	6 : 17/VI	7 : 15/VII
8 : 12/VIII	9 : 9/IX	10 : 7/X	11 : 4/XI	12 : 2/XII	13 : 30/XII.	



## II. SOURCES OF THE DATA

In order to diminish the effect of chance fluctuations in annual mortality, the data relating to the five years 1931 to 1935 were used for England and Wales and for Germany; but only those for the four years 1931 to 1934 were available for the United States, since at the time of computation the necessary figures for the year 1935 were not published.

## (a) ENGLAND AND WALES

For England and Wales as an entity—and only as an entity—the numbers of deaths assigned to every cause enumerated in the detailed international list of causes of death are shown by month of occurrence in the annual statistical reviews of the Registrar-General: from 1931 onwards the 1929 revision of this classification has been in use. The selection of diseases for analysis therefore depended upon the published data available in the other countries as regards the seasonal incidence of various diseases.

## (b) UNITED STATES OF AMERICA

The annual mortality statistics of the United States, published by the U.S. Department of Commerce and the Bureau of Census, provided the requisite data. Deaths, exclusive of stillbirths, are shown for important causes by months for each State, and for all the registration States combined. It may be as well to keep in mind that the whole of the United States was not included in the registration area until the year 1933, new States having been admitted from time to time since 1880 “on the basis of approximately complete registration of deaths and when the data showed that the deaths were recorded properly under adequate registration laws”. Thus in 1931, at the time of the commencement of our survey, 96·3 per cent. of the population in the continental United States were included in the registration area, whilst for the last two years, 1933 and 1934, the figures refer to the whole of the continental United States.

The American data may therefore be said to be comparable with those of England and Wales in that they refer to the whole country and include towns and both urban and rural areas. On the other hand, it may be objected that combining data relating to such vast and heterogeneous regions as compose the United States may produce a levelling effect which is not obtained in such a relatively small area as England and Wales, and may thus lessen the utility of the comparison. In order to examine the validity of this objection, and to overcome it should it prove to be of moment, an analysis was made of similar data relating only to the New England States—Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont. These States, in matters concerning population density, area, and climatic conditions, may perhaps be considered as approaching more nearly to corresponding conditions in England and Wales than other States of the federation or the registration area *in toto*.

Another objection to the comparison is that there may be an important distinction between mortality (both total and from particular causes of death) of native-born white, foreign-born white and coloured population of the United States. The published data of deaths by month of the year which distinguish colour, although available for some states, are not sufficiently complete to enable a separate analysis according to colour to be made. But if the distinction is limited to white as opposed to coloured population, then the New England analysis is hardly open to objection, for, as the following extract from the 1930 Census shows, 98·8 per cent. of the population was white.

Geographical Divisions.	All classes.	White.			Negro.	Others.
		Total.	Native.	Foreign born.		
United States .. ..	100	88·7	77·8	10·9	9·7	1·7
New England .. ..	100	98·8	76·3	22·5	1·2	0·0
Middle Atlantic .. ..	100	95·9	75·8	20·1	4·0	0·1
East North Central .. ..	100	96·0	83·2	12·7	3·7	0·3
West North Central .. ..	100	96·8	88·8	8·0	2·5	0·7
South Atlantic .. ..	100	71·9	69·9	1·9	28·0	0·1
East South Central .. ..	100	73·1	72·5	0·6	26·9	0·0
West South Central .. ..	100	74·7	73·3	1·4	18·7	6·5
Mountain .. ..	100	89·2	81·5	7·8	0·8	10·0
Pacific .. ..	100	91·5	77·4	14·2	1·1	7·4

The classification of causes of death in these American data, like that of the English, has been in accordance with the detailed international list, 1929 revision. The numbers of deaths occurring in each month, however, are not given for every heading of that list but only for certain specified causes or groups of causes, which will be found in Table 4 (p. 21).

### (c) GERMANY

Data for Germany which give the monthly deaths analysed by cause have been found only in official statistics published in the *Reichsgesundheitsblatt*. Here, month by month, are shown the numbers of deaths assigned to certain specified causes in the following areas:—

- (1) 52 large towns ;
- (2) Districts with 50,000 to 100,000 inhabitants ;
- (3) " " 30,000 to 50,000 " "
- (4) " " 15,000 to 30,000 " "
- (5) Total of divisions (1) to (4).

A total population figure is also given for each month, as the number of districts varies slightly in the consecutive returns.

Unfortunately these data possess several important defects which detract from their use for the purpose in view. One of these is that districts with less than 15,000 inhabitants are excluded.

Another is the distinction made between residents in the districts and strangers or visitors to the districts. The *total* deaths are shown separately for each group, residents and non-residents, but only the deaths of *residents* are analysed by cause. This would not have been material if a similar distinction had been made as regards the populations, but in the explanation to the tables it is stated that visitors whose residence is unknown are included in the resident population. The proportion of these to the total non-residents is not shown, and the effect of omitting the deaths occurring among them from the analysis by cause of death cannot be estimated or allowed for.

Further, there is no information as to the age and sex constitution of the population of these German districts, and, as will be shown, such knowledge is essential to a valid comparison of the mortalities of different areas. Hence only very limited use has been made of the German material.

## III. STATISTICAL ANALYSIS

## (a) DEATHS

The deaths in each of the five years, for each cause available by months, were extracted from the sources detailed above, and the monthly aggregates for the whole period obtained.

Only slight differences were found between the United States and Germany as to the particular diseases for which deaths were recorded by month of occurrence. As already observed, the English statistical publications give the monthly deaths for each individual heading in the international list, and it was, therefore, but a matter of grouping them to provide comparable figures for every item in either the German or the American lists.

## (b) POPULATIONS

*United States.*—The total estimated mid-year population figures for the areas in which the deaths occurred are recorded as follows:—

1931	..	..	..	118,157,000
1932	..	..	..	118,858,000
1933	..	..	..	125,693,000
1934	..	..	..	126,626,000
Aggregate	..	..		489,334,000
Average	..	..	..	122,333,500

The increased population in 1933 is due to the inclusion of Texas, the last State to be absorbed into the registration area, which by that act became complete.

*New England.*—The rates for the New England States were calculated by dividing the average number of deaths for the four years 1931 to 1934 by the average of the populations of the three years 1931, 1932 and 1933, since after 1933 the practice of stating the estimated mid-year population for each of the registration States was abandoned.

Estimated mid-year populations:—

	1931	1932	1933
Connecticut .. ..	1,624,000	1,634,000	1,646,000
Maine .. ..	800,000	801,000	802,000
Massachusetts .. ..	4,280,000	4,297,000	4,318,000
New Hampshire .. ..	467,000	468,000	469,000
Rhode Island .. ..	694,000	698,000	702,000
Vermont .. ..	360,000	360,000	361,000
Total .. ..	8,225,000	8,258,000	8,298,000

Three years' average = 8,260,000

As the population in the area was steadily increasing, the average used is almost certainly a little too low and the death rates for New England slightly high, but the difference involved is too small to affect the comparisons made in the analysis.

It will be observed that the mortality of the New England States, owing to the relatively large proportion of the New England population established in Massachusetts, will be greatly influenced by the mortality of that State.

*England and Wales.*—The estimated mid-year populations were :—

1931	..	..	..	39,988,000
1932	..	..	..	40,201,000
1933	..	..	..	40,350,000
1934	..	..	..	40,467,000
1935	..	..	..	40,645,000
Aggregate	..	..	..	201,651,000
Average	..	..	..	40,330,200

It was considered preferable to use these figures rather than the 1931 Census figure of 39,952,377, which would have been too low.

*Germany.*—The comparative population figures for the districts with over 15,000 inhabitants—those for which we have the deaths by cause—and for the whole of Germany are :—

	<i>Populations given for districts with over 15,000 inhabitants (average of twelve monthly estimates).</i>	<i>Germany as a whole, 1933 Census.</i>
1931	29,067,000	65,218,461 (including Saarland, 66,030,000)
1932	29,246,000	
1933	29,287,000	
1934	29,947,000	
1935	30,437,000	
Aggregate ..	148,584,000	
Average ..	29,716,800	

In the last two years under examination the Saarland districts are included.

About 45 per cent. of the population of Germany is included in the districts for study. Similar comparison of the numbers of deaths shows that, neglecting non-residents, we have only 41·7 per cent. of the total deaths, but if the non-resident deaths are included, then the proportion is increased to 46·7 per cent.

### (c) METHOD OF ANALYSIS

The results of an analysis very similar to this for the whole of England and Wales for the years 1921–25, 1926–30 and 1931–35, for a very large number of diseases, are to be found in the *Statistical Reviews*<sup>3</sup>. No comparison with other countries was there attempted, and hence in the first of these series it was sufficient to

<sup>3</sup> Registrar-General's Statistical Review of England and Wales : (1925) Text pp. 85 *et seq.*; (1931) Text pp. 100 *et seq.*; (1936) Text pp. 150 *et seq.*

express the average number of deaths per day in each month as percentages of the mean for the whole year, whilst in the subsequent analyses only the average number of deaths per day in each month is given. Thus the seasonal trend throughout the year was made evident, and also the months in which the maximum and minimum mortality occurred.

A disadvantage of this method, when one is considering the effect of the individual diseases in their relation to the total mortality, is that each disease is treated as having equal weight. In reality, a disease which shows an enormous swing from its maximum in the winter to its minimum in the summer may yet have little bearing on the appearance of the same phenomena in the total mortality, because of the almost negligible number of deaths for which it is responsible. This point becomes still more important when it is not only a question of the differences between the swings of the mortalities of different diseases in one country, but of a comparison between two or more countries in respect of these differences. An illustration is provided by taking an extreme case, that of the relation of the swing in measles to that in deaths from all causes (Table 1).

TABLE 1

*Average deaths per day in each month, expressed as percentages of the mean daily death rate for the whole year*

Month.	All causes of death.		Measles.	
	England and Wales.	United States.	England and Wales.	United States.
January .. ..	130	112	116	86
February .. ..	132	114	162	168
March .. ..	121	113	217	233
April .. ..	106	105	206	232
May .. ..	94	98	141	199
June .. ..	87	96	97	128
July .. ..	80	93	55	53
August .. ..	79	87	36	19
September .. ..	80	88	22	12
October .. ..	86	92	26	13
November .. ..	96	97	52	25
December .. ..	111	106	75	45
Whole Year .. ..	100	100	100	100

In this table are four series of percentages which show that, both in England and Wales and in the United States, the months of maximum and minimum mortality for all causes of death were respectively February and August: for measles, March and September. It also shows that for all causes the swing was greater in England than in the United States, but that for measles the contrary was true. The same features are apparent from Diagram 2, where the series are depicted graphically. Yet these series provide no information as to the influence of measles on the excess general

mortality in England in winter. To infer from the figures of this table and from the diagram that measles is not a contributory cause of our higher winter mortality would be entirely fallacious. The correct inference is simply that measles is not one of the diseases which contribute to the greater *swing of mortality* in England and Wales, which, of course, is not the same thing. That measles must be a contributory factor to the winter excess of mortality, in England and Wales as compared with the U.S.A., is obvious when one considers that the level of mortality from that disease in England is never, at any month of the year, less than twice as high as in the United States (cf. Tables 3 and 4).

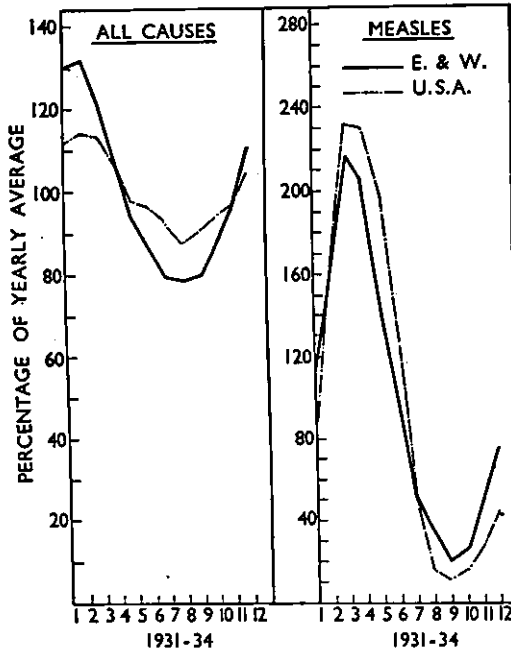


DIAGRAM 2. Monthly death rates expressed as percentages of the yearly average.

It was concluded, therefore, that to examine the swings of the various diseases merely by considering the monthly rates compared with their means was insufficient and would lead to no conclusive results. What was needed, it seemed, was the actual rates of mortality in each month of the year from each specified disease for each country under survey. From a comparison of such series of rates, it would be possible to observe which diseases contributed to the excess mortality in England in the winter and which to the relatively favourable position in summer. Such series would also show the range and the months of maximum and minimum mortality in respect of each disease.

The final stage of the analysis shows for each month of the year the amount contributed by each disease to the excess or defect in the general mortality of England and Wales as compared with the remaining countries.

*(d)* ANNUAL STANDARDISED DEATH RATES

Differences between the rates of mortality existing in two areas may be due not only to actual differences between the incidence of the disease but also to extraneous causes such as that the age and sex distribution of the populations is not the same. Comparison of the constitution of the populations shows that in the United States the population is somewhat younger than that of England and Wales, partly by reason of a relative excess of females at the older ages in the latter country: for New England the proportions at each age group are generally intermediate between those for England and for the whole of the United States.

Allowance has been made for these differences by calculating standardised rates based on the standard population of England and Wales for the year 1901. The published data enabled us to calculate such rates for each specified disease for the whole year, making correction for both age and sex as regards England and Wales and the United States and for age only as regards the New England States. In the German data no standardisation was possible since, as already remarked, no information was available regarding the age and sex distribution of the population in the districts for which the deaths are recorded. It is unlikely that the omission of correction for sex in the New England rates will invalidate the comparison of standardised rates of the particular diseases. For "all causes of death" it was found that, when only differences due to age were allowed for, the standardised rate was 9.519 per 1,000 per annum; and that when both age and sex were allowed for, it was 9.486—a difference of only 0.033 per 1,000.

By means of Table 2 the standardised and crude rates may be compared for each of the specified diseases in England and Wales, the United States and New England. It is also possible to see the effect of substituting standardised for crude rates in a comparison of the levels of mortality from these diseases in the three countries. The rates shown in the table are the average annual rates per 1,000 for the four years 1931-34 for the United States, and for the five years 1931 to 1935 for England and Wales. All sets of standardised rates are based on the 1901 standard population of England and Wales, and it should be added that the populations used in calculating the age group death rates were the aggregates of the estimated populations set out on pp. 11 and 12, distributed by age and sex in the same proportions as existed at the nearest applicable census, namely, 1930 for the U.S.A. and 1931 for England and Wales.

The table plainly shows the futility of comparing crude rates of mortality between England and Wales and the United States. Much of the difference in the levels is shown to be due not to actual differences in the incidence of the disease, but to the differences in the age constitution of the population. For example, by comparing the crude rates of mortality from all causes of death, the position of England and Wales is shown to be worse than that of the United States, but a comparison of standardised rates shows the mortality



TABLE 2  
Comparison between crude and standardised death rates for specified causes of death

	U.S.A. (1931-34).			New England (1931-34).			England and Wales (1931-35).			100 × E. & W. U.S.A.		100 × E. & W. New England.	
	Stand. rates per 1,000.	Crude rates per 1,000.	100 × Stand. Crude.	Stand. rates per 1,000.	Crude rates per 1,000.	100 × Stand. Crude.	Stand. rates per 1,000.	Crude rates per 1,000.	100 × Stand. Crude.	Stand- ardised.	Crude.	Stand- ardised.	Crude.
	Typhoid and paratyphoid fever ..	0.038	0.038	100.2	0.008	0.009	88.9	0.005	0.005	92.7	13	14	62
Measles .. .. .	0.035	0.031	112.9	0.022	0.017	129.4	0.102	0.068	149.3	289	219	464	400
Scarlet fever .. .. .	0.023	0.021	111.3	0.025	0.021	119.0	0.022	0.017	133.4	94	79	88	81
Diphtheria .. .. .	0.047	0.041	114.8	0.022	0.018	122.2	0.102	0.076	135.4	218	185	464	422
Whooping cough .. .. .	0.055	0.044	122.1	0.039	0.029	134.5	0.086	0.056	151.7	157	126	220	193
Influenza .. .. .	0.242	0.251	96.4	0.128	0.146	87.7	0.245	0.315	77.8	101	126	191	216
Dysentery .. .. .	0.023	0.022	106.6	0.004	0.004	100.0	0.003	0.003	90.7	11	13	75	75
Epidemic cerebrospinal meningitis	0.016	0.015	107.2	0.009	0.008	112.5	0.032	0.025	128.9	200	166	356	312
Erysipelas .. .. .	0.016	0.017	99.0	0.017	0.017	100.0	0.025	0.028	87.8	151	170	147	165
Encephalitis lethargica .. .. .	0.008	0.008	94.6	0.006	0.007	85.7	0.018	0.020	87.8	225	243	300	286
Tuberculosis of the respiratory system.	0.519	0.552	94.0	0.418	0.458	91.3	0.617	0.672	91.9	119	122	148	147
Other tuberculosis .. .. .	0.063	0.063	101.3	0.061	0.058	105.2	0.160	0.136	117.7	252	217	262	234
Malaria .. .. .	0.029	0.029	98.8	0.0004	0.0005	80.0	0.0005	0.0006	84.2	2	2	125	140
Diabetes .. .. .	0.192	0.215	89.4	0.205	0.282	72.7	0.107	0.155	68.6	56	72	52	55
†Cerebral haemorrhage and softening	0.672	0.779	86.2	0.677	0.956	70.8	0.472	0.726	65.1	70	93	70	76
Diseases of the heart .. .. .	1.946	2.266	85.9	2.193	3.036	72.2	1.788	2.658	67.3	92	117	81	88
Bronchitis .. .. .	0.033	0.035	94.6	0.038	0.046	82.6	0.373	0.492	75.8	1134	1415	982	1070
Pneumonia—all forms .. .. .	0.748	0.765	97.8	0.727	0.813	89.4	0.745	0.737	101.1	100	96	103	91
Diarrhoea and enteritis (all ages) ..	0.211	0.180	116.8	0.106	0.085	124.7	0.172	0.129	133.4	82	72	162	152
Nephritis .. .. .	0.738	0.854	86.4	0.650	0.890	73.0	0.280	0.395	71.0	38	46	43	44
Puerperal state .. .. .	0.114	0.108	105.1	0.097	0.094	103.2	0.064	0.065	98.8	56	60	66	69
Suicide .. .. .	0.139	0.162	85.9	0.127	0.155	81.9	0.106	0.135	78.1	76	84	84	87
Violence .. .. .	0.793	0.849	93.4	0.635	0.713	89.1	0.382	0.414	92.3	48	49	60	58
Other causes .. .. .	3.399	3.566	95.3	3.341	3.861	86.5	3.827	4.706	81.3	113	132	115	122
All causes .. .. .	10.099	10.912	92.5	9.554	11.722	81.5	9.733	12.033	80.9	96	110	102	103

Note.—In the U.S.A. and New England the standardised death rates do not include deaths occurring at unknown ages. The crude rates do include these.

† The scope of this heading is discussed on p. 27.

of the United States to be the heavier. A similar comparison between the whole of the United States and the New England States produces the same features and is evidence that New England is more like England and Wales than are the United States as a whole.

From those columns showing the standard rates expressed as percentages of the crude rates, it may be observed that the substitution of standardised rates has more effect in England and Wales than in the United States. For the diseases of older years, such as diabetes, cerebral haemorrhage, and heart diseases, the standardised rates of England and Wales are between sixty and seventy per cent. of the crude rates, in the United States between eighty and ninety per cent. For the diseases predominant in early life, the infectious diseases, the standardised rates in the United States are between 100 and 120 per cent. of the crude rates, in England between 130 and 150 per cent.

In the case of almost every disease, the index for New England lies between that of England and Wales and the United States.

The last four columns of the table show the different results obtained from a comparison between the annual mortality rates of England and Wales and the United States, and between the former and New England, according to whether standardised or crude rates are used. It may be observed, for example, that deaths classified under "diseases of the heart" produce a higher mortality rate in England than in the United States when crude rates are compared and a lower when standardised rates are compared. This is not so when England and New England are compared. Influenza, which in England is 126 per cent. of the American rate by crude figures, is only 101 per cent. by standardised figures. These and other examples which may be selected from these columns show the importance of standardisation in the method of analysis it has been decided to adopt.

Stress has been laid on this point in view of the unsuitability of the German data for treatment in the same way. There is no evidence which suggests that standardisation is any less essential in a comparison between Germany and England or Germany and America than it is between England and America. Hence, though some slight use has been made of the German data, it must be regarded rather in the light of illustration than of any attempt to show the relation of the mortality of that country to the others.

#### (e) STANDARDISATION OF MONTHLY DEATH RATES

Since it is proposed to compare the levels of mortality from specific diseases at different months of the year, it is necessary that standardised monthly death rates should be calculated. Owing to the lack of any official statistics giving a threefold tabulation of deaths by cause, age and month of occurrence, direct standardisation is precluded. To overcome the difficulty, crude monthly rates for each disease were first calculated and then corrected by multiplying them by the ratio which the standardised rate for the whole year for

the particular disease bore to the corresponding crude rate. These ratios are those given in Table 2 and have already been discussed. Thus, 80·9 per cent. of the monthly crude rates of England and Wales for all causes of death have been taken, 92·5 per cent. of those for the United States, and 81·5 per cent. of those for New England : for diabetes, 68·6 per cent. of the English monthly crude rates, 89·4 per cent. of the United States, and 72·7 per cent. of the New England rates.

Two assumptions underlie this process. The first, which may be made safely and is quite customary, is that the age and sex distribution of the population does not change greatly from one month to another throughout the year. The second is that the age and sex distribution of the deaths due to each particular disease does not change greatly from month to month.

In order to test that these assumptions were at least not so inaccurate as to invalidate the method of standardisation adopted, recourse was had to data<sup>4</sup> in which deaths recorded in the seven years, 1914 to 1920 are tabulated by cause, sex and age for the four quarters of the year. From these the actual standardised rates for particular diseases could be directly calculated for each quarter of the year. Selecting bronchitis as an example, the ratios of the standardised to the crude rates were as follows :—

*Percentage ratio of the standardised to the crude death rate*

	<i>England and Wales—(1914–1920).</i>				
	<i>1st quarter.</i>	<i>2nd quarter.</i>	<i>3rd quarter.</i>	<i>4th quarter.</i>	<i>Year.</i>
All causes of death ..	93·9	94·0	94·5	94·4	94·2
Bronchitis .. ..	90·2	89·5	88·7	88·4	89·5

If such small variation is found as regards a disease with so great a seasonal swing as bronchitis, then it is unlikely that any larger variation would be found for any other disease. Hence the assumption of a constant ratio between crude and standardised mortality throughout the year is sufficiently accurate.

<sup>4</sup> Registrar-General's Decennial Supplement (1921).

#### IV. COMPARISON OF THE PRINCIPAL FEATURES OF CERTAIN DISEASES IN ENGLAND AND WALES, THE U.S.A. AND NEW ENGLAND

The monthly standardised death rates calculated by the method which has been explained are tabulated for England and Wales, the United States and the New England States in Tables 3, 4 and 5 respectively. These Tables also give the list of diseases for which the deaths are recorded in America by month of occurrence, together with their code numbers in the international list. For each area a column has been inserted giving the average annual number of deaths, thus providing the reader with a general idea of the relative number of deaths on which the mortality rates of each disease are based. It should be noticed how close is the agreement between the monthly rates of "all causes" obtained (1) by direct standardisation, and (2) by summation of the individual disease rates calculated in the manner explained.

##### (a) ALL CAUSES OF DEATH

In all the three areas under survey, the maximum mortality occurs in February and the minimum in August. Between these two months the downward and upward trends are continuous—that is to say, the rates do not fluctuate. In England and Wales these points of maximum and minimum are 35·2 and 20·9 per million per day, a difference of 14·2. For the United States the maximum is 31·4 and the minimum 24·1, the difference here being only 7·3; whilst comparative figures for New England are 31·2 and 21·8, a difference of 9·3.

Thus, in the month when the mortality of both countries is at its peak, there occur every day in England and Wales 3·8 more deaths amongst every million persons than in the United States. This means that, if the rate of excess during the winter months were constant throughout the year, we should lose on a standard population of 40 millions at the rate of 55,480 deaths a year in excess of the United States. More strictly, we should say that in February the mortality in England and Wales is 112 per cent. of that in the United States and 113 per cent. of that in New England: in August the corresponding percentages are 87 and 96.

Diagram 3 shows graphically the monthly death rates from all causes of death in the three countries. From this it is evident that the mortality of the United States is higher than that of New England in every month of the year, that the mortality of England and Wales is in excess of that of the United States only in the first three months of the year, and in excess of the New England States only from December to April. In short, all the features of Diagram 1 which are being studied are reproduced in this diagram of the data under examination. There is the greater swing in England and Wales, with the maximum and minimum points in February and

TABLE 3

## ENGLAND AND WALES

Standardised death rates per day in each month, per million of the population

Cause of death.		Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average death rate per day throughout the year.	Recorded deaths. Average of five years.
Typhoid and paratyphoid fever ..	1, 2	0·011	0·014	0·012	0·012	0·011	0·013	0·011	0·013	0·016	0·017	0·019	0·011	0·013	213
Measles .. .. .	7	0·324	0·452	0·605	0·575	0·393	0·270	0·152	0·102	0·061	0·073	0·146	0·210	0·279	2,750
Scarlet fever .. .. .	8	0·081	0·076	0·072	0·078	0·065	0·048	0·045	0·035	0·039	0·049	0·063	0·073	0·060	667
Whooping cough .. .. .	9	0·297	0·396	0·376	0·320	0·272	0·220	0·171	0·162	0·150	0·111	0·141	0·206	0·234	2,274
Diphtheria .. .. .	10	0·372	0·366	0·299	0·271	0·234	0·210	0·214	0·215	0·241	0·272	0·291	0·382	0·280	3,046
Influenza .. .. .	11	2·241	2·174	1·274	0·679	0·315	0·168	0·085	0·075	0·102	0·187	0·303	0·544	0·670	12,693
Dysentery .. .. .	13	0·010	0·010	0·009	0·005	0·005	0·005	0·004	0·006	0·008	0·008	0·006	0·008	0·008	111
Erysipelas .. .. .	15	0·095	0·090	0·096	0·092	0·074	0·053	0·040	0·037	0·042	0·052	0·067	0·082	0·069	1,141
Encephalitis lethargica .. .. .	17	0·061	0·058	0·061	0·048	0·051	0·047	0·042	0·047	0·043	0·040	0·047	0·046	0·049	822
Epidemic cerebrospinal meningitis ..	18	0·098	0·129	0·130	0·134	0·104	0·089	0·070	0·057	0·050	0·055	0·055	0·071	0·086	988
Tuberculosis of the respiratory system	23	2·056	2·088	2·020	1·879	1·705	1·577	1·436	1·344	1·383	1·484	1·630	1·718	1·691	27,085
Other forms of tuberculosis .. .. .	24-32	0·443	0·493	0·514	0·534	0·513	0·487	0·443	0·386	0·361	0·366	0·348	0·371	0·438	5,476
Malaria .. .. .	38	0·003	0·001	0·002	0·001	0·001	0·002	0·001	0·002	0·001	0·001	0·001	0·002	0·002	23
Diabetes .. .. .	59	0·356	0·352	0·330	0·304	0·276	0·247	0·239	0·234	0·252	0·276	0·302	0·339	0·292	6,272
Cerebral haemorrhage and softening ..	†	1·516	1·531	1·496	1·369	1·252	1·186	1·098	1·052	1·099	1·172	1·321	1·460	1·294	29,278
Diseases of the heart .. .. .	90-95	6·240	6·297	5·921	5·186	4·581	4·195	3·867	3·710	3·889	4·291	4·953	5·759	4·900	107,229
Bronchitis* .. .. .	106	2·139	2·137	1·680	1·088	0·733	0·529	0·391	0·363	0·419	0·600	0·902	1·366	1·023	19,857
Pneumonia—all forms* .. .. .	107-109	3·613	3·692	3·168	2·373	1·717	1·366	1·015	0·925	1·026	1·337	1·815	2·566	2·042	29,726
Diarrhoea and enteritis (all ages)	119-120	0·457	0·436	0·448	0·409	0·405	0·425	0·447	0·544	0·635	0·555	0·460	0·454	0·473	5,223
Nephritis .. .. .	130-132	0·906	0·877	0·878	0·809	0·753	0·725	0·648	0·648	0·658	0·691	0·776	0·852	0·768	15,913
Puerperal state .. .. .	140-150	0·185	0·193	0·185	0·192	0·174	0·171	0·154	0·174	0·162	0·161	0·166	0·180	0·175	2,602
Suicide .. .. .	163-171	0·289	0·290	0·294	0·320	0·314	0·321	0·305	0·279	0·266	0·263	0·270	0·271	0·290	5,467
Violence .. .. .	172-198	1·090	1·046	1·024	0·978	0·978	1·021	1·066	1·138	1·031	0·989	1·048	1·161	1·046	16,714
Other causes .. .. .		11·871	11·983	11·567	10·787	10·208	9·820	9·460	9·400	9·442	9·785	10·398	11·210	10·485	189,813
All causes (by standardisation)		34·775	35·076	32·276	28·241	25·038	23·165	21·442	20·968	21·427	22·963	25·722	29·500	26·667	485,383
(by summation) .. .. .		34·754	35·181	32·461	28·441	25·134	23·196	21·404	20·948	21·376	22·835	25·528	29·342	26·667	
Difference .. .. .		+0·021	-0·105	-0·185	-0·200	-0·096	-0·031	+0·038	+0·020	+0·051	+0·128	+0·194	+0·158	—	—
*Bronchitis and pneumonia (combined)		5·752	5·829	4·848	3·461	2·450	1·895	1·406	1·288	1·445	1·937	2·717	3·932	3·065	—

Average annual population — 40,330,200.

† 82a, 97/1, 82b (3), 97/2 (part of)—the scope of this heading is discussed on p. 27.

TABLE 4  
 UNITED STATES OF AMERICA  
 Standardised death rates per day in each month, per million of the population

Cause of death.		Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average death rate per day throughout the year.	Recorded deaths. Average of four years.
Typhoid and paratyphoid fever ..	1, 2	0.057	0.049	0.043	0.044	0.053	0.103	0.168	0.199	0.181	0.149	0.111	0.074	0.103	4,599
Measles .. .. .	7	0.082	0.161	0.224	0.222	0.191	0.123	0.051	0.018	0.011	0.012	0.024	0.043	0.096	3,812
Scarlet fever .. .. .	8	0.089	0.096	0.100	0.091	0.080	0.051	0.028	0.022	0.028	0.048	0.069	0.073	0.063	2,567
Whooping cough .. .. .	9	0.129	0.155	0.180	0.169	0.182	0.191	0.181	0.148	0.121	0.107	0.110	0.122	0.149	5,469
Diphtheria .. .. .	10	0.169	0.130	0.104	0.077	0.062	0.056	0.056	0.073	0.136	0.231	0.247	0.203	0.129	5,004
Influenza .. .. .	11	1.535	1.447	1.373	0.853	0.418	0.195	0.117	0.121	0.160	0.256	0.437	1.074	0.662	30,677
Dysentery .. .. .	13	0.019	0.022	0.023	0.023	0.053	0.116	0.129	0.115	0.101	0.079	0.047	0.030	0.063	2,656
Erysipelas .. .. .	15	0.056	0.066	0.074	0.070	0.055	0.040	0.028	0.020	0.025	0.029	0.035	0.044	0.046	2,035
Encephalitis lethargica .. .. .	17	0.022	0.019	0.024	0.020	0.017	0.020	0.019	0.028	0.036	0.024	0.019	0.019	0.022	1,029
Epidemic cerebrospinal meningitis ..	18	0.062	0.065	0.065	0.063	0.051	0.033	0.030	0.028	0.024	0.025	0.033	0.041	0.043	1,803
Tuberculosis of the respiratory system	23	1.508	1.572	1.612	1.575	1.537	1.426	1.382	1.283	1.266	1.255	1.297	1.352	1.423	67,544
Other forms of tuberculosis .. .. .	24-32	0.168	0.183	0.190	0.201	0.194	0.197	0.185	0.166	0.154	0.153	0.147	0.148	0.174	7,667
Malaria .. .. .	38	0.029	0.021	0.024	0.031	0.038	0.076	0.112	0.135	0.167	0.162	0.103	0.046	0.079	3,562
Diabetes .. .. .	59	0.603	0.606	0.603	0.549	0.510	0.484	0.464	0.433	0.451	0.485	0.531	0.597	0.526	26,282
Cerebral haemorrhage and softening †	82a, 82c	2.026	2.088	2.057	1.938	1.847	1.758	1.682	1.527	1.601	1.748	1.833	1.994	1.840	95,330
Diseases of the heart .. .. .	90-95	6.007	6.151	6.032	5.656	5.318	4.974	4.748	4.350	4.512	4.944	5.357	5.981	5.331	277,172
Bronchitis* .. .. .	106	0.137	0.133	0.128	0.103	0.085	0.062	0.048	0.049	0.057	0.081	0.092	0.109	0.090	4,257
Pneumonia—all forms* .. .. .	107-109	3.449	3.432	3.280	2.559	1.836	1.162	0.862	0.809	0.969	1.407	2.037	2.884	2.050	93,633
Diarrhoea and enteritis (all ages) ..	119-120	0.298	0.298	0.302	0.332	0.491	0.834	0.975	0.930	0.931	0.764	0.441	0.306	0.577	22,052
Nephritis .. .. .	130-132	2.211	2.269	2.259	2.134	2.058	1.989	1.889	1.747	1.765	1.903	1.983	2.078	2.022	104,496
Puerperal state .. .. .	140-150	0.320	0.361	0.356	0.343	0.327	0.318	0.307	0.294	0.290	0.267	0.271	0.285	0.311	13,225
Suicide .. .. .	163-171	0.367	0.359	0.388	0.428	0.424	0.406	0.396	0.364	0.382	0.357	0.351	0.351	0.382	19,819
Violence .. .. .	172-198	1.987	1.996	1.906	1.924	2.034	2.387	2.690	2.307	2.181	2.151	2.226	2.265	2.172	103,917
Other causes .. .. .	9-523	9.733	9.793	9.781	9.479	9.322	9.475	9.364	8.911	8.867	8.965	9.099	9.263	9.313	436,284
All causes (by standardisation) ..	30.880	31.439	31.138	28.921	27.215	26.449	25.851	24.005	24.350	25.585	26.950	29.460	27.668	1,334,888	
(by summation) .. .. .	30.853	31.412	31.128	28.884	27.183	26.476	25.911	24.075	24.416	25.598	26.900	29.382	27.666	—	
Difference .. .. .	+0.027	+0.017	+0.010	+0.037	+0.032	-0.027	-0.060	-0.070	-0.066	-0.010	+0.050	+0.078	+0.002	—	
*Bronchitis and pneumonia (combined)		3.586	3.565	3.408	2.662	1.921	1.224	0.910	0.858	1.026	1.488	2.129	2.993	2.140	—

Average annual population — 122,339,500.

† The scope of this heading is discussed on p. 27.

TABLE 5  
NEW ENGLAND

Standardised death rates per day in each month, per million of the population

Cause of death.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average death rate per day throughout the year.	Recorded deaths. Average of four years.	
Typhoid and paratyphoid fever ..	1, 2	0.012	0.019	0.012	0.019	0.023	0.024	0.019	0.023	0.030	0.028	0.024	0.018	0.021	71
Measles .. .. .	7	0.107	0.136	0.116	0.092	0.091	0.050	0.030	0.019	0.006	0.009	0.023	0.045	0.060	140
Scarlet fever .. .. .	8	0.108	0.118	0.096	0.113	0.096	0.042	0.031	0.039	0.023	0.033	0.062	0.060	0.068	173
Whooping cough .. .. .	9	0.125	0.125	0.135	0.141	0.112	0.097	0.098	0.105	0.093	0.078	0.078	0.105	0.108	240
Diphtheria .. .. .	10	0.083	0.078	0.055	0.065	0.045	0.056	0.057	0.029	0.033	0.060	0.095	0.075	0.061	150
Influenza .. .. .	11	1.053	0.972	0.683	0.413	0.210	0.106	0.062	0.054	0.068	0.138	0.182	0.310	0.351	1,207
Dysentery .. .. .	13	0.005	0.003	0.005	0.005	0.009	0.004	0.010	0.021	0.023	0.010	0.012	0.009	0.010	29
Erysipelas .. .. .	15	0.056	0.092	0.088	0.081	0.067	0.049	0.030	0.016	0.018	0.015	0.035	0.032	0.048	144
Encephalitis lethargica .. .. .	17	0.023	0.015	0.019	0.023	0.015	0.011	0.015	0.017	0.011	0.009	0.015	0.012	0.015	55
Epidemic cerebrospinal meningitis ..	18	0.029	0.028	0.019	0.026	0.034	0.023	0.024	0.016	0.025	0.020	0.021	0.025	0.024	65
Tuberculosis of the respiratory system ..	23	1.285	1.244	1.351	1.270	1.284	1.117	1.079	1.029	0.975	0.995	1.050	1.066	1.145	3,781
Other forms of tuberculosis .. .. .	24-32	0.153	0.183	0.201	0.215	0.180	0.181	0.174	0.141	0.140	0.151	0.164	0.138	0.168	481
Malaria .. .. .	38	0.001	0.001	0.001	—	0.001	0.002	0.002	0.002	0.001	0.002	0.001	—	0.001	4
Diabetes .. .. .	59	0.666	0.667	0.637	0.579	0.591	0.499	0.514	0.475	0.488	0.500	0.529	0.597	0.561	2,326
Cerebral haemorrhage and softening† ..	82a, 82c	2.120	2.149	2.040	1.944	1.801	1.709	1.524	1.568	1.648	1.796	1.835	2.045	1.855	7,899
Diseases of the heart .. .. .	90-95	7.074	7.281	6.885	6.419	5.926	5.365	5.011	4.725	5.011	5.757	5.967	6.716	6.005	25,074
Bronchitis* .. .. .	106	0.182	0.168	0.140	0.145	0.102	0.071	0.045	0.053	0.050	0.088	0.096	0.116	0.104	380
Pneumonia—all forms* .. .. .	107-109	3.586	3.598	3.077	2.661	1.909	1.185	0.827	0.717	0.830	1.367	1.850	2.369	1.990	6,712
Diarrhoea and enteritis (all ages) ..	119-120	0.232	0.229	0.274	0.229	0.249	0.231	0.319	0.412	0.488	0.353	0.241	0.233	0.291	703
Nephritis .. .. .	130-132	1.953	2.035	2.059	1.935	1.837	1.633	1.520	1.458	1.572	1.722	1.818	1.828	1.779	7,348
Puerperal state .. .. .	140-150	0.285	0.330	0.300	0.294	0.283	0.245	0.277	0.251	0.245	0.371	0.361	0.325	0.296	1,280
Suicide .. .. .	163-171	0.313	0.263	0.362	0.433	0.393	0.347	0.373	0.329	0.371	1.794	1.850	1.909	1.741	5,893
Violence .. .. .	172-198	1.631	1.582	1.490	1.516	1.670	1.757	2.002	1.851	1.831	1.794	1.850	1.909	1.741	5,893
Other causes .. .. .	9.717	9.862	9.647	9.516	9.139	9.179	8.634	8.493	8.659	8.905	8.929	9.178	9.150	31,890	
All causes (by standardisation) ..	30.756	31.147	29.677	28.104	26.174	23.982	22.621	21.774	22.608	24.510	25.532	27.533	26.174	96,822	
(by summation) .. .. .	30.799	31.178	29.692	28.134	26.167	23.978	22.677	21.843	22.639	24.423	25.456	27.396	26.169	—	
Difference .. .. .	-0.043	-0.031	-0.015	-0.030	+0.007	+0.004	-0.056	-0.069	-0.031	+0.087	+0.076	+0.137	+0.005	—	
*Bronchitis and pneumonia (combined)	3.768	3.766	3.217	2.806	2.011	1.256	0.872	0.770	0.880	1.475	1.946	2.485	2.094	—	

Average annual population — 8,260,000.

† The scope of this heading is discussed on p. 27.

August—the only difference lying in the fact that, by taking an average of deaths over four or five years, the curve is smoother owing to the annual fluctuations being ruled out.

The answer to the question as to whether the New England States alone would compare more favourably with England and Wales than the United States as a whole is in the affirmative. The swing for the larger group is much the less, showing that the inclusion of such wide varieties of climate, race and other factors does produce a flattening effect on the range of mortality.

The figures relating to the German mortality also show the months of maximum and minimum to be February and August, and the range of the monthly rates in Germany to be about the same as in New England.

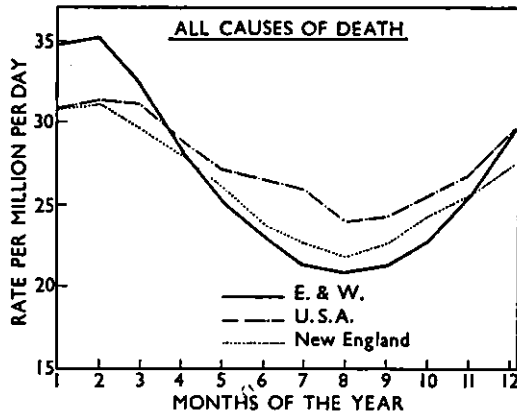


DIAGRAM 3. Standardised death rates per day in each month per million of the population (based on the five years 1931–35 for England and Wales, and on the four years 1931–34 for the United States).

The next point is to show to which causes of death the greater swing of England and Wales is due. Graphical comparison of the seasonal trends in the three countries for each of the specified diseases was made in the same manner as for all causes of death in Diagram 3. A selection of these, illustrating the different types of relationship which exist, is given in Diagrams 4 to 13.

In studying these comparisons it must always be kept in mind that, besides differences in the actual incidence of the diseases, other influences may be at work to enlarge or mitigate such differences. For some of these correction can be made, as by the use of standardised rates in correcting for differences between the populations in respect of age and sex constitution, but there is one important factor for which there can be no such allowance—*viz.*, what may be termed diversity of book-keeping methods. First, there probably exists diversity of practice between the medical professions of the two countries in assigning deaths to appropriate causes, and, following that, the rules set out for the selection of one from two or more jointly stated causes of death differ in the



two countries. For example, if measles and tuberculosis should jointly appear, then in England measles has preference<sup>5</sup>, but in America<sup>6</sup> tuberculosis.

From a study of Tables 3, 4 and 5, it will be found that, contrary to what might have been expected, there are not many individual causes of death in which the features of the total mortality relationships are reproduced, thus accounting for them. Only two causes of death, influenza and diseases of the heart, can be said to show, by reason of the greater downward swing of the English rates, both higher mortality in the winter and lower mortality in the summer in England and Wales than in the United States. And even in regard to these two diseases, the double phenomenon only exists when the comparison is between England and Wales and the whole of the States. Furthermore, in these two cases it is only in the months of January and February that the English mortality is in excess.

How then *does* this peculiarity found in the relation between the total mortality of the two countries arise?

After a close examination of the data, it appeared that the diseases could be grouped according to the similarity or dissimilarity of the seasonal trends in the two countries, and according to the relative levels of mortality. Five distinct groups could be readily identified.

(b) GROUP 1. DISEASES SHOWING HIGHER MORTALITY FOR ENGLAND AND WALES THROUGHOUT THE YEAR

(Winter +; Summer +)

In the first group may be placed those diseases in which the rate of mortality is higher in England than in the United States in every month of the year, where the trend is generally downward from winter to summer in both countries, but where there is no excessive upward swing of the winter rates in England. Thus the ratio of the rates of the two countries is roughly constant throughout the year and results in a belt of excess mortality for England of a fairly stable amount. This group may be termed (Winter +; Summer +), and includes diphtheria, erysipelas, encephalitis lethargica and non-respiratory tuberculosis. When only the New England States are compared with England, diarrhoea and enteritis (all ages) may also be included in this group, since, under that heading, there is fairly constant excess for England although the swing is upward during the summer months. Probably the seasonal trends for diphtheria, which are depicted in Diagram 4, show most clearly the features of the mortality of this group. It is true that all the criteria are not fulfilled in each case, that for example the steeper rise of the American rates from diphtheria in autumn alters the relation between the rates in that season, that encephalitis lethargica shows a somewhat

<sup>5</sup> Manual of the international list of causes of death as adapted for use in England and Wales. H.M. Stationery Office, London, 1931.

<sup>6</sup> Manual of Joint Causes of death. U.S.A. Dept. of Commerce. Govt. Printing Office, Washington, 1933.

similar departure, and that the peak of non-respiratory tuberculosis occurs not in the winter but in the spring ; but as a group they do provide this belt of excess for England, neither particularly accentuated in winter nor notably diminished in summer.

The figures on p. 26 for group 1, abstracted from Tables 3, 4 and 5, show that the range of the rates for each of these diseases is of about the same order in each country although the level of the mortality is always highest in England. For non-respiratory tuberculosis the range is somewhat greater in England, but, as will appear later, not so excessive that the disease would fall into the group with excessive winter mortality.

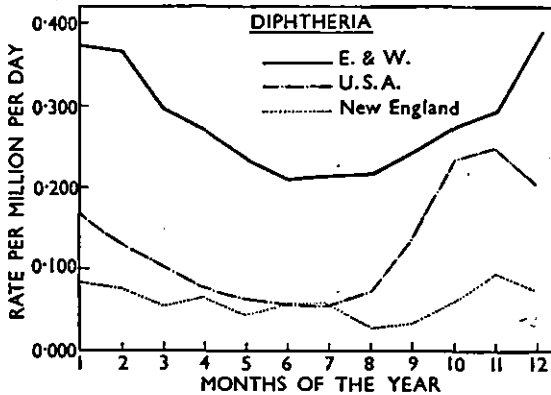


DIAGRAM 4, illustrating Group 1 (Winter + ; Summer +). Standardised death rates per day in each month per million of the population (based on the five years 1931-35 for England and Wales, and on the four years 1931-34 for the United States).

(c) GROUP 2. DISEASES SHOWING LOWER MORTALITY FOR ENGLAND AND WALES THROUGHOUT THE YEAR  
(Winter - ; Summer -)

In opposition to this belt of excess mortality, there is another group of diseases where, although the swing is generally again downward from winter to summer, the American rates are consistently in excess of the English. This group may be called (Winter - ; Summer -), and includes diabetes, cerebral haemorrhage, nephritis, puerperal causes, and, since it provides constant advantage to England but not on account of its seasonal trend, suicide. Again there is an addition to the list when only the New England States are compared, for then diseases of the heart must be included. Except for suicide, all in this group show a very regular swing in both countries and the relation between the rates is roughly constant throughout the year to the advantage of England, giving a belt of lower mortality which, as will be shown later, is far in excess of the belt of higher mortality provided by group 1. These features are illustrated by Diagram 5, which shows the monthly rates for diabetes in each country.

GROUP 1.—Diseases showing higher mortality for England and Wales throughout the year

Group 1 Diseases (+ ; +).	England and Wales.			United States.			New England.		
	Maximum.	Minimum.	Differ- ence.	Maximum.	Minimum.	Differ- ence.	Maximum.	Minimum.	Differ- ence.
Diphtheria .. .. .	0·382 Dec.	0·210 June	0·172	0·247 Nov.	0·056 June	0·191	0·095 Nov.	0·029 Aug.	0·066
Erysipelas .. .. .	0·096 Mar.	0·037 Aug.	0·069	0·074 Mar.	0·020 Aug.	0·054	0·092 Feb.	0·016 Aug.	0·076
Encephalitis lethargica .. .. .	0·061 Mar.	0·040 Oct.	0·021	0·036 Sept.	0·017 May	0·017	0·023 Apr.	0·009 Oct.	0·014
Non-respiratory tuberculosis .. .. .	0·534 Apr.	0·348 Nov.	0·186	0·201 Apr.	0·147 Nov.	0·054	0·215 Apr.	0·138 Dec.	0·077
Diarrhoea and enteritis .. .. .	0·635 Sept.	0·405 May	0·230	—	—	—	0·488 Sept.	0·229 Apr.	0·259

GROUP 2.—Diseases showing lower mortality for England and Wales throughout the year

Group 2 Diseases (- ; -).	England and Wales.			United States.			New England.		
	Maximum.	Minimum.	Differ- ence.	Maximum.	Minimum.	Differ- ence.	Maximum.	Minimum.	Differ- ence.
Diabetes .. .. .	0·356 Jan.	0·234 Aug.	0·122	0·606 Feb.	0·433 Aug.	0·173	0·667 Feb.	0·475 Aug.	0·192
Cerebral haemorrhage .. .. .	1·531 Feb.	1·052 Aug.	0·479	2·088 Feb.	1·527 Aug.	0·561	2·149 Feb.	1·524 July	0·625
Nephritis .. .. .	0·906 Jan.	0·648 July	0·258	2·269 Feb.	1·747 Aug.	0·522	2·059 Mar.	1·458 Aug.	0·601
Puerperal state .. .. .	0·193 Feb.	0·154 July	0·039	0·361 Feb.	0·267 Oct.	0·094	0·330 Feb.	0·212 Oct.	0·118
Suicide .. .. .	0·321 June	0·263 Oct.	0·058	0·428 Apr.	0·351 Nov.	0·077	0·433 Apr.	0·325 Nov.	0·108
Diseases of the heart .. .. .	6·297 Feb.	3·710 Aug.	2·587	—	—	—	7·281 Feb.	4·725 Aug.	2·556

The figures on p. 26 for group 2, abstracted from Tables 3, 4 and 5, summarise the features peculiar to this group. For each disease (except diseases of the heart) the difference between the maximum and minimum mortality is greatest in New England and least in England and Wales. At every point the English figure is well below that for America, and in fact except for cerebral haemorrhage, nephritis and diseases of the heart the English maximum is less than the minimum found in the other two areas. It may be as well, however, to draw attention to certain details in regard to each disease.

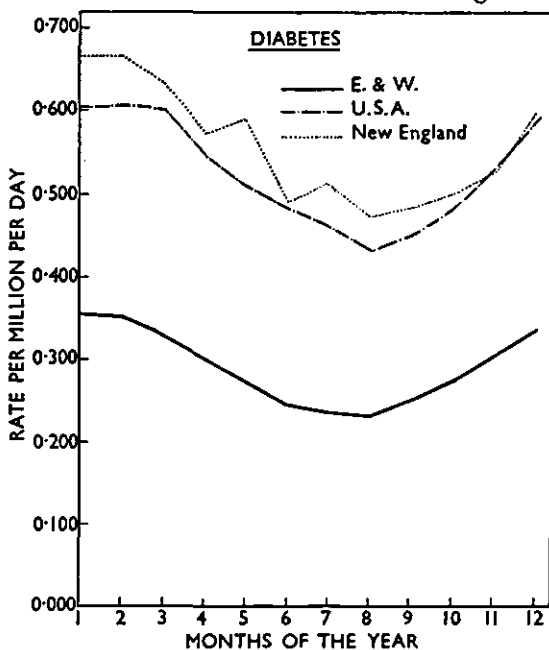


DIAGRAM 5, illustrating Group 2 (Winter — ; Summer —). Standardised death rates per day in each month per million of the population (based on the five years 1931–35 for England and Wales, and on the four years 1931–34 for the United States).

*Diabetes.*—This is the only one of the general diseases which has a place in our list. The tables and Diagram 5 show that the mortality in England is little more than one half that in the United States. The comparative averages for the year are:—England and Wales 0.292 per million per day; United States 0.526; and New England 0.561.

*Cerebral haemorrhage and softening.*—For the American data the deaths included under this heading are assigned to code numbers 82a and 82c of the international list, which correspond to 82a and 82b(3) in the list as adopted by the Registrar-General for England and Wales. Of deaths due to diseases of the nervous system, these are the only ones tabulated by month of occurrence in the American material. Dr. Stocks<sup>7</sup> has drawn attention to the fact that in the United States, deaths from cerebral haemorrhage associated with

<sup>7</sup> Stocks, P. (1933). In *Arteriosclerosis*. Edited by E. V. Cowdry. Pp. 220–225. New York.

*arteriosclerosis* are included under 82a and similarly deaths from cerebral softening *with mention of arteriosclerosis* under their 82c (our 82b(3)), whereas in England and Wales there are special sub-headings for these. Deaths from arteriosclerosis with cerebral haemorrhage are in England tabulated under 97(1), whereas deaths from arteriosclerosis with record of other cerebral vascular lesion are allocated to 97(2). From a table of secondary causes Dr. Stocks has estimated that 30 per cent. of the deaths in 97(2) are cerebral softening or apoplexy with mention of arteriosclerosis (the remainder being thrombosis, hemiplegia, etc., with arteriosclerosis).

It is evident therefore that, given the deaths in the United States in groups 82a and 82c (cerebral haemorrhage—with and without arteriosclerosis), no true comparison of these with deaths in England and Wales can be made except as against the summation of the deaths in the four groups—

82a—cerebral haemorrhage (including apoplexy) ;

82b(3)—cerebral softening ;

97(1)—arteriosclerosis with cerebral haemorrhage ;

97(2)—30 per cent. of these deaths—arteriosclerosis with record of other cerebral lesion.

This is the basis of comparison which has been used throughout the tables in this report, and it is found that in England and Wales the level of mortality from cerebral haemorrhage and softening is thus 1·294 deaths per million per day, in the United States 1·840 and in the New England States 1·855.

*Nephritis*.—Similarly, the advantage to England provided by the difference between the mortality from nephritis in this country and in the States may be to a large extent a matter of book-keeping ; for, as has been stated in a recent publication,<sup>8</sup> the death rate of no other disease has been so greatly affected in England and Wales by changes of opinion and practice in assigning deaths to this cause. And if that is true within the limits of one country, the effect is likely to be much greater when a comparison of the rates of different countries is being attempted.

*The puerperal state*.—The question as to whether death rates from puerperal causes should be based on the number of live births, the female population of child-bearing age, the total female population or even the total population, must depend on the use to which the rates, when calculated, are put. In this analysis the relation is being studied between the mortality from puerperal causes and the total mortality. The basis must therefore be the same as the general mortality, namely the total male and female population. On this basis the average levels of mortality are :—

England and Wales	..	..	0·175	per million per day.
United States	..	..	0·311	" " " "
New England	..	..	0·265	" " " "

<sup>8</sup> Greenwood, M. and Russell, W. T. (1938). Bright's disease, nephritis and arterio-sclerosis. A contribution to the history of medical statistics. *Biometrika*, 29, 249.

The same relationship between the countries is obtained when the mortality from puerperal causes is expressed per 1,000 births (either live births only, or live and still births combined). The figures are then:—

	<i>Puerperal deaths per diem.</i>	
	(a) <i>Per 1,000 live births only.</i>	(b) <i>Per 1,000 live and still births.</i>
England and Wales .. .. .	0·012	0·011
United States .. .. .	0·017	0·017
New England .. .. .	0·016	0·016

In this country there is practically no seasonal variation in the mortality from puerperal causes, though in the years under survey July appears as the most favourable month. But in the United States and New England, there is a decided fall in the trend from February, a peak month, to October.

Dr. Tandy<sup>9</sup> showed that the American deaths assigned to the puerperal state would be reduced by 15 per cent. if assignment were carried out as in England and Wales. This is due to the assignment of many of our deaths to other causes associated with pregnancy (tabulated separately in the text of the *Statistical Reviews*) where the United States would give preference to the maternal cause. This correction would modify, but not eliminate the difference between the rates of the two countries—*e.g.*, in Table 2 the ratio of the English crude rates to those of the United States would be changed only from 60 to 70 per cent. and, to quote from Dr. Tandy's conclusions, "differences in methods of assignment are insufficient to explain the high maternal mortality rate of the United States as compared with foreign countries".

*Suicide.*—A peculiarly low rate for New England for the month of February causes the graphs of England and Wales and New England to cross. This low rate probably arises by chance and should not preclude the inclusion of suicide in this group. In both England and Wales and the United States the rates seem to be higher in the second quarter of the year, but apart from this there is no seasonal trend.

*Diseases of the heart.*—In the comparison between England and Wales and the whole of the United States, deaths from this cause fall into another group (group 5), but Diagram 12 shows that as between the former and New England the two curves are almost parallel, New England being in excess throughout the year.

It may be said, therefore, that the diseases of group 2 have no bearing on the relatively high winter mortality of England but do have some influence on the low summer mortality. Thus far, if

<sup>9</sup> Tandy, E. C. (1935). Comparability of maternal mortality rates in the United States and certain foreign countries. *U.S. Dep. Lab. Child. Bur. Publ. No. 229.*

the general mortality consisted of these two groups only, the curves for the two countries would be roughly parallel with a downward swing from winter to summer, England and Wales being the lower throughout the year.

(d) GROUP 3. DISEASES SHOWING HIGHER MORTALITY FOR ENGLAND AND WALES THROUGHOUT THE YEAR, ENHANCED DURING THE WINTER  
(Winter ++ ; Summer +)

The first group is, however, reinforced by another set of diseases also providing continuous excess of English over American mortality, but in which the upward swing of the winter rates attains peaks for England of much greater proportion than those reached in the States. This group may be designated (Winter ++ ; Summer +). It comprises measles, whooping cough (although for this the American rates show an upward summer trend), epidemic cerebrospinal meningitis, respiratory tuberculosis, and bronchitis and pneumonia when in combination. Diagrams 6 and 9, showing the monthly death rates for respiratory tuberculosis and for bronchitis and pneumonia, illustrate the features of group 3. Influenza (Diagram 11) should be included in this group only if the comparison is between England and New England, but the aggregate of unspecified diseases must be added to the list in both comparisons. To the enormous upward swing of the rates of each individual member of this group, the excessive winter mortality of England is undoubtedly due ; but whilst each member of the group also provides a slight excess in the summer, this, as will be proved later, is not sufficient to neutralise entirely the advantage provided by group 2.

The maximum and minimum points are given on p. 31, and it will be observed how much greater is the range for each disease of this group in England than in the United States. These figures also show how much greater is the English excess at the winter maxima than at the summer minima.

Attention is drawn to the following points :—

*Whooping cough.*—The figures reveal striking dissimilarities in the seasonal trends of mortality. It is true that in all three areas the incidence of the disease is at a minimum in October, but here the similarity ends. In England the rise is very rapid, the peak being attained in February—only four months after the minimum. In the United States as a whole, the rise is much more gradual and the maximum is not reached until June. In New England the peak occurs in April. But it is in the enormous upward swing of the English mortality in the winter months that the greatest disparity occurs.

*Tuberculosis of the respiratory system.*—The well-known swing of mortality from this disease, so clearly depicted in Diagram 6, is of such importance that it may be of some interest to consider what proportion of the annual death rate occurs in each month. This is shown in Table 6 and, since these figures are unaffected by standardisation, those referring to Germany are also included.

GROUP 3.—Diseases showing higher mortality for England and Wales throughout the year,  
enhanced during the winter

Group 3 Diseases (+ + ; +).	England and Wales.			United States.			New England.		
	Maximum.	Minimum.	Differ- ence.	Maximum.	Minimum.	Differ- ence.	Maximum.	Minimum.	Differ- ence.
Measles .. .. .	0·605 Mar.	0·061 Sept.	0·544	0·224 Mar.	0·011 Sept.	0·213	0·136 Feb.	0·006 Sept.	0·130
Whooping cough .. ..	0·396 Feb.	0·111 Oct.	0·285	0·191 June	0·107 Oct.	0·084	0·141 Apr.	0·078 Oct.	0·063
Epidemic cerebrospinal meningitis	0·134 Apr.	0·050 Sept.	0·084	0·065 Mar.	0·024 Sept.	0·041	0·034 May	0·016 Aug.	0·018
Respiratory tuberculosis ..	2·088 Feb.	1·344 Aug.	0·744	1·612 Mar.	1·255 Oct.	0·357	1·351 Mar.	0·975 Sept.	0·376
Bronchitis and pneumonia ..	5·829 Feb.	1·288 Aug.	4·541	3·586 Jan.	0·858 Aug.	2·728	3·768 Jan.	0·770 Aug.	2·998
Other causes .. .. .	11·983 Feb.	9·400 Aug.	2·583	9·781 Mar.	8·867 Sept.	0·914	9·862 Feb.	8·493 Aug.	1·369
Influenza .. .. .	2·241 Jan.	0·075 Aug.	2·166	—	—	—	1·053 Jan.	0·054 Aug.	0·999



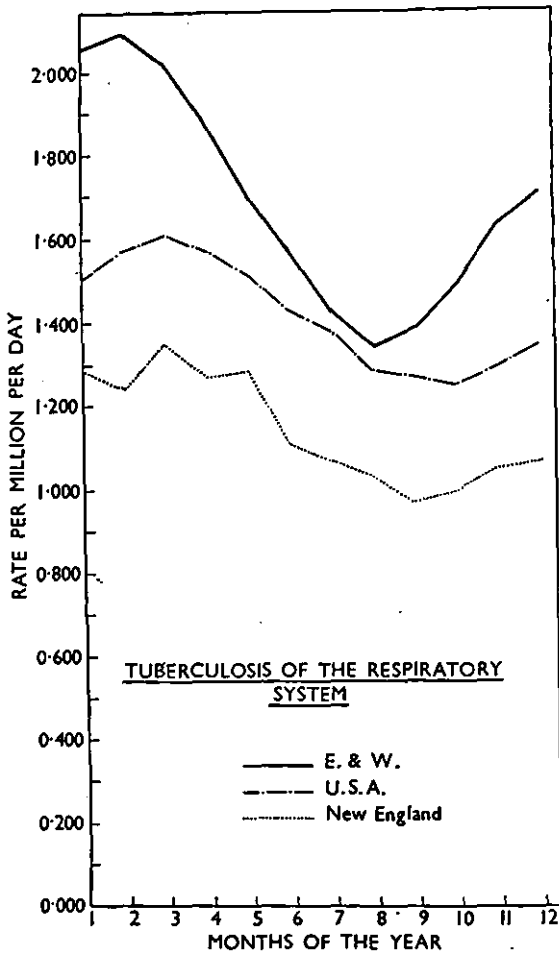


DIAGRAM 6, illustrating Group 3 (Winter ++ ; Summer +). Standardised death rates per day in each month per million of the population (based on the five years 1931-35 for England and Wales, and on the four years 1931-34 for the United States).

TABLE 6  
TUBERCULOSIS OF THE RESPIRATORY SYSTEM  
*Average daily death rates in each month as percentages of the average daily death rate throughout the year*

Month.	England and Wales.	United States.	New England.	Germany.
January .. ..	122	106	112	107
February .. ..	123	111	109	117
March .. ..	110	113	118	112
April .. ..	111	111	111	113
May .. ..	101	108	112	108
June .. ..	93	101	97	101
July .. ..	85	97	94	90
August .. ..	79	90	90	86
September .. ..	82	89	85	87
October .. ..	88	88	87	89
November .. ..	96	91	92	92
December .. ..	102	95	93	100

These figures again present, but in different form, the greater swing of the rates in England and Wales, the range being from 123 per cent. of the mean in February to 79 per cent. in August. In Germany the swing is somewhat less—from 117 to 86 per cent. of the mean, in New England—from 118 to 85, and in the United States still less—113 to 88 per cent. Nevertheless, as has already been pointed out, it does not follow from the fact that a disease shows a greater swing in one country than in another that there must therefore be a crossing over of the rates, so that one country is in excess at one part of the year and the other in excess in the remaining part. There is greater mortality from respiratory tuberculosis in England at every month of the year, but the extra swing does serve to increase the amount of excess in the winter months.

It is surprising, perhaps, that the mortality in the New England States should compare so favourably with the mortality in the whole registration area. The explanation probably lies in the fact that the proportion of coloured people, amongst whom the mortality from respiratory tuberculosis is known to be higher than amongst whites, is very small in the New England States (*see* p. 9).

*Bronchitis and pneumonia.*—The advisability of combining data relating to these two causes of death in any statistical analysis of death certification has long been recognised. Dr. T. H. C. Stevenson<sup>10</sup> drew attention in 1909 to the fact that, whereas in practice about 50 per cent. of all deaths of young children from the combined diseases were ascribed to pneumonia, the results of a series of post-mortem examinations in two London hospitals for children showed 525 deaths at ages 0–5 from pneumonia as against 29 from bronchitis. “Such differences of view,” he said, “are bound in time to influence general certification in the direction of the position taken up in the hospitals, as the opinions prevalent there are constantly being spread amongst the medical profession.” He concluded that it would seem that the custom of certifying in one or the other way has varied from time to time in different directions, and that all the evidence pointed to the conclusion that, in comparing mortality rates of different periods, the only safe course is to study the combined records of the two diseases.

Again, in a later report,<sup>11</sup> he found that bronchitis and pneumonia showed remarkable contrasts in their regional distribution, suggesting that the “bronchitis” of one area may include a number of deaths which would be attributed to pneumonia in another, and *vice versa*. Since this passage is again quoted in more recent times<sup>12</sup> in support of the argument that there is an important amount of transfer of deaths between these assigned causes, it may be accepted that the difficulties attending correct certification of these causes of death still persist.

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<sup>10</sup> 72nd Annual Report of the Registrar-General (1909), p. 69.

<sup>11</sup> Registrar-General's Statistical Review of England and Wales (1925), p. 60.

<sup>12</sup> *Ibid.* (1932), p. 84.

And if this is true regarding different parts of such a small area as England and Wales, still more will it be true regarding the larger area of the United States.

It is nevertheless interesting to compare the relation between the trends of the diseases in the two countries, first of all individually and then observing the alterations in the relationship when the two are combined.

*Bronchitis.*—The month of the year when the death rate from bronchitis is highest in all three areas is January. It is least in England in August, in America in July. The maximum and minimum rates are :—

	<i>Maximum.</i>	<i>Minimum.</i>	<i>Difference.</i>
England and Wales ..	2·139 January	0·363 August	1·776
United States ..	0·137 January	0·048 July	0·089
New England ..	0·182 January	0·045 July	0·137

At the maximum point the England and Wales rate is 15 times as great as that of the United States and 12 times that of New England. The average rates for the year, which are 1·023, 0·090 and 0·104 per million per day in the three regions, show that the mortality from this cause in England is 11 times as great as in the United States and 10 times as great as in New England.

Diagram 7 shows the enormous difference between the English and American experiences from bronchitis, both from the point of view of swing and as regards the level of mortality.

*Pneumonia.*—When the data for pneumonia are examined in the same way, February appears as the maximum month in England and New England but January for the States as a whole. August is the minimum month in all cases. The maximum and minimum rates are :—

	<i>Maximum.</i>	<i>Minimum.</i>	<i>Difference.</i>
England and Wales ..	3·692 February	0·925 August	2·767
United States ..	3·449 January	0·809 August	2·640
New England ..	3·598 February	0·717 August	2·881

Pneumonia shows a higher rate of mortality than bronchitis in all three areas, but so much higher in America that for pneumonia the three levels of mortality are fairly close. Although the English figures are higher than the American at both the maxima and the minima, it must not be concluded from this that there is constant excess for England throughout the year. Diagram 8 shows that in the months of March to May, and again from October to December, the English rates are below those of the whole of the States. Comparing New England and England, this is also true except for the

month of December. This disease is thus shown to afford excess mortality to England both in winter and summer, but a slight advantage during the spring and autumn.

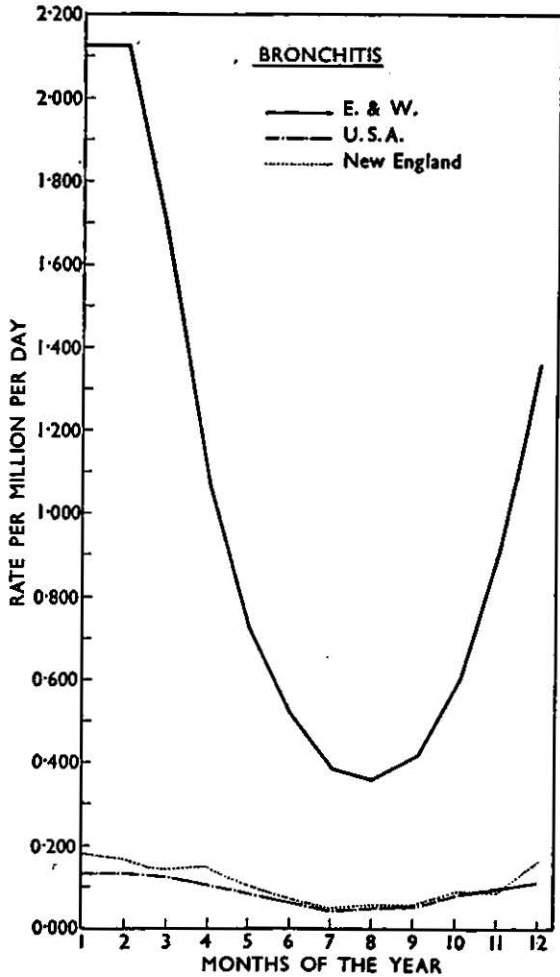


DIAGRAM 7. Standardised death rates per day in each month per million of the population (based on the five years 1931-35 for England and Wales, and on the four years 1931-34 for the United States).

*Bronchitis and pneumonia combined.*—When the data for the two diseases are combined, it is found that the maxima and minima occur at the same months as for pneumonia. Diagram 9 shows that there is no crossing over of the English and American lines of trend, and that there is excess in England at every month of the year. There is still enormous excess in winter due to the bronchitis element, but the pneumonia element has imparted its swing to the American rates. The annual averages are now 3.065, 2.140 and 2.094, signifying that the English level of mortality for the two diseases is 143 and 146 per cent. of the whole of the States and of the New England section respectively. Undoubtedly the difference between

the number of deaths credited to bronchitis in the two countries is the largest factor so far encountered in the search for the cause of England's excessive winter mortality.

Since these two diseases are so important, it may be as well to see what information can be obtained from reference to the German data. In Table 7 the monthly mortality is expressed as a percentage of the yearly mean for each country—including Germany. The following points are worthy of notice. In Germany the maximum for both diseases occurs in February and the minimum in August, and in this the German resembles the English experience rather than the American. The swing of bronchitis is greater in Germany than in America, but not so great as in England. For pneumonia, on the contrary, the swing in Germany is less than in the other countries, and this is still true when the diseases are treated in combination.

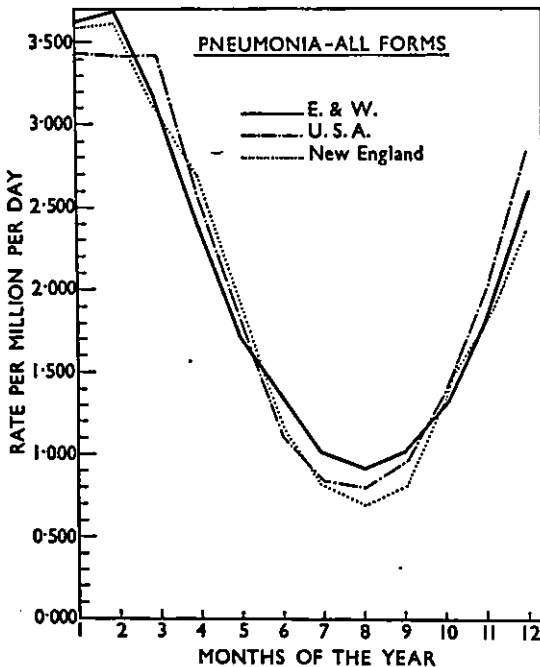


DIAGRAM 8. Standardised death rates per day in each month per million of the population (based on the five years 1931-35 for England and Wales, and on the four years 1931-34 for the United States).

*Influenza.* Fortunately, the data relating to the mortality from influenza are not complicated for the years under survey by any world-wide epidemic such as that of 1918-19, or as occurred in 1928-29 in the countries studied. The comparative annual rates are :—England 0.670, United States 0.662 and New England 0.351 deaths per million per day. How this difference between the New England rate and the others is produced is made clear by Diagram 11, which shows that whereas the English excess over the United States in the first two months of the year is compensated by a favourable

TABLE 7  
BRONCHITIS AND PNEUMONIA

*Daily death rate in each month expressed as percentages of the average daily rate for the whole year*

	England and Wales.			United States of America.			New England.			Germany.		
	Bronch.	Pneum.	B + P	Bronch.	Pneum.	B + P	Bronch.	Pneum.	B + P	Bronch.	Pneum.	B + P
January ..	209	177	188	153	168	168	174	180	179	157	143	146
February ..	209	181	190	148	167	167	161	181	180	189	162	167
March ..	164	155	158	142	160	159	135	155	154	140	141	141
April ..	106	116	113	115	125	124	139	134	134	118	124	123
May ..	72	84	80	95	90	90	98	96	96	91	94	94
June ..	52	67	62	69	57	57	68	59	60	68	80	78
July ..	38	50	50	54	42	43	43	42	42	50	66	63
August ..	36	45	42	55	39	40	51	36	37	49	59	57
September ..	41	50	47	63	47	48	48	48	42	55	61	60
October ..	59	65	63	91	69	70	85	70	70	74	71	71
November ..	88	89	89	102	99	99	92	93	93	96	87	89
December ..	134	126	128	121	141	140	111	119	119	119	116	116

relation in all the other months, its excess over the New England rates is not only much greater during January and February but also never entirely disappears at any time during the year. Hence only as regards comparison between England and New England is influenza to be included in group 3. If, as has been suggested,

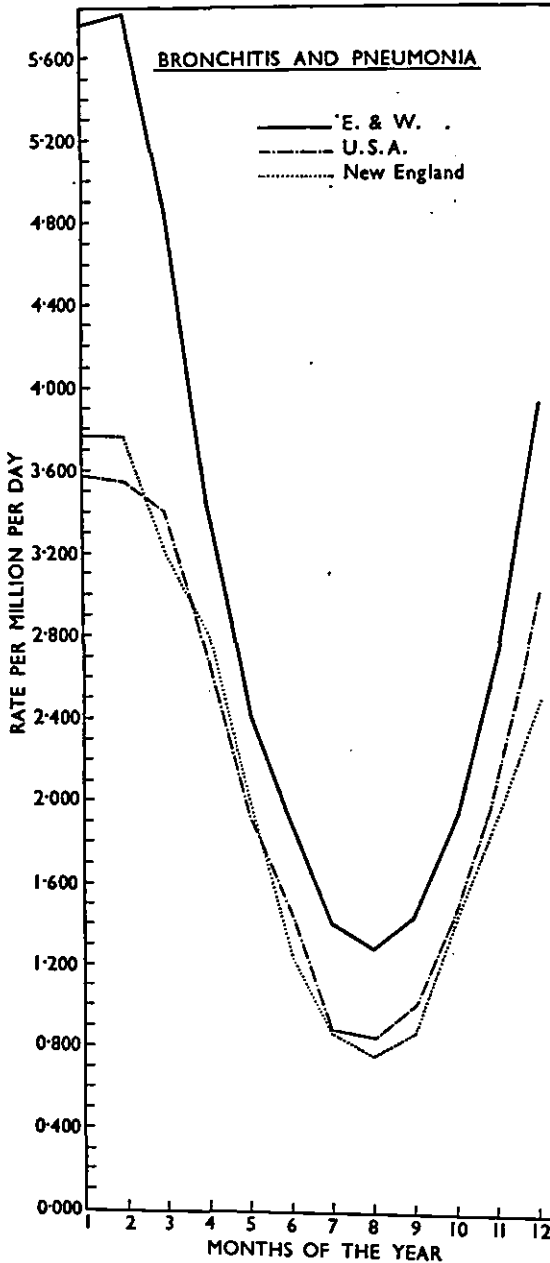


DIAGRAM 9, illustrating Group 3 (Winter ++; Summer +). Standardised death rates per day in each month per million of the population (based on the five years 1931-35 for England and Wales, and on the four years 1931-34 for the United States).

New England is preferable for comparison with England and Wales than the whole registration area of the United States, it must be granted that the recorded mortality from influenza in the home country is from 50 to 100 per cent. greater throughout the year.

*Other causes of death.*—The deaths due to all diseases other than those specifically listed in Table 2 are aggregated in the American published statistics of deaths by month of the year. To complete the picture a comparison of the seasonal trends of this group of unspecified diseases must be included, and, as will appear, in the aggregate they fall into group 3. Since care has been taken to make the code numbers of the specified diseases agree for the two countries, there is no reason why, superficially, the aggregate of the remainder should not also be comparable. There is still the difficulty, however, that deaths which it is the practice in one country to allocate to one of the specified diseases, may in the other country be allocated to the unspecified group and *vice versa*. Taking the figures as they stand, the following summary shows the annual levels of the unspecified group in the three areas.

*Average deaths per day per million*

	<i>England and Wales.</i>	<i>U.S.A.</i>	<i>New England.</i>
Specified causes ..	16·182	18·353	17·019
Other causes .. ..	10·485	9·313	9·150
All causes .. ..	26·667	27·666	26·174

Thus the aggregate of diseases in the United States which it has not been possible to analyse constitute 33·7 per cent. of all diseases, and in New England, 35·0 per cent.; whilst the corresponding group in the English returns amounts to 39·3 per cent. of all causes. Excess for England exists throughout the year, being much greater in the winter. From the figures given on p. 31, it is evident that there is contained in this group of diseases quite a substantial portion of the winter excess of England, and to this extent, with the data at present available, the problem as to the cause of the excess is incapable of solution.

Since this unanalysed group constitutes so large a proportion of the total mortality, it seemed of general interest to provide a table (Table 8) showing the main diseases included and their contributions to the total mortality of the three areas, even though seasonal figures are not available. Percentage figures of this nature are apt to be misleading, and too great importance should not be attached to them; for, if the incidence of one disease is particularly high, then the proportion of the total due to other diseases is automatically lowered. Only general deductions can be made, and of these the most important is that just over one-third of the mortality in the unspecified group is attributable to cancer, which at any rate in England can be shown to have little or no seasonal



TABLE 8

The main diseases or groups of diseases included in the unspecified group (other causes) and their contribution to the total mortality

Disease, or group of diseases.	Code Nos. in International list.	Deaths as percentage of the total deaths from all causes.		
		England and Wales	U.S.A.	New England
Syphilis .. .. .	34	0.27	0.82	0.39
General paralysis of the insane ..	80, 83	0.36	0.43	0.37
Purulent infection and septicaemia	36	0.15	0.07	0.04
Cancer—				
Malignant tumours .. .. .	45-53	12.75	9.39	12.00
Non-malignant tumours .. .. .	54	0.32	0.30	0.31
Tumours, unspecified .. .. .	55	0.26	0.15	0.15
Rheumatic diseases (except diabetes mellitus)	56-58, 60-69	1.52	1.12	0.68
Diseases of the blood .. .. .	70-74	0.94	0.74	0.85
Chronic poisonings .. .. .	75-77	0.02	0.28	0.43
Cerebral embolism and cerebral thrombosis	82b*	1.17	0.42	0.55
Hemiplegia and other paralysis ..	82d†	0.25	0.30	0.12
Other diseases of the nervous system	{ 78, 79, 81 and 84-89 }	2.78	1.48	1.33
Aneurysm .. .. .	96	0.28	0.16	0.13
Other diseases of the circulatory system	{ Part of 97(2) and 98-103 }	2.89	1.91	2.93
Other diseases of the respiratory system	{ 104-105 and 110-114 }	1.01	0.71	0.58
Peptic ulcer .. .. .	117	0.87	0.55	0.58
Appendicitis .. .. .	121	0.61	1.32	1.20
Cirrhosis of liver .. .. .	124	0.29	0.68	0.64
Other diseases of the liver .. .. .	125-127	0.54	0.77	0.88
Other diseases of the digestive system	{ 115, 116, 118, 122, 123, 128, 129 }	1.95	1.91	1.62
Other diseases of the genito-urinary system	133-139	1.58	1.26	1.12
Congenital diseases .. .. .	157-161	4.09	4.87	4.82
Senility .. .. .	162	3.56	0.80	0.45
Ill-defined diseases .. .. .	199-200	0.27	1.60	0.28
All other diseases not included either in this list or in Table 2	{ 3-6, 14, 16, 19-22, 33, 35, 39-44, 151-156 }	0.37	0.61	0.47
Total other causes .. .. .	—	39.10	32.68	32.94
Specified (Table 2) .. .. .	—	60.90	67.32	67.06
All causes .. .. .	—	100.00	100.00	100.00

\* This is 82b (1) and 82b (2) in the English Reports.

† This is 82c in the English Reports.

variation,<sup>18</sup> so that it is impossible for cancer to play any part in the enhanced winter excess found to exist in "other causes". Next in importance are the congenital diseases, and here the evidence shows that in England both congenital debility and premature birth have high winter mortality. The high proportion of

<sup>18</sup> Registrar-General's Statistical Review of England and Wales: (1925) Text pp. 85 *et seq.*; (1931) Text pp. 100 *et seq.*; (1936) Text pp. 150 *et seq.*

mortality in England, as compared with the United States and New England, in respect of senility, rather suggests that many deaths ascribed in England to this cause are in America ascribed to some other causes—this may partly account for the high proportion of deaths in England found in the unspecified group. Apart from these, "other causes" is seen to be composed of many diseases which individually are of small account, but in the aggregate amount to 15 to 20 per cent. of the total mortality: many of these must produce excess mortality for England in the winter as compared with America, again of little account except in the aggregate and incapable of analysis without more detailed data for the American experience.

To sum up, the addition of group 3 entails that the curves showing the trend of mortality in England and the United States would no longer be parallel but would cross; the English line would be much higher in winter and very slightly lower in summer.

(e) GROUP 4. DISEASES SHOWING LOWER MORTALITY FOR ENGLAND AND WALES THROUGHOUT THE YEAR, ENHANCED DURING THE SUMMER  
(Winter — ; Summer — —)

Just as group 1 has been reinforced by group 3, so group 2 (Winter — ; Summer —) is reinforced by a group of diseases in which the advantage of England is accentuated in the summer. This is brought about, not by enhanced downward swing in the English, but by enhanced upward trend of the American rates in the hot summer months. The group comprises typhoid fever, dysentery, malaria and—of chief importance—deaths from violence; it is expressed by the symbols (Winter — ; Summer — —) and is typified in diagram 10 (mortality from violent deaths). If the New England States only are compared with England, then dysentery and malaria are not to be included. Hence the amount of advantage given to England by this group is much greater in the comparison with the U.S.A. than with New England. In both cases the influence of this group on the winter relation is ineffectual as against the excess produced by group 3. In the summer, however, it does materially increase the small favourable balance still remaining from the second group, so that in the middle of the year the curve of the U.S.A. is pushed further above that of England.

The number of deaths on which the rates in England for typhoid fever, dysentery and malaria are based is so small that the monthly rates seem to portray random fluctuations rather than any seasonal trend. This is also true of typhoid fever in New England. It is clear from the figures on p. 43 that, whilst in the two smaller areas the ranges of mortality are slight and with but little difference between the summer and the winter incidence, in the whole of the United States these diseases have very high peaks during the summer months, the absence of which in England contributes to the relatively low mortality of this country during that period of the year.

*Deaths from violence.*—Possibly the largest contribution to the summer advantage of English mortality rates is that which accrues from the lower rate of deaths from violence. A glance at Diagram 10 will show how the consistent advantage experienced throughout the year is enhanced during the summer by the upward swing of the rates in America from the March figure of 1·906 to the July figure of 2·690. The English curve shows two peaks, in August and December, and for the five years under survey the December one is the higher. In the United States and in New England, December also shows as a bad month, but not so bad as July. The mortality in England is less than half of that in the United States, as is shown by the following data of average annual standardised rates:—

England and Wales	..	1·046	per million per day.
United States	.. ..	2·172	" " " "
New England	.. ..	1·741	" " " "

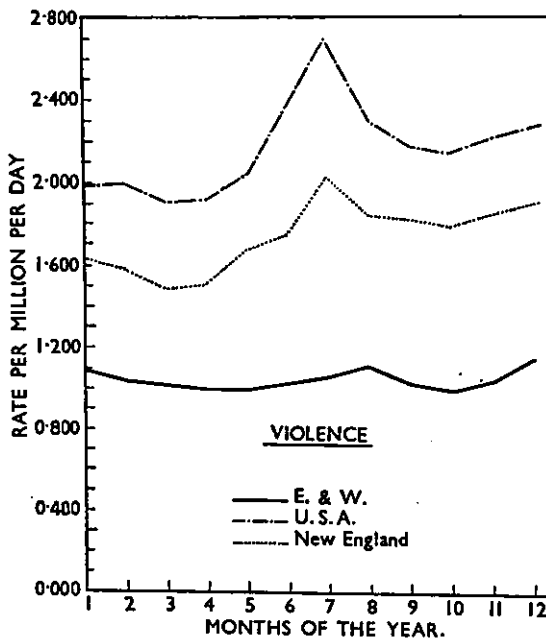


DIAGRAM 10, illustrating Group 4 (Winter — ; Summer — —). Standardised death rates per day in each month per million of the population (based on the five years 1931–35 for England and Wales, and on the four years 1931–34 for the United States).

With the addition of this group, the combined effect of groups 1 to 4 produces curves of mortality for England and America, the relation between which is broadly the same as that which exists between the curves of their total mortality; and this without the inclusion of any disease in which the double phenomenon is present.

GROUP 4.—*Diseases showing lower mortality for England and Wales throughout the year, enhanced during the summer*

<i>Group 4 Diseases</i> (— ; — —).	<i>England and Wales.</i>			<i>United States.</i>			<i>New England.</i>		
	<i>Maximum.</i>	<i>Minimum.</i>	<i>Differ- ence.</i>	<i>Maximum.</i>	<i>Minimum.</i>	<i>Differ- ence.</i>	<i>Maximum.</i>	<i>Minimum.</i>	<i>Differ- ence.</i>
Typhoid fever .. ..	0·019 Nov.	0·011	0·008	0·199 Aug.	0·043 Mar.	0·156	0·030 Sept.	0·012 Mar.	0·018
Deaths from violence .. ..	1·138 Aug.	0·978 Apr.	0·160	2·690 July	1·906 Mar.	0·784	2·002 July	1·490 Mar.	0·512
Dysentery .. ..	0·010 Jan.	0·004 July	0·006	0·129 July	0·019 Jan.	0·110	—	—	—
Malaria .. ..	0·003 Jan.	0·001	0·002	0·167 Sept.	0·021 Feb.	0·146	—	—	—

(f) GROUP 5. DISEASES SHOWING HIGHER MORTALITY FOR ENGLAND AND WALES DURING THE WINTER, AND LOWER MORTALITY DURING THE SUMMER, THAN IN THE U.S.A.

(Winter + ; Summer -)

For every disease in this group, the relation between the mortality rates of the two countries is similar to that found for the total

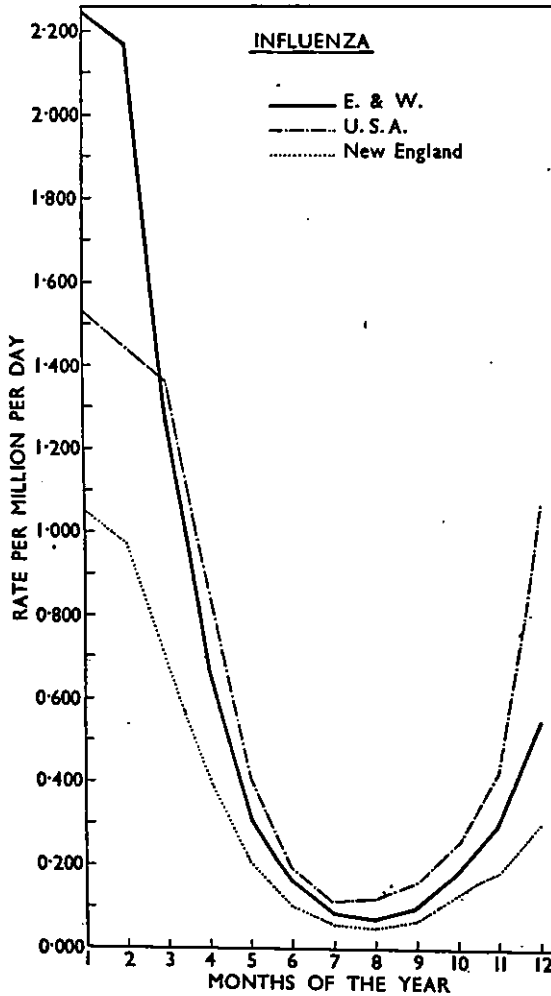


DIAGRAM 11, illustrating Group 5 (Winter + ; Summer -). Standardised death rates per day in each month per million of the population (based on the five years 1931-35 for England and Wales, and on the four years 1931-34 for the United States).

mortality rates—namely, in the winter, excess for England ; in the summer, excess for America. In the comparison of England with the United States both influenza (Diagram 11) and heart diseases (Diagram 12) have a higher winter maximum and a lower summer minimum in England. So also have diarrhoea and enteritis

(Diagram 13), which class of diseases is, however, to be distinguished from the other two members of the group by reason of its incidence

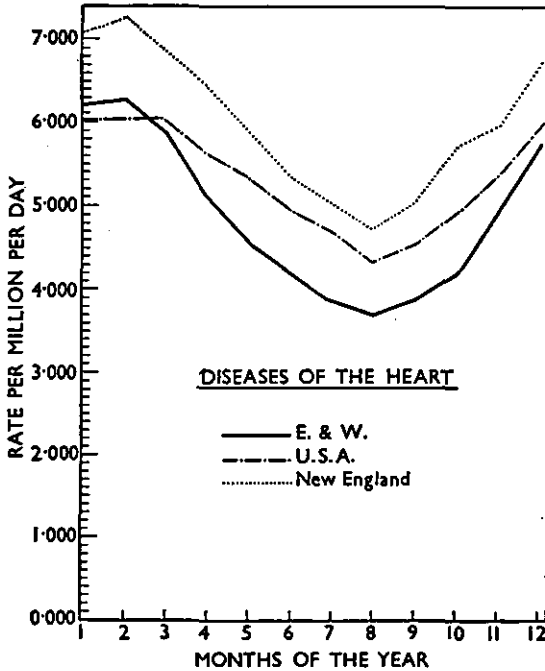


DIAGRAM 12, illustrating Group 5 (Winter + ; Summer -). Standardised death rates per day in each month per million of the population (based on the five years 1931-35 for England and Wales, and on the four years 1931-34 for the United States).

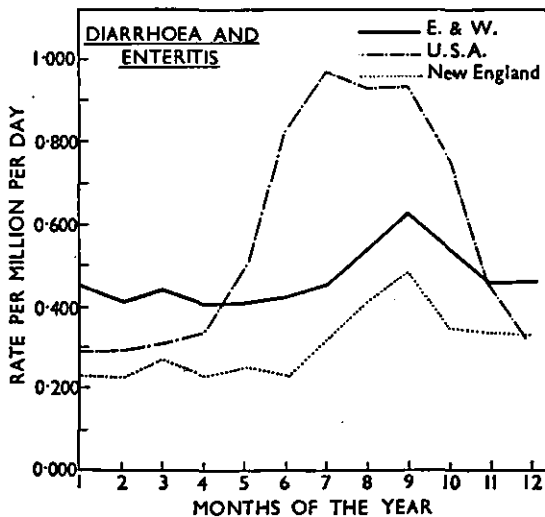


DIAGRAM 13, illustrating Group 5 (Winter + ; Summer -). Standardised death rates per day in each month per million of the population (based on the five years 1931-35 for England and Wales, and on the four years 1931-34 for the United States).

being greater in summer than in winter. Furthermore it forms the only instance in the present study in which the English statistics are less detailed than the American. Whilst the deaths by month of occurrence are given separately for ages under and over 2 years in the United States, in the English publications no such distinction is made, and it has therefore been necessary to treat all ages together.

It will be recollected that in the comparison between England and the New England States, influenza fell into group 3, heart diseases into group 2, and diarrhoea and enteritis into group 1. Their place in the table for group 5 is filled by dysentery and malaria, chiefly for the sake of completeness, for although they do show winter excess and summer advantage for England which justifies their inclusion in this group, the death rate in both England and New England is negligible. The maximum and minimum rates are given on p. 47.

*Diseases of the heart.*—From the international list of diseases of the circulatory system deaths by month of occurrence are tabulated in the United States for a group consisting of pericarditis, acute endocarditis, chronic endocarditis, diseases of the myocardium, diseases of the coronary arteries, angina pectoris and "other diseases of the heart". Excluded from the list are aneurysm (except of the heart), arteriosclerosis (except of the coronary arteries), gangrene, and diseases of the lymphatic system. The deaths credited to the specified group produce standardised death rates of 4·900 per million per day in England and Wales, against 5·331 in the United States. Diagram 12 shows that in the first two months of the year, the English rate is higher than that of the United States as a whole, but not higher than in the New England States. The figures given on p. 47 show that at the maxima in February there is some little excess of the English rate.

It should therefore be clear that the diseases of group 5 serve but to accentuate the relationships obtained from the summation of the previous groups, and not to produce them.

To complete the picture there is one disease which is in direct contrast to group 5. This is scarlet fever and may be symbolised (Winter— ; Summer+) since in England as compared with America the mortality is lower in the winter and higher in the summer. But in all three areas its influence on the total mortality is so small as to be negligible.

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It is to be observed that, whilst the analysis has disposed of the assumption that the double phenomenon found in the relation between the rates of total mortality is but the reflection of a similar double phenomenon in many individual diseases, it does not preclude the fact that certain diseases having a greater swing in England than in America do contribute to the greater swing found in the general mortality. On the contrary, the deduction has been drawn that

GROUP 5.—Diseases showing higher mortality for England and Wales during the winter, and lower during the summer, than in the U.S.A.

Group 5 Diseases. (+ ; -).	England and Wales.			United States.			New England.		
	Maximum.	Minimum.	Differ- ence.	Maximum.	Minimum.	Differ- ence.	Maximum.	Minimum.	Differ- ence.
Influenza .. .. .	2·241 Jan.	0·075 Aug.	2·166	1·535 Jan.	0·117 Aug.	1·418	—	—	—
Heart diseases .. .. .	6·297 Feb.	3·710 Aug.	2·587	6·151 Feb.	4·350 Aug.	1·801	—	—	—
Diarrhoea and enteritis .. .. .	0·635 Sept.	0·405 May	0·239	0·975 July	0·298 Jan.	0·677	—	—	—
Dysentery .. .. .	0·010 Jan.	0·004 July	0·006	—	—	—	0·023 Sept.	0·003 Feb.	0·020
Malaria .. .. .	0·003 Jan.	0·001	0·002	—	—	—	0·002 July	0·001	0·001



to the diseases of group 3 (Winter ++ ; Summer +), with their excessive upward winter swing in England, is due the relatively high mortality apparent in England in the winter. The differences in swing have been illustrated by calculating the differences between maxima and minima, *i.e.*, comparing differences of range, but the variations in the monthly rates may also be measured in relation to their means, and in Table 9 are set out for each disease having a pronounced downward trend from winter to summer, the means, the standard deviations, and the coefficients of variation  $\frac{100 \times \text{s.d.}}{\text{Mean}}$  as calculated for each area, the last named being a measurement of the swing.

The arrangement of this table follows the grouping which has already been made. From group 1 are taken diphtheria and erysipelas, for both of which the coefficient of variation is smaller in England than in either the United States as a whole or in the New England States. It may therefore be said that in the group showing constant excess, there is more variation around the mean in the more favourable rates of America. Again in group 2, from which are taken diabetes, cerebral haemorrhage and nephritis, it is the country with the lowest monthly rates, in this group England, which has the greatest swing.

Passing to group 3, which chiefly accounts for the excessive winter mortality in England, it is nevertheless found that for measles and cerebrospinal meningitis there is greater swing in the United States. This arises, of course, by reason of the relative smallness of the mean as regards these diseases in the United States. For respiratory tuberculosis the swing is greatest in England, the coefficients being 15, 9 and 11 in the three areas respectively. Bronchitis by itself shows almost twice as much variability in England as in the United States, the comparative coefficients being 61, 36 and 42. But when combined with pneumonia the difference is reduced, the figures then being 52 for England and 47 for the States.

As regards the unspecified group—which comprises such a large proportion of the total mortality—the coefficients of variation differ considerably, being 9 for England as compared with 3 for the United States and 5 for New England. These figures are less than for all causes of death and much less than for the specified causes. In all likelihood, the influence of cancer is in a large measure responsible for these low figures, for it has been shown (Table 8) that deaths from cancer, which in England at any rate show almost an entire lack of variability, account for 32 per cent. of the "other causes" group in England, 30 per cent. in the United States and 37 per cent. in the New England States.

Influenza, in group 5, shows the greatest swing of any disease in England and New England, but less than that of measles in the States as a whole. Diseases of the heart also show greater swing in England, but the criteria of the group made the appearance of this feature a certainty.

TABLE 9

Showing the mean monthly mortality and the variability in the monthly rates as expressed by the coefficient of variation, for those diseases showing pronounced seasonal trend from high winter to low summer mortality

	England and Wales.			United States of America.			New England.		
	Mean.	S.D.	C. of V.	Mean.	S.D.	C. of V.	Mean.	S.D.	C. of V.
<i>Group 1 (+ ; +)</i>									
Diphtheria .. .. .	0.281	0.059	21	0.129	0.066	51	0.061	0.019	31
Erysipelas .. .. .	0.068	0.023	34	0.045	0.018	40	0.048	0.028	58
<i>Group 2 (- ; -)</i>									
Diabetes .. .. .	0.292	0.044	15	0.526	0.064	12	0.561	0.071	13
Cerebral haemorrhage .. .. .	1.296	0.169	13	1.841	0.180	10	1.857	0.200	11
Nephritis .. .. .	0.768	0.095	12	2.024	0.167	8	1.781	0.191	11
<i>Group 3 (++ ; +)</i>									
Measles .. .. .	0.280	0.183	65	0.097	0.080	82	0.060	0.044	73
Bronchitis .. .. .	1.029	0.630	61	0.090	0.032	36	0.105	0.044	42
Pneumonia—all forms .. .. .	2.051	0.970	47	2.057	0.988	48	2.000	1.010	51
Bronchitis + pneumonia .. .. .	3.080	1.597	52	2.148	1.017	47	2.104	1.055	50
Cerebrospinal meningitis .. .. .	0.087	0.030	34	0.043	0.017	40	0.024	0.005	21
Respiratory tuberculosis .. .. .	1.693	0.256	15	1.422	0.129	9	1.145	0.130	11
<i>Group 3b (++ ; +)</i>									
Other causes .. .. .	10.494	0.929	9	9.315	0.298	3	9.155	0.430	5
<i>Group 5 (+ ; -)</i>									
Influenza .. .. .	0.679	0.757	111	0.666	0.534	80	0.354	0.342	97
Diseases of the heart .. .. .	4.907	0.924	19	5.336	0.604	11	6.011	0.835	14
Scarlet fever (- ; +) .. .. .	0.060	0.016	27	0.064	0.028	44	0.068	0.035	51
All Causes .. .. .	26.717	5.002	19 ± 4	27.684	2.487	9 ± 2	26.199	3.105	12 ± 2.5

Other points of interest from the table are that, with the exception of diphtheria, measles and cerebrospinal meningitis, variability is less in the whole of the United States than in the New England States.

For the general mortality the standard errors of the coefficients of variation have been calculated. They are:—England and Wales  $18.73 \pm 3.95$ , United States  $8.98 \pm 1.85$ , New England  $11.85 \pm 2.45$ . None of the differences between these coefficients is statistically significant, but the fact that—as shown by Diagram 1—such differences appear consistently over a series of years should be admitted as evidence that they do not arise merely by chance.

V. THE EXTENT TO WHICH INDIVIDUAL DISEASES CONTRIBUTE TO THE EXCESS OR DEFECT IN THE GENERAL MORTALITY OF ENGLAND AND WALES

The conclusions arrived at in the previous section were expressed in very general terms. It was shown that the double feature found when the general mortalities were compared was not a reflection of similar double features in several individual diseases, but was due to the combined influence of very dissimilar features in the particular diseases. In order to give some precision to the results by indicating at each month of the year the amount of influence exerted by each specified disease upon the resultant defect or excess in this country's total mortality, the following method was adopted.

For each disease the difference between the English and the United States standardised rate for every month of the year was expressed as a percentage of the United States general mortality rate for the month in question. The results are tabulated in Table 10. Positive and negative signs distinguish between instances where the English rates are higher or lower than those of the United States. The following figures in respect of tuberculosis of the respiratory system may be taken as an illustration :—

Standardised daily death rate for May per million in		
England and Wales.. .. .	=	1.705
Standardised daily death rate for May per million in		
the U.S.A. .. .. .	=	1.537
Excess ..	=	+ 0.168

Excess in England expressed as a percentage of the general mortality of the U.S.A. for May (27.183 per million per day) .. = 0.618 per cent.

A similar process, except that New England rates were substituted for those of the United States as a whole, provided the results shown in Table 11.

Tables 10 and 11 may be read both vertically and horizontally, Vertically they provide an answer to the question as to how the excess or defect in the general mortality of England and Wales in each month is distributed amongst the different diseases. Horizontally, they show the change in the relation between the two countries as regards the incidence of each disease throughout the year—in which month the difference between the mortalities was greatest and in which month it was least.

In order to indicate in more detail how the results should be read, the interpretation of the results for the month of January in Table 10 may be elaborated as follows :—The difference between the average daily death rate from all causes of death in England and Wales and in the U.S.A. was 12.644 per cent. of the United States figure, the English rate being the higher. Of this 12.644 per cent., + 6.489 per cent. was due to bronchitis (the percentage being increased to + 7.020 if bronchitis and pneumonia are taken together),

TABLE 10

## ENGLAND AND WALES AND UNITED STATES OF AMERICA

Showing in percentage form, how the difference between the average daily death rate in each month from all causes of death in the two areas, is distributed amongst the various causes of death

1931-35

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Whole year.
Typhoid and paratyphoid fever ..	- 0.149	- 0.111	- 0.100	- 0.111	- 0.155	- 0.340	- 0.608	- 0.772	- 0.676	- 0.516	- 0.342	- 0.214	- 0.325
Measles .. .. .	+ 0.784	+ 0.928	+ 1.224	+ 1.222	+ 0.743	+ 0.555	+ 0.390	+ 0.349	+ 0.205	+ 0.238	+ 0.454	+ 0.568	+ 0.661
Scarlet fever .. .. .	- 0.026	- 0.064	- 0.090	- 0.052	- 0.055	- 0.008	+ 0.066	+ 0.054	+ 0.045	+ 0.012	+ 0.022	-	+ 0.011
Whooping cough .. .. .	+ 0.545	+ 0.767	+ 0.630	+ 0.523	+ 0.331	+ 0.110	- 0.039	+ 0.058	+ 0.119	+ 0.016	+ 0.115	+ 0.286	+ 0.307
Diphtheria .. .. .	+ 0.658	+ 0.751	+ 0.626	+ 0.672	+ 0.693	+ 0.582	+ 0.610	+ 0.590	+ 0.430	+ 0.160	+ 0.164	+ 0.609	+ 0.546
Influenza .. .. .	+ 2.288	+ 2.314	- 0.318	- 0.602	- 0.379	- 0.102	- 0.123	- 0.191	- 0.238	- 0.270	- 0.498	- 1.804	+ 0.029
Dysentery .. .. .	- 0.029	- 0.038	- 0.045	- 0.062	- 0.177	- 0.419	- 0.482	- 0.453	- 0.381	- 0.277	- 0.152	- 0.075	- 0.199
Erysipelas .. .. .	+ 0.126	+ 0.076	+ 0.071	+ 0.076	+ 0.070	+ 0.049	+ 0.046	+ 0.071	+ 0.070	+ 0.090	+ 0.119	+ 0.129	+ 0.083
Encephalitis lethargica .. .. .	+ 0.126	+ 0.124	+ 0.119	+ 0.097	+ 0.125	+ 0.102	+ 0.089	+ 0.087	+ 0.029	+ 0.063	+ 0.104	+ 0.092	+ 0.098
Epidemic cerebrospinal meningitis..	+ 0.117	+ 0.204	+ 0.209	+ 0.246	+ 0.195	+ 0.212	+ 0.154	+ 0.120	+ 0.106	+ 0.117	+ 0.082	+ 0.102	+ 0.155
Tuberculosis of the respiratory system	+ 1.776	+ 1.643	+ 1.311	+ 1.052	+ 0.618	+ 0.570	+ 0.208	+ 0.253	+ 0.479	+ 0.895	+ 1.238	+ 1.246	+ 0.969
Other forms of tuberculosis.. .. .	+ 0.891	+ 0.987	+ 1.041	+ 1.153	+ 1.174	+ 1.095	+ 0.996	+ 0.914	+ 0.848	+ 0.832	+ 0.747	+ 0.759	+ 0.954
Malaria .. .. .	- 0.084	- 0.064	- 0.071	- 0.104	- 0.186	- 0.279	- 0.428	- 0.552	- 0.680	- 0.629	- 0.371	- 0.150	- 0.278
Diabetes .. .. .	- 0.801	- 0.809	- 0.877	- 0.848	- 0.861	- 0.895	- 0.868	- 0.827	- 0.815	- 0.816	- 0.859	- 0.878	- 0.846
Cerebral haemorrhage and softening	- 1.653	- 1.773	- 1.802	- 1.870	- 2.189	- 2.160	- 2.254	- 1.973	- 2.056	- 2.242	- 1.903	- 1.817	- 1.974
Diseases of the heart .. .. .	+ 0.755	+ 0.465	+ 0.357	+ 0.627	+ 2.711	+ 2.942	+ 3.400	+ 2.658	+ 2.552	+ 2.551	+ 1.502	+ 0.756	+ 1.551
Bronchitis* .. .. .	+ 6.489	+ 6.380	+ 4.998	+ 3.410	+ 2.984	+ 1.764	+ 1.324	+ 1.304	+ 1.483	+ 2.028	+ 3.011	+ 4.278	+ 3.372
Pneumonia—all forms* .. .. .	+ 0.531	+ 0.828	+ 0.360	+ 0.644	- 0.438	+ 0.771	+ 0.590	+ 0.482	+ 0.233	- 0.273	+ 0.825	- 1.082	+ 0.029
Diarrhoea and enteritis (all ages) ..	+ 0.515	+ 0.439	+ 0.469	+ 0.267	- 0.316	- 1.545	- 2.038	- 1.603	- 1.212	- 0.816	+ 0.071	+ 0.504	+ 0.376
Nephritis .. .. .	- 4.230	- 4.431	- 4.437	- 4.587	- 4.801	- 4.774	- 4.789	- 4.565	- 4.534	- 4.735	- 4.487	- 4.173	- 4.533
Puerperal state .. .. .	- 0.437	- 0.535	- 0.549	- 0.523	- 0.603	- 0.555	- 0.590	- 0.408	- 0.524	- 0.414	- 0.390	- 0.357	- 0.492
Suicide .. .. .	- 0.253	- 0.220	- 0.302	- 0.374	- 0.405	- 0.321	- 0.351	- 0.353	- 0.475	- 0.367	- 0.301	- 0.272	- 0.333
Violence .. .. .	- 2.907	- 3.024	- 2.833	- 3.275	- 3.885	- 5.159	- 6.268	- 4.856	- 4.710	- 4.539	- 4.379	- 3.757	- 4.070
Other causes .. .. .	+ 7.610	+ 7.163	+ 5.737	+ 4.528	+ 3.259	+ 1.303	+ 0.370	+ 2.031	+ 2.355	+ 3.203	+ 4.829	+ 6.627	+ 4.236
All causes .. .. .	+12.644	+11.999	+ 4.282	- 1.534	- 7.538	-12.389	-17.394	-12.989	-12.451	-10.794	- 5.100	- 0.136	- 3.611
*Bronchitis and pneumonia (combined)	+ 7.020	+ 7.208	+ 4.626	+ 2.766	+ 1.946	+ 2.535	+ 1.914	+ 1.786	+ 1.716	+ 1.755	+ 2.186	+ 3.196	+ 3.343

Note.—Total on which these percentages are based is the sum of the standardised rates of individual causes in United States of America, not the actual all causes rate, standardised.

TABLE 11

## ENGLAND AND WALES AND NEW ENGLAND

Showing in percentage form, how the difference between the average daily death rate in each month from all causes of death in the two areas, is distributed amongst the various causes of death

1931-35

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Whole year.
Typhoid and paratyphoid fever ..	- 0.003	- 0.016	—	- 0.025	- 0.046	- 0.046	- 0.035	- 0.046	- 0.062	- 0.045	- 0.020	- 0.026	- 0.031
Measles ..	+ 0.705	+ 1.014	+ 1.647	+ 1.717	+ 1.154	+ 0.918	+ 0.538	+ 0.380	+ 0.243	+ 0.262	+ 0.483	+ 0.602	+ 0.837
Scarlet fever ..	- 0.088	- 0.135	- 0.081	- 0.132	- 0.118	+ 0.029	+ 0.062	+ 0.018	+ 0.071	+ 0.066	+ 0.004	+ 0.047	- 0.030
Whooping cough ..	+ 0.558	+ 0.869	+ 0.812	+ 0.636	+ 0.611	+ 0.513	+ 0.322	+ 0.261	+ 0.252	+ 0.135	+ 0.247	+ 0.369	+ 0.482
Diphtheria ..	+ 0.938	+ 0.924	+ 0.822	+ 0.732	+ 0.722	+ 0.642	+ 0.692	+ 0.852	+ 0.919	+ 0.868	+ 0.770	+ 1.121	+ 0.837
Influenza ..	+ 3.857	+ 3.855	+ 1.990	+ 0.945	+ 0.401	+ 0.259	+ 0.104	+ 0.096	+ 0.150	+ 0.201	+ 0.475	+ 0.854	+ 1.219
Dysentery ..	+ 0.016	+ 0.022	+ 0.013	—	+ 0.015	+ 0.004	- 0.026	- 0.069	- 0.066	- 0.008	- 0.024	- 0.004	- 0.008
Erysipelas ..	+ 0.127	- 0.006	+ 0.027	+ 0.039	+ 0.027	+ 0.017	+ 0.044	+ 0.096	+ 0.106	+ 0.151	+ 0.126	+ 0.183	+ 0.080
Encephalitis lethargica ..	+ 0.123	+ 0.138	+ 0.141	+ 0.089	+ 0.138	+ 0.150	+ 0.119	+ 0.137	+ 0.141	+ 0.127	+ 0.126	+ 0.124	+ 0.130
Epidemic cerebrospinal meningitis..	+ 0.224	+ 0.324	+ 0.374	+ 0.384	+ 0.268	+ 0.275	+ 0.203	+ 0.188	+ 0.110	+ 0.143	+ 0.134	+ 0.168	+ 0.237
Tuberculosis of the respiratory system	+ 2.503	+ 2.707	+ 2.253	+ 2.165	+ 1.609	+ 1.918	+ 1.574	+ 1.442	+ 1.802	+ 2.002	+ 2.278	+ 2.380	+ 2.086
Other forms of tuberculosis ..	+ 0.943	+ 0.994	+ 1.054	+ 1.134	+ 1.273	+ 1.276	+ 1.186	+ 1.122	+ 0.976	+ 0.860	+ 0.723	+ 0.850	+ 1.032
Malaria ..	+ 0.006	—	+ 0.003	+ 0.004	—	—	- 0.004	—	—	- 0.004	—	+ 0.007	+ 0.004
Diabetes ..	- 1.007	- 1.010	- 1.034	- 0.977	- 1.204	- 1.030	- 1.213	- 1.103	- 1.042	- 0.917	- 0.892	- 0.942	- 1.028
Cerebral haemorrhage and softening	- 1.961	- 1.982	- 1.832	- 2.044	- 2.480	- 2.181	- 1.879	- 2.362	- 2.425	- 2.555	- 2.019	- 2.135	- 2.144
Diseases of the heart ..	- 2.708	- 3.156	- 3.247	- 4.383	- 5.140	- 4.879	- 5.045	- 4.647	- 4.956	- 6.003	- 3.993	- 3.493	- 4.223
Bronchitis* ..	+ 6.354	+ 6.315	+ 5.187	+ 3.352	+ 2.411	+ 1.910	+ 1.526	+ 1.419	+ 1.630	+ 2.086	+ 3.166	+ 4.563	+ 3.512
Pneumonia—all forms* ..	+ 0.088	+ 0.301	+ 0.308	- 1.024	- 0.734	+ 0.755	+ 0.829	+ 0.952	+ 0.866	+ 0.205	+ 0.137	+ 0.719	+ 0.199
Diarrhoea and enteritis—all ages ..	+ 0.731	+ 0.664	+ 0.586	+ 0.640	+ 0.596	+ 0.809	+ 0.564	+ 0.604	+ 0.649	+ 0.827	+ 0.860	+ 0.807	+ 0.695
Nephritis ..	- 3.399	- 3.714	- 3.978	- 4.002	- 4.143	- 3.787	- 3.845	- 3.708	- 4.037	- 4.221	- 4.093	- 3.563	- 3.863
Puerperal state ..	- 0.325	- 0.439	- 0.387	- 0.363	- 0.417	- 0.309	- 0.542	- 0.353	- 0.367	- 0.209	- 0.346	- 0.124	- 0.344
Suicide ..	- 0.078	+ 0.087	- 0.229	- 0.402	- 0.302	- 0.108	- 0.300	- 0.229	- 0.464	- 0.401	- 0.216	- 0.091	- 0.222
Violence ..	- 1.757	- 1.719	- 1.569	- 1.912	- 2.645	- 3.069	- 4.128	- 3.264	- 3.534	- 3.296	- 3.151	- 2.730	- 2.656
Other causes ..	+ 6.994	+ 6.803	+ 6.466	+ 4.518	+ 4.085	+ 2.673	+ 3.642	+ 4.152	+ 3.459	+ 3.603	+ 5.771	+ 7.417	+ 5.101
All causes ..	+ 12.841	+ 12.839	+ 9.326	+ 1.091	- 3.948	- 3.261	- 5.614	- 4.097	- 5.579	- 6.502	+ 0.283	+ 7.103	+ 1.903
*Bronchitis and pneumonia (combined)	+ 6.442	+ 6.616	+ 5.493	+ 2.328	+ 1.677	+ 2.665	+ 2.355	+ 2.371	+ 2.496	+ 1.891	+ 3.029	+ 5.282	+ 3.711

Note.—Total on which these percentages are based is the sum of the standardised rates of individual causes in New England, not the actual all causes rate, standardised.

+ 2.288 per cent. to influenza, + 1.776 per cent. to respiratory tuberculosis, and + 0.891 per cent. to other forms of tuberculosis. Measles provided + 0.784 per cent., heart disease + 0.755 per cent. and unspecified causes + 7.610 per cent. In fact, if we take all the diseases which in January provided excess mortality for England (those with positive signs), the figure amounts to + 23.2 per cent.: but balanced against this are the diseases in regard to which England possesses an advantage in January, and these in the aggregate amount to - 10.6 per cent., thus reducing the total excess from + 23.2 to + 12.6 per cent. Principal amongst the latter group are nephritis (-4.230 per cent.), deaths from violence (-2.907 per cent.), and cerebral haemorrhage (-1.653 per cent.).

Reading the table horizontally is merely to retrace the ground covered in the detailed discussion of the previous section, but some quantitative precision is reached in this way. Where the signs are all positive, as in the case of measles, this indicates that the mortality from measles is higher in England than in the United States at every month of the year. It can be seen again from the table that the greatest difference between the rates occurs in March and the least difference in September.

The sign for whooping cough changes to negative for the month of July, showing that the English mortality falls below that of the United States in this month. But the amount of defect is negligible compared with the defect in the total mortality for that month. That is the point which these tables are designed to show.

An objection to the horizontal interpretation of the tables may be raised on the ground that the measuring-rod, in one case the general mortality of the United States and in the other that of New England, is itself a varying quantity. It can be argued that, even if the death rates from disease "x" were constant in both countries from February to August, the method adopted would show increasing excess or defect solely on account of the fall in the general mortality over this period. Whilst admitting the pertinence of this objection, it is not considered of sufficient magnitude to warrant abandonment of the device, which is sound if not abused by misinterpretation.

It should therefore be carefully kept in view throughout this section that, whenever the amount of difference between the rates of the two countries is compared, the difference is always to be understood as measured in relation to the total mortality. If, for example, it is stated that the excess mortality of England from disease "x" was greater in July than in March, it must be understood to imply that the excess from the disease in July measured by the general mortality rate for July is greater than the excess in March measured by the general mortality rate for March. This is the chief reason why the United States general mortality and not that of England was selected as the measuring rod. The amount of variation is less in the former country, and hence more stability is given to the results.

*All causes of death.*—It has already been shown from Diagram 3 that the general mortality of England and Wales was only in excess of that in the United States for the first three months of the year. The amount of that excess may now be measured. It was greatest in January (+ 12·644 per cent. of the total U.S.A. mortality), nearly as great in February (+ 11·999 per cent.), fell in March (+ 4·282 per cent.), and became slightly in defect in April (— 1·534 per cent.). The defect steadily increased, reaching the figure of — 17·394 per cent. in July, and then fell again.

When England is compared with New England, the amount of excess in the first two months is about the same as when the comparison is with the whole of the States, + 12·841 in January and + 12·839 in February. There is however less fall in March, + 9·326, and in April the English rate is still slightly in excess, + 1·091. The defect never reaches the amount found in the comparison with all the States, the greatest recorded occurring in October (— 6·502), and for the last two months of the year England is again in excess.

*General discussion of the results.*—To examine Tables 10 and 11 disease by disease would be but to repeat what has been said in Section IV, and consideration may now be given to Tables 12 and 13, which have been obtained by combining the data of Tables 10 and 11 according to the groups of diseases devised in the previous section.

It will be recollected that group 1 provided a belt of fairly stable excess mortality for England throughout the year. From Table 12 it can be seen how stable this amount actually is. It fluctuates only from 1·134 in November to 2·002 in May, and it may be repeated that the interpretation of the figures is that the difference between English and U.S.A. mortality in the month of January amounted to + 12·642 per cent. of the U.S.A. figure, + 1·801 being contributed by group 1. Within the group, non-respiratory tuberculosis is the predominant element.

In Table 13 the amount contributed by group 1 is slightly higher. This is principally due to the fact that, in the comparison of England with New England, it was found more accurate to include diarrhoea and enteritis in this group. If the amount of constant excess contributed by diarrhoea (as shown by Table 11) is deducted from group 1 of Table 13, it will be found that the figures then are much closer to those of Table 12.

Group 2 consists of diseases favourable to England to a fairly constant extent throughout the year. Tables 12 and 13 show that the amount of this advantage far outweighs the amount of excess provided by the previous group. It is, in fact, seven to eight times as great in the comparison with the U.S.A. and five to six times as great in the comparison with New England. The principal constituents of the group are nephritis and cerebral haemorrhage, the former by itself providing about half the total contributed by the group. Of the yearly average of — 8·178 provided by this



TABLE 12

## ENGLAND AND WALES AND UNITED STATES OF AMERICA

*Comparing the composition of the excess or defect of mortality in England and Wales at each month of the year*

Group and type of seasonal incidence.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1 (Winter + ; Summer +) ..	+ 1·801	+ 1·938	+ 1·857	+ 1·998	+ 2·002	+ 1·828	+ 1·741	+ 1·662	+ 1·377	+ 1·145	+ 1·134	+ 1·589	+ 1·681
2 (Winter - ; Summer -) ..	- 7·374	- 7·763	- 7·967	- 8·302	- 8·819	- 8·705	- 8·852	- 8·216	- 8·404	- 8·574	- 7·940	- 7·487	- 8·178
3a (Winter + ; Summer +) ..	+ 10·242	+ 10·748	+ 8·000	+ 5·808	+ 3·833	+ 3·982	+ 2·627	+ 2·566	+ 2·625	+ 3·021	+ 4·075	+ 5·398	+ 5·435
3b (Other Causes) ..	+ 7·810	+ 7·163	+ 5·737	+ 4·528	+ 3·529	+ 1·303	+ 0·370	+ 2·031	+ 2·355	+ 3·203	+ 4·829	+ 6·627	+ 4·236
4 (Winter - ; Summer -) ..	- 3·169	- 3·237	- 3·049	- 3·552	- 4·353	- 6·197	- 7·784	- 6·633	- 6·447	- 5·961	- 5·244	- 4·196	- 4·872
5a (Winter + ; Summer -) ..	+ 3·043	+ 2·779	- 0·675	- 2·229	- 3·090	- 3·044	- 3·523	- 2·849	- 2·790	- 2·821	- 2·000	- 2·560	- 1·522
5b (Winter + ; Summer -) ..	+ 0·515	+ 0·439	+ 0·469	+ 0·267	- 0·315	- 1·545	- 2·038	- 1·603	- 1·212	- 0·816	+ 0·071	+ 0·504	- 0·376
* (Winter - ; Summer +) ..	- 0·026	- 0·064	- 0·090	- 0·052	- 0·055	- 0·008	+ 0·066	+ 0·054	+ 0·012	- 0·022	-	-	- 0·011
All causes (percentage excess) ..	+12·642	+11·998	+ 4·282	- 1·533	- 7·538	-12·387	-17·394	-12·988	-12·451	-10·791	- 5·100	- 0·136	- 3·606

The basis of classification is the seasonal relationship existing between the English and American disease mortality rates and is explained in the text. The composition of the groups is as follows:—

1. Diphtheria erysipelas, encephalitis lethargica, tuberculosis (non-respiratory)
  2. Diabetes, cerebral haemorrhage, nephritis, the puerperal state, suicide.
  - 3a. Measles, whooping cough, epidemic cerebrospinal meningitis, respiratory tuberculosis, bronchitis and pneumonia combined.
  - 3b. Aggregate of unspecified causes.
  4. Typhoid fever, dysentery, malaria, deaths from violence.
  - 5a. Influenza, heart disease.
  - 5b. Diarrhoea and enteritis (all ages).
- \* Scarlet fever only (see p. 46).

TABLE 13

## ENGLAND AND WALES AND NEW ENGLAND

*Comparing the composition of the excess or defect of mortality in England and Wales at each month of the year*

Group and type of seasonal incidence.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1 (Winter + ; Summer +) ..	+ 2·862	+ 2·714	+ 2·630	+ 2·634	+ 2·756	+ 2·894	+ 2·605	+ 2·811	+ 2·791	+ 2·853	+ 2·605	+ 3·085	+ 2·774
2 (Winter - ; Summer -) ..	- 9·478	-10·214	-10·707	-12·171	-13·686	-12·294	-12·824	-12·402	-13·291	-14·306	-11·549	-10·348	-11·824
3a (Winter ++ ; Summer +) ..	+14·289	+15·385	+12·569	+ 8·175	+ 5·720	+ 6·548	+ 5·096	+ 4·738	+ 5·053	+ 4·634	+ 6·646	+ 9·655	+ 8·572
3b (Other Causes) .. .. .	+ 6·994	+ 6·803	+ 6·466	+ 4·518	+ 4·085	+ 2·673	+ 3·642	+ 4·152	+ 3·459	+ 3·603	+ 5·771	+ 7·417	+ 5·101
4 (Winter - ; Summer --) ..	- 1·760	- 1·735	- 1·569	- 1·937	- 2·691	- 3·115	- 4·163	- 3·310	- 3·596	- 3·341	- 3·171	- 2·756	- 2·687
5 (Winter + ; Summer -) ..	+ 0·022	+ 0·022	+ 0·016	+ 0·004	- 0·015	+ 0·004	- 0·030	- 0·069	- 0·066	- 0·012	- 0·024	+ 0·003	- 0·004
* (Winter - ; Summer +) ..	- 0·088	- 0·135	- 0·081	- 0·132	- 0·118	+ 0·029	+ 0·062	- 0·018	+ 0·071	+ 0·066	+ 0·004	+ 0·047	- 0·030
All causes (percentage excess) ..	+12·841	+12·840	+ 9·324	+ 1·091	- 3·949	- 3·261	- 5·614	- 4·097	- 5·579	- 6·503	+ 0·283	+ 7·103	+ 1·903

The basis of classification is the seasonal relationship existing between the English and New England disease mortality rates and is explained in the text. The composition of the groups is as follows:—

1. Diphtheria, erysipelas, encephalitis lethargica, tuberculosis (non-respiratory), diarrhoea and enteritis (all ages).
2. Diabetes, cerebral haemorrhage, diseases of the heart, nephritis, puerperal state, suicide.
- 3a. Measles, whooping cough, influenza, epidemic cerebrospinal meningitis, respiratory tuberculosis, bronchitis and pneumonia combined.
- 3b. Other causes.
4. Typhoid fever, deaths from violence.
5. Dysentery and malaria.
- \* Scarlet fever only (see p. 46).

group, nephritis accounts for  $-4.533$ , cerebral haemorrhage for  $-1.974$ , diabetes for  $-0.846$ , puerperal causes for  $-0.492$ , and suicide for  $-0.333$ .

The increased amount due to this group when the comparison is with New England is owing to the inclusion of diseases of the heart, which, with an average contribution of  $4.223$ , is the prime element.

The most important group (Winter ++ ; Summer +) is considered next. The difference between the English mortality and that of the United States from this group of diseases in January amounts to  $+10.242$  per cent. of the total mortality of the latter. If the aggregate of the unspecified causes is also included, as it should be, with this type, the difference amounts to  $+17.852$  per cent. In July the difference, though still in excess for England, falls to  $2.997$  per cent. of the total U.S.A. mortality. Thus, as was noted in the previous section, the group of constant excess when reinforced by this group 3 far outweighs the group of constant advantage in the first four months of the year ; but with the great downward swing of the diseases of group 3 in England, most of the excess vanishes, and from May to October the advantage provided by the second group exceeds the aggregate of groups 1 and 3.

As regards the relative importance of the members of this group, first place must be given to the unspecified diseases. The amount provided by them (3b) in the first three months of the year amounted to about 70 per cent. of that provided by all other members of the group together (3a) (Table 12). From October to the end of the year the contribution of the unspecified section exceeds that of the remainder of the group. After these in importance are bronchitis and pneumonia combined, which contribute  $+7.020$  at the beginning of the year, but only  $+1.914$  in July. Respiratory tuberculosis is next in importance, its contribution ranging from  $+1.776$  in January to  $+0.208$  in July.

When Table 13 is considered with regard to the influence of this group on the comparison of England with the New England States, it is found that although the unspecified group is still the predominant element, it never exceeds the aggregate of other members. But this is only because in this comparison the group is enhanced by the addition of another member, influenza, the mortality rates of which in England have been found to be at every month in excess of those in New England. The importance of this disease is second only to bronchitis and pneumonia : in January its contribution is  $+3.857$ , but in August it falls as low as  $+0.096$ . Nevertheless, even with this substantial addition, the same feature is seen in New England as in the whole of the States—that from May to October the aggregate contribution of groups 1 and 3 is insufficient to neutralise entirely the favourable advantage obtained by England from group 2.

Thus, when group 2 is reinforced by the inclusion of group 4, which contains diseases particularly favourable to England during

the summer, the ultimate relation between the total mortalities is definitely fixed. In winter the advantage provided by this group is of little effect against the group of high winter excess, but from June to September it is effective in counteracting its influence. This is not quite the case when Table 13 is considered; for, whereas in the comparison with the States the group comprises typhoid fever, dysentery, malaria and deaths from violence, in the comparison with New England dysentery and malaria are omitted.

The influence of the higher rate in the United States from deaths from violence is too important to be passed over without mention. The excess in the United States, equivalent in January to 2·907 per cent. of the total mortality, increases until in July it amounts to 6·268 per cent., thus providing four-fifths of the total contribution of this group or one-third of the total advantage possessed by England in its most favourable month. As regards New England, its relative effect is at least as strong if not more so.

Finally, consideration may be given to the diseases which contribute both to England's excess in the winter and advantage in the summer—influenza, heart diseases and, by a different type of influence, diarrhoea and enteritis: as has already been shown, none of these portrays the double phenomenon in the comparison with New England. As concerns the excess provided in January and February, influenza is the more important, its contribution in those two months being 2·288 and 2·314, as compared with 0·755 and 0·465 from heart disease. In March they are both slightly lower in England than in the United States, and in April this advantage has increased to 2·229 per cent. of the total mortality of the States; it increases monthly until, in July, it reaches the figure of 3·523 per cent., after which it fluctuates between 2 and 3 per cent. until the end of the year. Thus whilst it is only in these two diseases that the phenomena under consideration appear, it may be concluded that the general mortality is in no way dominated by these diseases nor is it merely a reflection of the features they show. It is more correct to regard the phenomena as produced by the combination of the four earlier groups, and enhanced by these two diseases. Diarrhoea and enteritis, which also show substantially to the advantage of England from June to October but somewhat to its disadvantage from January to April, provide this by reason of a greater rise in the summer in America than in England.

## VI. BRONCHITIS AND PNEUMONIA—AGE AND REGIONAL DISTRIBUTION

The importance of bronchitis and pneumonia has been found sufficiently pronounced to merit a supplementary analysis in order to provide information as to the age and regional distribution of the mortality from these diseases. This information can relate to annual rates only, since, as stated earlier, data relating to seasonal incidence do not exist except for England and Wales as a whole. In this section, therefore, all mortality rates, whilst calculated for precisely the same periods and based on the same assumptions as those calculated in the previous sections, are annual rates per 1,000 and not average deaths per day in each month per million of the population.

### (a) ENGLAND AND WALES

For England and Wales, standardised rates for "persons" and rates in five broad age groups, distinguishing sex, have been calculated for the main divisions into which the country is customarily divided by the Registrar-General in the regional and density summaries of the annual reports. These rates are shown in Table 14 for both bronchitis and pneumonia separately, and for the two diseases combined.

*Bronchitis.*—It is at the oldest age group that the mortality from bronchitis is the highest. At ages of 65 and over, the rate in every division of the country is never less than twelve times that of the standardised rate for all ages. Next in importance to this group, though with a rate equivalent to only one-sixth in size, is the youngest group of ages—under 5. Here the average for males for the whole country is 0·76 per 1,000 as against 4·69 at ages 65 and over. Briefly, it may be said that bronchitis has some significance during the first five years of life, but is relatively negligible from 5 to 45. After age 45 the mortality rapidly increases, until after age 65 the number of deaths increases to nearly 5 per 1,000 per year.

*Pneumonia.*—In contrast to bronchitis, it may be seen from the pneumonia section of the table that for England and Wales as a whole it is the youngest and not the oldest age group that provides the highest rate of mortality (for males, 3·60 per 1,000 at ages 0–4, and 2·84 at ages 65 and over). But this is not true of all parts of the country. The converse holds in Greater London, the South East, and South West regions, whilst in the Eastern region and in the aggregate of rural districts the rates for the youngest and the oldest groups only slightly differ.

*Bronchitis and pneumonia combined.*—It is important to bear in mind therefore, when the rates of the combined diseases are examined in section (c) of the table, that whilst the rates at ages 65 and over are composed of about 60 per cent. bronchitis and 40 per cent. pneumonia, the rates at ages under 5 are about 83 per cent. pneumonia and only 17 per cent. bronchitis.

TABLE 14

Age and Regional distribution of mortality from bronchitis and pneumonia in England and Wales  
Average of years 1931-35 — rates per 1,000 of the population

		(a) Bronchitis.						(b) Pneumonia.						(c) Bronchitis and pneumonia.								
		0—	5—	25—	45—	65+	Crude.	Stand-ard-ised.	0—	5—	25—	45—	65+	Crude.	Stand-ard-ised.	0—	5—	25—	45—	65+	Crude.	Stand-ard-ised.
England and Wales	M.	0.759	0.019	0.075	0.569	4.691	0.492	0.373	3.598	0.160	0.381	1.107	2.844	0.737	0.745	4.357	0.179	0.456	1.676	7.535	1.229	1.118
	F.	0.615	0.016	0.037	0.264	4.281	—	—	2.870	0.120	0.201	0.511	2.374	—	3.485	0.136	0.238	0.775	6.655	—	—	
South East Region (ex-cluding Greater London)	M.	0.378	0.014	0.046	0.352	3.919	0.438	0.260	2.064	0.106	0.255	0.810	2.393	0.560	0.500	2.442	0.120	0.301	1.162	6.312	0.998	0.760
	F.	0.352	0.011	0.025	0.145	3.547	—	—	1.704	0.090	0.170	0.410	1.876	—	2.056	0.101	0.195	0.555	5.523	—	—	
Greater London	M.	0.455	0.012	0.072	0.597	4.335	0.408	0.312	3.286	0.115	0.312	1.237	3.915	0.744	0.738	3.741	0.127	0.384	1.834	8.250	1.152	1.050
	F.	0.360	0.012	0.029	0.210	3.724	—	—	2.541	0.091	0.180	0.568	3.167	—	2.901	0.103	0.209	0.778	6.891	—	—	
Northern Region	M.	1.087	0.025	0.102	0.703	5.157	0.549	0.473	4.840	0.223	0.486	1.267	2.878	0.880	0.939	5.927	0.248	0.588	1.970	8.035	1.429	1.412
	F.	0.875	0.021	0.051	0.365	4.976	—	—	3.876	0.164	0.252	0.598	2.395	—	4.751	0.185	0.303	0.963	7.371	—	—	
Midland Region	M.	0.719	0.019	0.064	0.514	4.938	0.484	0.374	3.521	0.169	0.454	1.175	2.734	0.730	0.737	4.240	0.188	0.518	1.689	7.672	1.214	1.111
	F.	0.578	0.014	0.034	0.268	4.476	—	—	2.755	0.109	0.180	0.474	2.219	—	3.333	0.123	0.214	0.742	6.695	—	—	
Eastern Region	M.	0.570	0.015	0.032	0.331	4.214	0.508	0.295	2.148	0.107	0.245	0.701	2.010	0.536	0.487	2.718	0.122	0.277	1.032	6.224	1.044	0.782
	F.	0.438	0.013	0.012	0.179	4.312	—	—	1.871	0.085	0.151	0.379	1.799	—	2.309	0.098	0.163	0.558	6.111	—	—	
South West Region	M.	0.540	0.017	0.054	0.374	4.370	0.535	0.298	1.905	0.101	0.244	0.723	2.195	0.543	0.468	2.445	0.118	0.298	1.097	6.565	1.078	0.766
	F.	0.436	0.013	0.022	0.178	3.986	—	—	1.598	0.087	0.175	0.374	1.955	—	2.034	0.100	0.197	0.552	5.941	—	—	
Welsh Region	M.	1.110	0.018	0.076	0.738	5.740	0.568	0.467	3.601	0.131	0.321	0.948	2.572	0.671	0.697	4.711	0.149	0.397	1.686	8.312	1.239	1.164
	F.	0.885	0.020	0.050	0.323	4.802	—	—	2.848	0.122	0.185	0.409	2.116	—	3.733	0.142	0.235	0.732	6.918	—	—	
Aggregate of County Boroughs	M.	0.912	0.023	0.101	0.746	5.298	0.552	0.454	4.894	0.211	0.510	1.399	3.166	0.907	0.956	5.706	0.234	0.611	2.145	8.464	1.459	1.410
	F.	0.734	0.018	0.043	0.350	5.008	—	—	3.837	0.145	0.244	0.605	2.567	—	4.571	0.163	0.287	0.955	7.575	—	—	
Aggregate of Urban Districts	M.	0.850	0.021	0.068	0.529	4.841	0.508	0.384	3.258	0.160	0.355	0.950	2.357	0.656	0.672	4.108	0.181	0.423	1.479	7.198	1.164	1.055
	F.	0.676	0.016	0.041	0.276	4.281	—	—	2.651	0.123	0.187	0.438	1.993	—	3.327	0.139	0.228	0.714	6.274	—	—	
Aggregate of Rural Districts	M.	0.679	0.015	0.046	0.321	4.125	0.463	0.304	2.289	0.120	0.283	0.744	2.283	0.569	0.526	2.968	0.135	0.329	1.065	6.408	1.032	0.830
	F.	0.585	0.016	0.028	0.158	3.824	—	—	1.926	0.102	0.172	0.401	1.878	—	2.511	0.118	0.200	0.559	5.702	—	—	

Regions.—The constitution of the regions is:—

*Greater London.*  
The area coincident with the City of London and Metropolitan Police Districts—approximately 15 miles radius from Charing Cross.

*South East.*  
Bedfordshire.  
Berkshire.  
Buckinghamshire.  
Essex.  
Hertfordshire.  
Kent.  
London.  
Middlesex.  
Oxfordshire.  
Southampton.  
Surrey.  
Sussex—  
East.  
West.  
Wight, Isle of.

*Northern.*  
Durham.  
Northumberland.  
Cumberland.  
Westmorland.  
Yorkshire—  
East Riding.  
North Riding.  
West Riding.  
York C.B.  
Cheshire.  
Lancashire.

*Midland.*  
Gloucestershire.  
Herefordshire.  
Shropshire.  
Staffordshire.  
Warwickshire.  
Worcestershire.  
Derbyshire.  
Leicestershire.  
Northamptonshire.  
Nottinghamshire.  
Peterborough, Soke of.

*Eastern.*  
Cambridgeshire.  
Ely, Isle of.  
Huntingdonshire.  
Lincolnshire—  
Part of Holland.  
Part of Kesteven.  
Part of Lindsey.  
Norfolk.  
Rutlandshire.  
Suffolk—  
East.  
West.

*South West.*  
Cornwall.  
Devonshire.  
Dorsetshire.  
Somersetshire.  
Wiltshire.

*Wales.*  
Brecknockshire.  
Carmarthenshire.  
Glamorganshire.  
Monmouthshire.  
Anglesey.  
Caernarvonshire.  
Cardiganshire.  
Denbighshire.  
Flintshire.  
Merionethshire.  
Montgomeryshire.  
Pembrokeshire.  
Radnorshire.

Another important point to observe as regards both diseases is the excess of male over female mortality, particularly at ages 45-64, in which group there is in nearly every division 100 per cent. excess. At the oldest group of ages, the amount of excess is much less (in the case of the Eastern region the excess for bronchitis entirely disappears).

The following are the chief points to be remembered from Table 14. (1) That the greater part of bronchitis mortality occurs at ages over 65 in all parts of the country. (2) That for pneumonia, both the oldest and the youngest age groups are important. In the Northern and Midland regions, in Wales, and in the densely populated towns, the youngest age group is the more important; in the remaining divisions, the oldest group is more important, but only slightly, than the youngest group. (3) That there is excess male mortality from both diseases, particularly in the 45-64 group of ages.

To obtain a clearer picture of the regional distribution of these two diseases, the rates of Table 14 for each division of the country at each age group have been expressed as percentages of the rate for the whole country. The results are tabulated in Table 15. It will be seen that only in the Northern region and in the aggregate of county boroughs were the rates in excess of the average for the whole country at every age group without exception. This is true both of bronchitis and of pneumonia. For females, it is also true of the urban districts as regards bronchitis. Although the Northern region includes those areas which suffered most severely from the economic depression of 1930-1932, it would seem advisable to warn readers against relating the excess shown for this region to the economic depression. In previous work<sup>14</sup> it has been proved that the Northern districts have experienced consistent excess mortality from all causes of death at least since 1911, and there is no reason to suppose that bronchitis and pneumonia are any exception to this.

In Wales, male mortality from bronchitis is very high at ages under 5 and over 45, and for females at every group of ages. Pneumonia mortality however is not above the average at any group of ages except in females between 5 and 24.

The Midland region may be said to experience mortality either slightly above or slightly below average. The remaining districts of the South East, South West, and Eastern England, and particularly the aggregates of the rural areas, show mortality rates from both diseases well below the average. In Greater London the pneumonia rates at ages over 45 are exceedingly high.

Concentrating attention on the bronchitis rates at ages 65 and over, in which group we have shown that most of the bronchitis mortality occurs, we observe that in Wales the male mortality is 122 and the female mortality 112 per cent. of that for England and Wales as a whole. In the aggregate of County Boroughs the

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<sup>14</sup> Lewis-Faning, E. (1938). A study of the trend of mortality rates in urban communities of England and Wales, with special reference to "depressed areas." *Rep. publ. Hlth med. Subj., Lond., No. 86.*

TABLE 15—ENGLAND AND WALES  
Mortality from bronchitis and pneumonia in certain regions and density aggregates of England and Wales expressed as percentages of that for the whole country

	Males.					Females.					Persons.
	0—	5—	25—	45—	65+	0—	5—	25—	45—	65+	All Ages Standardised.
<b>(a) Bronchitis</b>											
England and Wales .. .. .	100	100	100	100	100	100	100	100	100	100	100
South East Region (excluding Greater London)	50	74	61	62	84	57	69	68	55	83	70
Greater London .. .. .	60	63	96	105	92	59	75	78	80	87	84
Northern Region .. .. .	143	132	136	124	110	142	131	138	138	116	127
Midland Region .. .. .	95	100	85	90	105	94	88	92	102	105	100
Eastern Region .. .. .	75	79	43	58	89	71	81	32	68	101	79
South West Region .. .. .	71	89	72	66	93	71	81	59	67	93	80
Welsh Region .. .. .	146	95	101	130	122	144	125	135	122	112	125
Aggregate of County Boroughs .. .. .	120	121	135	131	113	119	113	116	133	117	122
Aggregate of Urban Districts .. .. .	112	111	91	93	103	110	100	111	105	100	103
Aggregate of Rural Areas .. .. .	90	79	61	56	88	95	100	76	60	89	82
<b>(b) Pneumonia</b>											
South East Region (excluding Greater London)	57	66	67	73	84	59	75	85	80	83	67
Greater London .. .. .	91	72	82	112	138	89	76	90	111	133	99
Northern Region .. .. .	135	139	128	114	101	135	137	125	117	101	126
Midland Region .. .. .	98	106	119	106	96	96	90	90	93	93	99
Eastern Region .. .. .	60	67	64	63	71	65	71	75	74	76	65
South West Region .. .. .	53	63	64	65	77	56	72	87	73	82	63
Welsh Region .. .. .	100	82	84	86	90	99	102	92	80	89	94
Aggregate of County Boroughs .. .. .	136	132	134	126	111	134	121	121	118	108	128
Aggregate of Urban Districts .. .. .	91	100	93	86	83	92	102	93	86	84	90
Aggregate of Rural Districts .. .. .	64	75	74	67	80	67	85	86	78	79	71
<b>(c) Bronchitis and Pneumonia</b>											
South East Region (excluding Greater London)	56	67	66	69	84	59	74	82	72	83	68
Greater London .. .. .	86	71	84	109	109	83	76	88	100	104	94
Northern Region .. .. .	136	139	129	118	107	136	136	127	124	111	126
Midland Region .. .. .	97	105	114	101	102	96	90	90	96	101	99
Eastern Region .. .. .	62	68	61	62	83	66	72	68	72	92	70
South West Region .. .. .	56	66	65	65	87	58	74	83	71	89	69
Welsh Region .. .. .	108	83	87	101	110	107	104	99	94	104	104
Aggregate of County Boroughs .. .. .	131	131	134	128	112	131	120	121	123	114	126
Aggregate of Urban Districts .. .. .	94	101	93	88	96	95	102	96	92	94	94
Aggregate of Rural Districts .. .. .	68	75	72	64	85	72	87	84	72	86	74



corresponding figures are 113 and 117 per cent., in the Northern region 110 and 116 per cent., and in the Midland region 105 per cent. for both sexes. Whilst these excesses are not as large as appear in, for example, the youngest group of ages, it must be remembered that a reduction of bronchitis mortality at ages over 65 would be much more effective in reducing this country's general mortality than a proportionate reduction at any other age group.

Turning to pneumonia, and taking into consideration the conclusions arrived at from Table 14, it is clear that of those districts in which pneumonia produces the highest rate in the youngest age group, the Northern region and the aggregate of County Boroughs are the only divisions showing excess (35 per cent.). This is a very large figure and relates to both males and females. On the other hand, of those districts where pneumonia rates are highest at the oldest group, it is in Greater London and to a less extent in the aggregate of County Boroughs that the excess is found: Greater London has excess mortality from pneumonia at ages over 65 amounting to 38 per cent. for males and 33 per cent. for females.

#### (b) NEW ENGLAND

For our purpose New England is not so readily divided into geographical divisions as is England and Wales. Data showing deaths by causes and distributed by age are published only for each of the States and for towns of which the population at the Census of 1930 amounted to 100,000. A list of these towns appears in the footnote to Table 16. In Connecticut, there are three; in Massachusetts, nine; and in Rhode Island only one. The remaining three States have no towns of this size. By suitably combining the deaths and populations, it has been possible to compute rates for each State, both including and excluding the relative towns, comparable with those already given for England and Wales. The tabulation is shown in Table 16.

As in the previous analysis concerning New England, it has not been possible to distinguish sex in the age-distributed rates or to allow for it in standardisation. For comparative purposes the table shows rates for the whole of England and Wales on the same basis, and it will be noticed that here the standardised rates for both bronchitis and pneumonia agree precisely with those given in Table 14, where correction *was* made for sex differences.

In New England the number of deaths attributed to bronchitis is small and when these are subdivided by state, towns and age, the numbers in the sub-groups become exceedingly small and give rise to random fluctuations in the rates. It is evident that, as in England and Wales, the bronchitis mortality is principally of importance at ages over 65. As regards pneumonia, whilst the mortality of the youngest age group is large, in no division does it exceed in importance the mortality of the oldest age group, as it does in the Northern and Midland regions of England and Wales.

TABLE 16—NEW ENGLAND

Age distribution of mortality from bronchitis and pneumonia in each State and in towns of which the population on 1st April, 1930, amounted to 100,000

Average of years 1931-34—rates per 1,000 of the population

	Bronchitis.								Pneumonia.								Bronchitis and Pneumonia.							
						All ages.								All ages.								All ages.		
	0—	5—	25—	45—	65+	Crude.	Stand- ard- ised.	0—	5—	25—	45—	65+	Crude.	Stand- ard- ised.	0—	5—	25—	45—	65+	Crude.	Stand- ard- ised.			
England and Wales	0.688	0.017	0.055	0.407	4.457	0.492	0.373	3.238	0.140	0.286	0.791	2.576	0.737	0.745	3.926	0.157	0.341	1.198	7.033	1.229	1.118			
<i>New England—</i>																								
Total area..	0.095	0.003	0.006	0.034	0.418	0.046	0.038	2.028	0.123	0.337	0.968	4.503	0.813	0.727	2.123	0.126	0.843	1.002	4.921	0.859	0.765			
Towns* ..	0.074	0.003	0.007	0.039	0.344	0.036	0.033	2.956	0.153	0.454	1.345	6.000	1.030	1.004	3.030	0.156	0.461	1.384	6.344	1.066	1.037			
Remainder ..	0.104	0.004	0.006	0.031	0.442	0.051	0.040	1.635	0.110	0.280	0.808	4.017	0.718	0.615	1.739	0.114	0.286	0.839	4.459	0.769	0.655			
<i>Connecticut—</i>																								
Total area..	0.076	0.005	0.005	0.033	0.345	0.036	0.033	1.463	0.114	0.320	1.001	4.100	0.686	0.641	1.539	0.119	0.325	1.034	4.445	0.722	0.674			
Towns* ..	0.098	0.006	0.007	0.039	0.232	0.029	0.032	1.857	0.141	0.431	1.515	5.919	0.869	0.890	1.955	0.147	0.438	1.554	6.151	0.898	0.922			
Remainder ..	0.066	0.004	0.004	0.030	0.377	0.038	0.033	1.294	0.103	0.269	0.810	3.599	0.611	0.551	1.360	0.107	0.273	0.840	3.976	0.649	0.584			
<i>Maine—</i>																								
Total area..	0.286	0.004	0.010	0.041	0.610	0.092	0.072	1.873	0.117	0.249	0.760	3.949	0.777	0.625	2.159	0.121	0.259	0.801	4.559	0.869	0.697			
<i>Massachusetts—</i>																								
Total area..	0.065	0.003	0.007	0.033	0.387	0.040	0.033	2.306	0.132	0.369	1.028	4.776	0.864	0.793	2.371	0.135	0.376	1.061	5.163	0.904	0.826			
Towns* ..	0.072	0.002	0.008	0.042	0.376	0.039	0.035	3.289	0.160	0.458	1.300	6.011	1.071	1.040	3.361	0.162	0.466	1.342	6.387	1.110	1.075			
Remainder ..	0.060	0.003	0.007	0.026	0.393	0.041	0.032	1.616	0.113	0.300	0.837	4.063	0.717	0.625	1.676	0.116	0.307	0.863	4.456	0.758	0.657			
<i>New Hampshire—</i>																								
Total area..	0.082	0.005	0.006	0.045	0.504	0.065	0.043	1.753	0.109	0.251	0.672	4.298	0.784	0.613	1.835	0.114	0.257	0.717	4.802	0.849	0.656			
<i>Rhode Island—</i>																								
Total area..	0.091	0.003	0.001	0.026	0.308	0.032	0.030	2.141	0.126	0.356	1.109	5.373	0.861	0.808	2.232	0.129	0.357	1.135	5.681	0.893	0.838			
Towns* ..	0.036	0.003	—	0.019	0.275	0.024	0.021	2.786	0.131	0.467	1.376	6.038	1.041	0.983	2.822	0.134	0.467	1.395	6.313	1.065	1.004			
Remainder ..	0.119	0.003	0.002	0.030	0.327	0.037	0.035	1.802	0.123	0.291	0.942	4.989	0.757	0.708	1.921	0.126	0.293	0.972	5.316	0.794	0.743			
<i>Vermont—</i>																								
Total area..	0.075	—	0.005	0.034	0.590	0.067	0.042	1.855	0.090	0.243	0.805	4.386	0.815	0.636	1.930	0.090	0.248	0.839	4.976	0.882	0.678			

\* Only towns with a population of over 100,000 at the Census of 1st April, 1930, are included.

<i>Connecticut.</i>	<i>Massachusetts.</i>	<i>Rhode Island.</i>
Bridgeport.	Boston.	Providence.
Hartford.	Cambridge.	
New Haven.	Falls River.	
	Lowell.	
	Lynn.	
	New Bedford.	
	Somerville.	
	Springfield.	
	Worcester.	

TABLE 17

## NEW ENGLAND

Mortality rates from bronchitis and pneumonia in the New England States and towns of 100,000 inhabitants expressed as percentages of the rates for England and Wales

	Bronchitis.						Pneumonia.						Bronchitis and Pneumonia.						
	0—	5—	25—	45—	65+	All Ages Standardised.	0—	5—	25—	45—	65+	All Ages Standardised.	0—	5—	25—	45—	65+	All Ages Standardised.	
England and Wales ..	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
<i>New England—</i>																			
Total area .. ..	14	17	11	8	9	10	63	88	118	122	175	98	54	80	101	84	70	68	
Towns* .. ..	11	17	13	10	8	9	91	109	159	170	233	135	77	99	135	116	90	93	
Remainder .. ..	15	23	11	8	10	11	50	79	98	102	156	82	44	73	84	70	63	59	
<i>Connecticut—</i>																			
Total area .. ..	11	29	9	8	8	9	45	81	112	127	159	86	39	76	95	86	63	60	
Towns* .. ..	14	35	13	10	5	9	57	101	151	192	230	119	50	94	128	130	87	82	
Remainder .. ..	10	23	7	7	8	9	40	74	94	102	139	74	35	68	80	70	57	52	
<i>Maine—</i>																			
Total area .. ..	42	23	18	10	14	19	58	84	87	96	153	84	55	77	76	67	65	62	
<i>Massachusetts—</i>																			
Total area .. ..	9	17	13	8	9	9	71	94	129	130	185	106	60	86	110	89	73	74	
Towns* .. ..	10	12	15	10	8	9	102	114	160	164	233	140	86	103	137	112	91	96	
Remainder .. ..	9	17	13	6	9	9	50	81	105	106	158	84	43	74	90	72	63	59	
<i>New Hampshire—</i>																			
Total area .. ..	12	29	11	11	11	12	54	78	88	85	167	82	47	73	75	60	68	59	
<i>Rhode Island—</i>																			
Total area .. ..	13	17	2	6	7	8	66	90	124	140	209	108	57	82	105	95	81	75	
Towns* .. ..	5	17	—	5	6	6	86	94	163	174	234	132	72	85	137	116	90	90	
Remainder .. ..	17	17	4	7	7	9	56	88	102	119	194	95	49	80	86	81	76	66	
<i>Vermont—</i>																			
Total area .. ..	11	—	9	8	13	11	57	64	85	102	170	85	49	57	72	70	71	61	

\* Only towns with a population of over 100,000 at the Census of 1st April, 1930, are included.

Perhaps the most surprising fact indicated by these figures is that, whereas in England the towns have bronchitis mortality between 10 and 30 per cent. in excess of the rest of the country, in New England considered as a whole they have an advantage over the less populated areas. This is not so for pneumonia. Some data analysed by Herrington and Moriyama<sup>15</sup> are relevant. They correlated mortality rates from influenza, broncho-pneumonia, and asthma, for the 44 States of the United States, with various climatic and socio-economic indices, and found a negative correlation of  $-0.69$  between influenza and per cent. of urban population, of  $-0.38$  between asthma and per cent. of urban population, but positive correlations between broncho- and lobar-pneumonia and urbanisation.

It will also be observed that the bronchitis rates are higher in those States where no large towns exist.

In Table 17 the rates in these various divisions of New England are expressed as percentages of the rates for the whole of England and Wales. The section of the table devoted to bronchitis serves to emphasise the disparity between the English and American rates from this disease which has been shown in the main section of this report, the English rates being approximately ten times as large as in the States. As regards pneumonia, especially in the towns and particularly at the older ages, the advantage is with England and Wales.

To conclude, it seems advisable to remind the reader that the separation of the figures relating to bronchitis and pneumonia, which has been made in this section, is subject to the same qualifications as were set out earlier on p. 33.

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<sup>15</sup> Herrington, L. P., and Moriyama, I. M. (1939). The relation of mortality from certain respiratory diseases to climatic and socio-economic factors. *Amer. J. Hyg.*, 29. 111.

## VII. SUMMARY AND CONCLUSIONS

*Summary.*—For many years the mortality of England and Wales as compared with that of Germany and the United States has been higher in the winter and lower in the summer months of the year. The high rate in the winter is generally attributed to the respiratory group of diseases, and it is often implied that the double phenomenon apparent in the relations between the total rates of mortality is but the reflection of similar features existing between the rates of the countries as regards these and other diseases.

The object of this investigation was to render the comparison more precise by the use of statistical analysis in contrasting the seasonal trends and swing of the individual diseases, their points of maxima and minima, and the comparative levels of mortality in the different countries in each month of the year. In the last stage of the work it is shown how the excess winter and deficient summer mortality of England is distributed amongst the various diseases.

The scope of the analysis was limited by the official data available in the respective countries. It was possible to examine individually only those diseases in regard to which the number of deaths occurring in each month is recorded. A list of these will be found in Table 3. The data related to the period 1931–1934 for America and to 1931–1935 for England and Wales and for Germany.

It has been argued in Section II that for an accurate solution of the problem the use of standardised monthly rates of mortality was essential, and since these were not available for Germany only very limited use has been made of the German data. So far as the relation between the rates of England and Germany is concerned, the investigation offers no explanation of the phenomenon.

Special attention has been given, however, to that portion of the United States which may be considered to compare most closely with England and Wales, namely the New England States.

For every disease for which the data were available, average daily rates in each month of the year per million of the population, and standardised on the 1901 standard population of England and Wales, were calculated for England, the United States, and the New England States. These rates have been compared as regards seasonal trend, maxima and minima, range and variability, the more important diseases being discussed separately. For each month the contribution of each disease towards the total difference between the English and American mortality has been computed.

*Conclusions.*—This lengthy analysis, like most statistical inquiries, has had set-backs owing to the incompleteness or ambiguity of the data. Owing to incompleteness of sub-classification in official data, it has been necessary to form an inconveniently large and heterogeneous group of "unspecified causes", the importance of which may be judged from the fact that it amounts to 39 per cent. of the English and 33 per cent. of the American annual mortality from all causes of death. Owing to variations of medical custom or official book-keeping, differences in rates of mortality from similar or associated causes—*e.g.*, pneumonia and bronchitis—may be more decisive

on paper than in reality. Nevertheless, in spite of such inevitable weaknesses, one can draw some fairly certain conclusions and plausible inferences from these.

In the first place, there is no doubt of the winter disadvantage and summer advantage of England and Wales over the United States as a whole, in respect of rates of mortality. When the comparison is between England and New England, the winter disadvantage of the former persists, but the summer advantage—which varied from 12 to 17 per cent. when comparison was made with the United States as a whole—is reduced to between 3 and 6 per cent.

In the next place, as might have been expected, this general effect is compounded of a large number of special effects. Very few causes of death—indeed only two—when expressed in graphs give seasonal curves which could be said to reproduce the form of the all-causes graph; it is not generally true that a cause of death which is above the American standard in the winter is below that standard in summer. It appears, then, that the largest contributors by name to an unfavourable winter balance in England are bronchitis, influenza, respiratory tuberculosis and pneumonia, the total excesses of which amount to more than 10 per cent. of the whole standardised death rate (*see* Table 10) in February. In July, the month of most favourable comparison, the two large factors of seasonal advantage are diseases of the heart and violence, which together show a balance favourable to England of nearly 10 per cent. of the whole death rate. The word seasonal is emphasised because both cerebral haemorrhage and nephritis also give substantial credit balances in July: but they persist in the winter whereas the balance for heart disease in the winter is slightly unfavourable.

From these results certain conclusions may be drawn. Both advantage and disadvantage depend on factors of mortality which are in some degree preventable. On the one hand, it is obvious that the American authorities are not likely to permit the rate of mortality from violence to remain so high. On the other, the view expressed long ago by Dr. Stevenson<sup>16</sup> that pneumonia was a preventable disease, and that some parts of England and Wales had a good deal to learn with respect to prevention, may without much risk be extended to bronchitis; while nobody is likely to question the importance of environmental factors (using environmental to include nutritional) in respiratory tuberculosis. Influenza of the period studied perhaps comes within the same group. It has been shown elsewhere that it is probable that the unfavourable rates of mortality in certain parts of the country, especially the industrial north, are not primarily due to transitory economic phenomena, but have had a quasi-permanence. This seasonal analysis brings out the same point. Yet it is true that preventable mortality is in question.

In the present state of the nation, these facts do not lose importance.

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<sup>16</sup> Registrar-General's Annual Report for England and Wales (1912), p. 94.