An analysis of the infantile mortality of Scarborough, for the thirty years, 1876-1905, with recommendations / by John Knight, Medical Officer of Health.

1.Enclos:

JOHN KNIGHT, M.D., D.P.H., CAMB.
MEDICAL OFFICER OF HEALTH.

Health Department.
King Street.
Scarborough. 6th. May 1907.

Dear Sir,

In reply to your circular letter allow me to say that I shall be glad to forward you a copy of my Annual Report for the Library.

Meantime I have pleasure in enclosing a copy of my special Report on Infantile Mortality, the preparation of which has somewhat delayed the appearance of the Annual Report.

Yours faithfully,

John Knight

The Librarian,

British Medical Association Library,

429 Strand, W.C.

AN ANALYSIS

OF THE

INFANTILE MORTALITY

OF

SCARBOROUGH,

For the Thirty Years, 1876--1905,

WITH

Recommendations.

BY

JOHN KNIGHT, M.D., D.P.H., Camb.,

Medical Officer of Health.

Health Department,

King Street,

Scarborough,

28th January, 1907.

To the Town Council of the Borough of Scarborough.

Gentlemen,

The following Report is based upon the examination of the weekly death-returns for thirty years. Each infantile death has been abstracted and classified according to the new Local Government Board Table issued in 1906.

I have the honour to be,

Gentlemen,

Your obedient Servant,

JOHN KNIGHT.

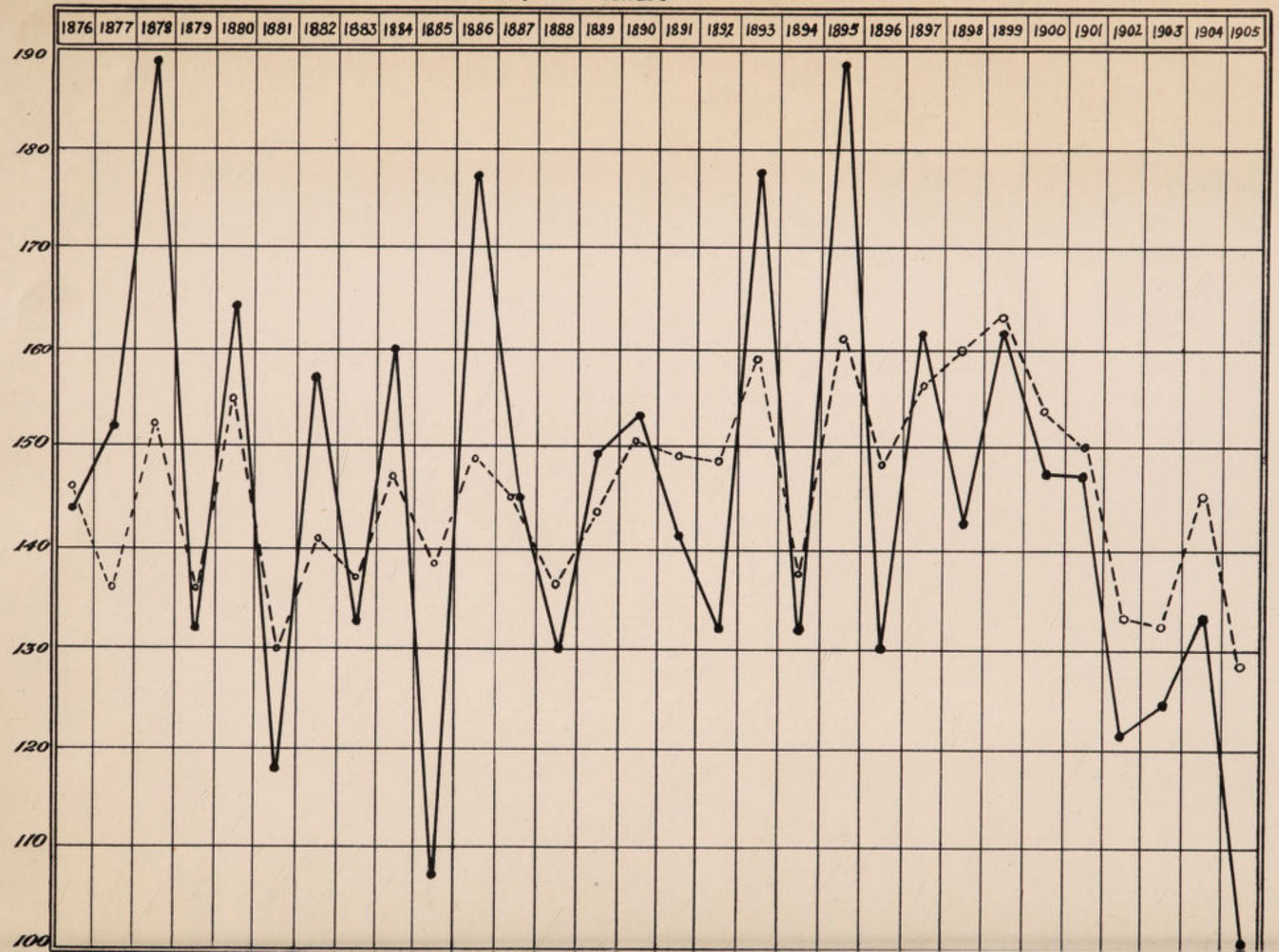
INFANTILE DEATH RATE

1876 to 1905 INCLUSIVE

SCARBOROUGH ——————

ENGLAND AND WALES - - - - - - - -

CHART A.



INFANTILE DEATH-RATES, 1876-1905.

Year.	Scarborough.	England and Wales.
1876	144	146
1877	152	136
1878	188	152
1879	132	135
1880	164	153
1881	118	130
1882	157	141
1883	133	137
1884	160	147
1885	107	138
1886	176	149
1887	145	145
1888	130	136
1889	149	144
1890	153	151
1891	141	149
1892	132	148
1893	177	159
1894	132	137
1895	188	161
1896	130	148
1897	161	156
1898	142	160
1899	161	163
1900	147	154
1901	147	151
1902	121	133
1903	124	132
1904	133	145
1905	100	128

Scarborough—Average 144. England and Wales—Average 145.

REPORT.

The term "infantile mortality" denotes the annual number of deaths, in any community, of children under the age of one year. Such number of deaths, stated as a proportion per thousand births registered, constitutes the "infantile death-rate."

In this connection, the expression, "per thousand births registered," is universally accepted as being practically equivalent to "per thousand living under the age of one year." The rates so calculated have the advantage of being based upon two actually ascertained facts, the number of infantile deaths and of births registered.

Attention has been specially directed of recent years to the infantile mortality largely owing to three considerations :—

(1). During the last thirty years there has been a steady fall in the general death-rate, but the infantile death-rate has remained almost stationary.

(2). The same period has witnessed a marked decline in the birth-rate.

(3). The infantile death-rate is a very high one.

This combination of falling birth-rate and stationary infantile death-rate not only justifies, but urgently calls for an enquiry into the causes of infantile mortality.

In order to thoroughly appreciate the excessive death-rate of infants under one year, comparison must be made with the death-rates at other periods of life.

The general death-rate, *i.e.*, the annual number of deaths per thousand living at all ages, really covers a number of death-rates which vary enormously from one another, as will be seen from the subjoined Table.

In 1904 the general death-rate of England and Wales was 16·2 per 1,000. Analysed into death-rates per thousand living at certain age-periods, it yielded the following results :

Under 5 years.	5 to 10 years.	10 to 15 years.	15 to 20 years.	20 to 25 years.	25 to 35 years.	35 to 45 years.	45 to 55 years.	55 to 65 years.	65 to 75 years.	75 to 85 years.
51·6	3·5	2·1	3·0	3·8	5·3	8·8	15·0	29·2	62·3	131·4

For the same year the infantile death-rate was 145 per thousand, a rate which is not approached at any other age under 75 years, and is many times that prevailing between the ages of 10 and 20 years.

The course pursued by the infantile death-rate of England and Wales, and of Scarborough during the period under review (1876 to 1905) is shown by Chart "A." Two features are specially noticeable :—

(1). The fluctuation of the rate from year to year.

(2). The close correspondence of the local with the general rate, the greater variation in the former being due to the much smaller numbers dealt with.

A marked reduction of the rate has taken place in the last 5 year period, but how little real improvement has been made can be seen from the following Table :—

TABLE I.

INFANTILE DEATH-RATES.

SCARBOROUGH.			ENGLAND & WALES.		
1876-1880 ..	156 per 1,000		1876-1880 ...	144 per 1,000	
1881-1885 ...	135 ,,	average 147	1881-1885 ...	138 ,,	average 145
1886-1890 ..	150 ,,		1886-1890 ...	145 ,,	
1891-1895 ..	154 ,,		1891-1895 ..	150 ,,	
1896-1900 ...	148 ,,	average 142	1896-1960 ...	156 ,,	average 148
1901-1905 ...	125 ,,		1901-1905 ...	138 ,,	

For the thirty years under review the infantile death-rate of Scarborough is 144 and of England and Wales 145 per 1,000.

Later it will be shown that the fluctuation of the rate from year to year is largely influenced by the relative prevalence of Epidemic Diarrhœa.

Attention may now be directed to the Seasonal Variation in number of the infantile deaths.

Chart "B" represents the infantile deaths for the last 30 years for each week of the year, and Chart "C" collects these into quarters of the year. The greatest number of deaths occur in the third quarter (31·3%), the least in the second (21%); the first (22·3%) and fourth quarters (25·4%) being intermediate.

This yearly distribution of the infantile deaths presents a marked contrast to that of the deaths at all ages. Of the general population, the deaths are most numerous in the first quarter and least at the third. Evidently, therefore, some influences specially inimical to infant life come into play during the third quarter of the year.

Examination of the Weekly Chart shews that the deaths suddenly and markedly increase in the middle of the third quarter, and this increase is maintained into the first part of the fourth quarter.

—TOTAL— INFANTILE—DEATHS—
IN WEEKLY AND QUARTERLY PERIODS

CHART B.

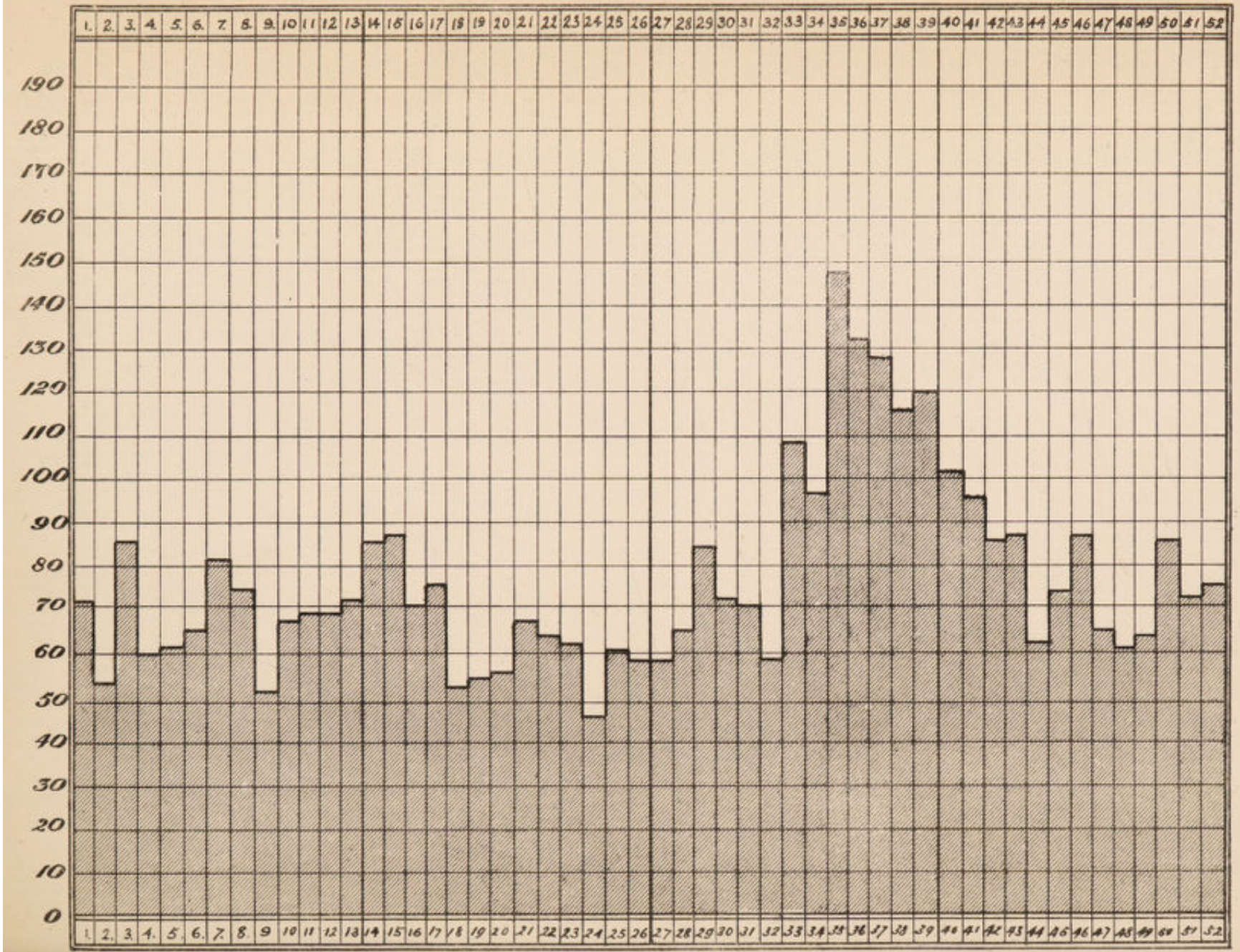
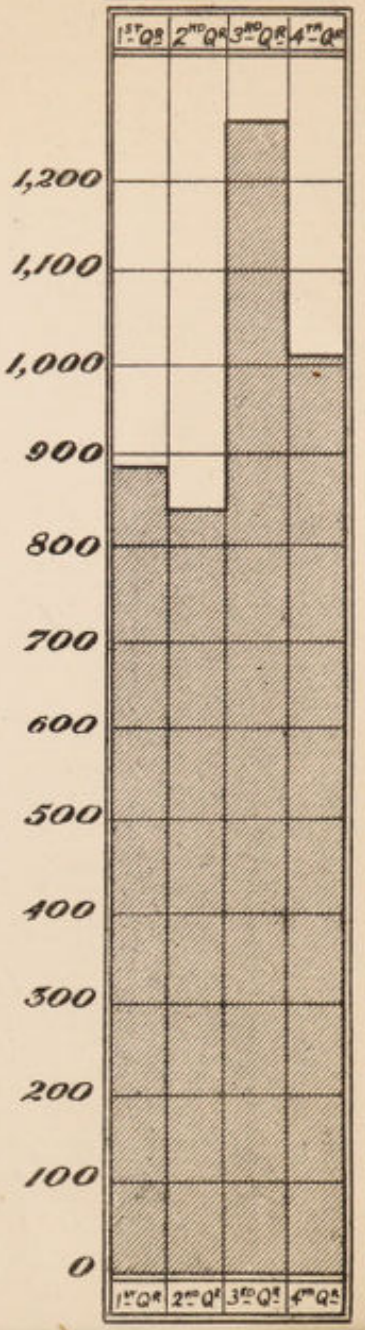
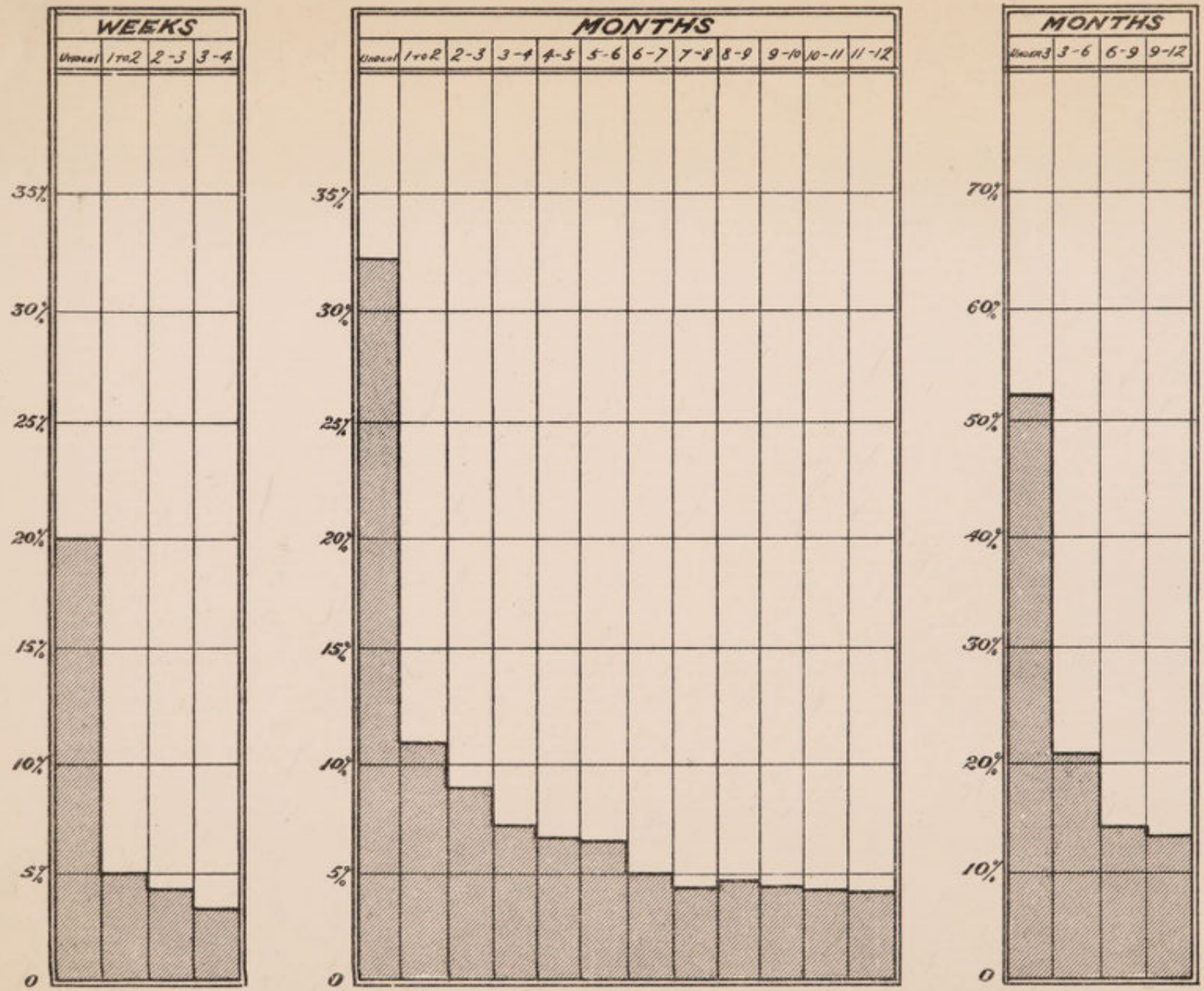


CHART C.



PERCENTAGE-OF-TOTAL-DEATHS
AT AGE PERIODS
CHART D.



When the quarterly charts of the various groups of diseases are studied, it will be found that this characteristic excess of deaths in the third quarter is due to Diarrhœal diseases.

AGES OF INFANTS AT DEATH.

The newly-born infant has but a slender hold upon existence, a hold which, however, becomes increasingly tenacious with every day that the infant survives. The risk of death is greatest on the day of birth, but rapidly decreases during the first week. By the end of the first week the chances of survival are enormously enhanced, and are continually improving, though at a much slower rate, during the first twelve months of life.

In round numbers 20%, or one-fifth, of the deaths occur under the age of one week, 33%, or one-third of the total deaths, under one month, 53%, or more than one-half, under three months, 20% between three and six months, 14% between six and nine months. and 13% between nine and twelve months. (See Chart D.)

The actual number of deaths at each of these age-periods from 1876 to 1905 is as follows:—

TABLE II.

Under 1 week.	1 to 2 weeks.	2 to 3 wks.	3 to 4 wks.	Under 1 month.	1 to 2 months.	2 to 3 m'ths.	3 to 4 m'ths.	4 to 5 m'ths.	5 to 6 m'ths.	6 to 7 m'ths.	7 to 8 m'ths.	8 to 9 m'ths.	9 to 10 m'ths.	10 to 11 m'ths.	11 to 12 m'ths.	Total.
778	202	167	141	1288	442	362	287	266	263	197	181	183	176	174	173	3992

As at almost all other age periods, so under the age of one year, males die in proportionally greater numbers than females, from nearly all the various causes.

INFLUENCE OF ILLEGITIMACY.

Of much greater importance than the influence of sex in determining a high mortality, is the influence of illegitimacy.

The unfavourable conditions under which these unfortunate infants come into the world are so obvious as to need little comment. Not only do a large proportion of these infants begin life handicapped with hereditary disease, but it may be said generally that in the rearing of them neglect reaches its maximum.

These facts are so thoroughly appreciated that it is customary to reckon the deaths of legitimate and illegitimate infants separately. The deaths of legitimate and illegitimate infants are stated as proportions per 1,000 legitimate and illegitimate births respectively.

During the thirty years now dealt with the average infantile death-rate of Scarborough was 144 per 1,000. But while the death-rate among legitimate infants was only 133 per 1,000, that of illegitimates was 280 per 1,000, or more than double.

No matter what communities be selected for examination, the death-rate of illegitimate infants is always much greater than that of legitimate

It will thus be apparent that in districts with a high proportion of illegitimate births, the infantile death-rate will be correspondingly high, other conditions being equal.

Unfortunately, the amount of illegitimacy in Scarborough is very great. The proportion of illegitimate to total births during the last thirty years is 91 per 1,000, or more than double the rate (44) of England and Wales for the same period.

Had all the births been legitimate, or rather, had illegitimate infants only died at the same rate as legitimate, there would have been 3,661 infantile deaths instead of 3,992—a saving of fully 8%.

The influence of illegitimacy in determining the cause of death will be considered later, when the principal diseases of which infants die are dealt with.

INFANTILE DEATH-RATES OF WARDS.

As great differences frequently exist between the death-rates of various divisions of a town as between those of several towns. The infantile death-rate shews this variation to a marked degree. The subjoined Table gives the total infantile death-rate, those of legitimate and illegitimate infants, in the different Wards, expressed to the nearest whole number

TABLE III.

	N.W.	N.	C.	E.	W.	S.	Whole Town.
Total Infantile Death-rate... ..	123	166	162	156	143	90	144
Death-rate of Legitimate Infants	113	149	145	143	131	86	133
Death-rate of Illegitimate Infants	197	326	357	335	316	190	280

It will be noted that the total rate is highest in the North Ward and lowest in the South, as is also that of legitimate infants.

The death-rate of illegitimate infants is highest in the Central Ward and lowest in the South.

Further, in the North, Central, East, and West Wards practically 1 of every 3 illegitimate children born dies within the first year of life.

Whether the best or worst Ward, as regards infantile mortality, be taken, illegitimate infants die at twice the rate of legitimate.

DISEASES CAUSING INFANTILE DEATHS.

The Reports of Medical Officers of Health for the year 1905 contained a new Local Government Board form in which the infantile deaths were tabulated according to the fatal disease and the age at death. This Table (No. 4) has been made the basis of the present report, all the infantile deaths during the last thirty years in the Borough having been classified according to it.

Examination of Table 4 and Chart E shews that the chief causes of death in infants are, in descending order of importance:—Wasting Diseases, Diarrhœal Diseases, Convulsions, Respiratory Diseases, Common Infectious Diseases, and Tuberculous Diseases. Together these account for 89·6% of the total deaths.

Wasting Diseases	34·3%
Diarrhœal Diseases	17·1%
Convulsions	14·8%
Respiratory Diseases	14·4%
Common Infectious Diseases	4·6%
Tuberculous Diseases	4·4%
	89·6%

In studying Chart "A" attention was called to the remarkable fluctuation of the infantile death-rate from year to year.

The six groups of diseases indicated above being the chief factors in the infantile mortality, it may now be asked which of them mainly contribute to raise the death-rate above the average. To answer this question the deaths from these causes in the five years with the highest, and the five years with the lowest death-rates, have been calculated with the result shewn by Chart "F.'

TABLE IV.

TABLE V. OF LOCAL GOVERNMENT BOARD. BOROUGH OF SCARBOROUGH.

INFANTILE MORTALITY DURING THE YEARS 1876 TO 1905 INCLUSIVE.

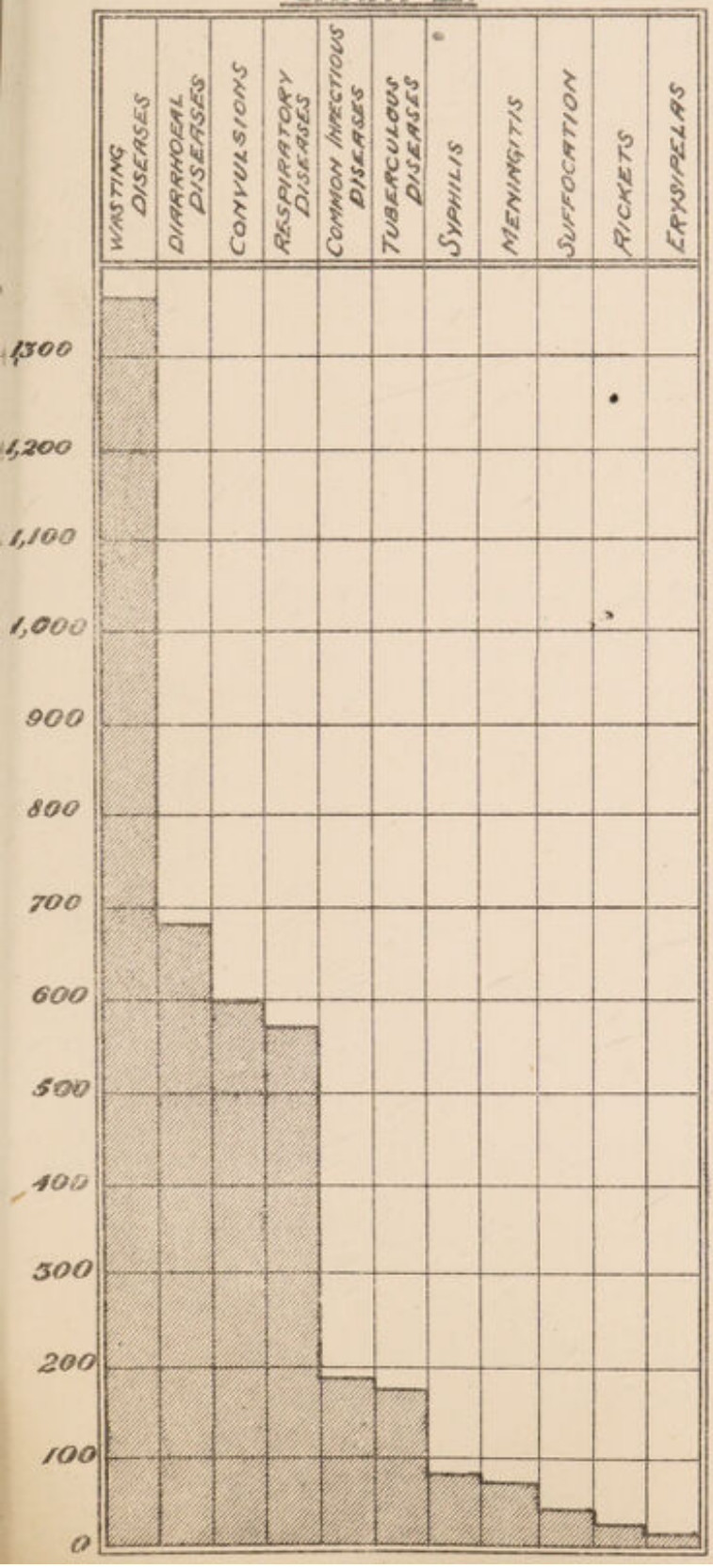
Deaths from stated Causes in Weeks and Months under One Year of Age.

CAUSE OF DEATH.	Under 1 Week.	1-2 Weeks.	2-3 Weeks.	3-4 Weeks.	Total under 1 Month.	1-2 Months.	2-3 Months	3-4 Months.	4-5 Months.	5-6 Months.	6-7 Months.	7-8 Months.	8-9 Months.	9-10 Months.	10-11 Months.	11-12 Months.	Total Deaths under One Year.
Common Infectious Diseases. Small Pox	...	...	...	...	..	...	...	1	..	..	..	...	...	1	...	..	2
Chicken Pox	..	...	...	...	..	...	..	2	...	1	...	...	...	...	1	...	4
Measles	...	..	...	1	1	...	...	1	3	2	1	4	3	11	7	11	44
Scarlet Fever	..	...	...	..	...	...	1	...	1	..	2	1	...	...	...	2	7
Diphtheria : Croup	...	...	..	..	..	2	1	...	1	...	...	..	3	1	6	2	16
Whooping Cough	..	...	2	.	2	7	16	8	4	10	8	11	7	8	14	16	111
Total	...	...	2	1	3	9	18	12	9	13	11	16	13	21	28	31	184
Diarrhœal Diseases. Diarrhœa, all forms	...	4	14	11	29	53	71	70	45	52	37	33	27	34	17	22	490
Enteritis *not Tuberculous*	3	8	10	4	25	19	12	22	12	17	12	8	8	5	2	3	145
Gastritis, Gastro-intestinal Catarrh	...	2	2	2	6	13	14	6	1	3	3	1	1	1	0	1	50
Total	3	14	26	17	60	85	97	98	58	72	52	42	36	40	19	26	685
Wasting Diseases. Premature Birth	441	46	37	33	557	42	13	10	2	2	.	.	1	...	1	1	629
Congenital Defects	134	37	30	25	226	55	26	14	14	8	10	6	2	1	4	2	368
Injury at Birth	14	...	1	..	15	...	...	...	...	...	..	...	..	..	...	...	15
Want of Breast Milk	..	..	...	...	...	1	...	...	.	2	..	...	...	...	..	...	3
Atrophy, Debility, Marasmus	42	19	27	15	103	52	52	33	34	24	14	14	13	9	5	3	356
Total	631	102	95	73	901	150	91	57	50	36	24	20	16	10	10	6	1371
Tuberculous Diseases. Tuberculous Meningitis	...	...	...	...	...	1	3	3	4	6	4	3	4	2	6	4	40
Tuberculous Peritonitis : Tabes Mesenterica	1	1	1	...	3	7	10	6	12	12	10	7	2	7	5	10	91
Other Tuberculous Diseases	..	...	...	1	1	5	...	2	3	7	5	3	5	4	7	5	47
Total	1	1	1	1	4	13	13	11	19	25	19	13	11	13	18	19	178
Erysipelas	1	2	..	2	5	4	1	1	1	1	1	1	1	...	...	..	16
Syphilis	3	3		8	16	15	17	6	12	6	2	...	3	...	1	1	79
Rickets	...	..	...	1	1	2	1	2	1	1	...	1	...	4	5	3	21
Meningitis (*not tuberculous*)	1	1	...	1	3	5	4	4	6	4	11	8	4	6	9	5	69
Convulsions	101	63	27	25	216	76	44	30	37	36	22	23	28	32	24	25	593
Respiratory Diseases. Bronchitis	5	4	4	3	16	49	39	31	46	38	27	31	33	29	37	22	398
Laryngitis	..	...	...	...	...	..	1	...	1	2	2	...	2	...	2	2	12
Pneumonia	...	2	1	1	4	13	16	14	14	12	17	13	19	12	18	14	166
Total	5	6	5	4	20	62	56	45	61	52	46	44	54	41	57	38	576
Suffocation, overlaying	8	2	1	0	11	6	6	4	..	3	1	1	3	.	..	5	40
Other Causes	21	11	8	8	48	16	15	16	12	13	8	12	14	9	6	11	180
	778	202	167	141	1288	442	362	287	266	263	197	181	183	176	174	173	3992

INFANTILE DEATHS IN SCARBOROUGH FROM PRINCIPAL DISEASES

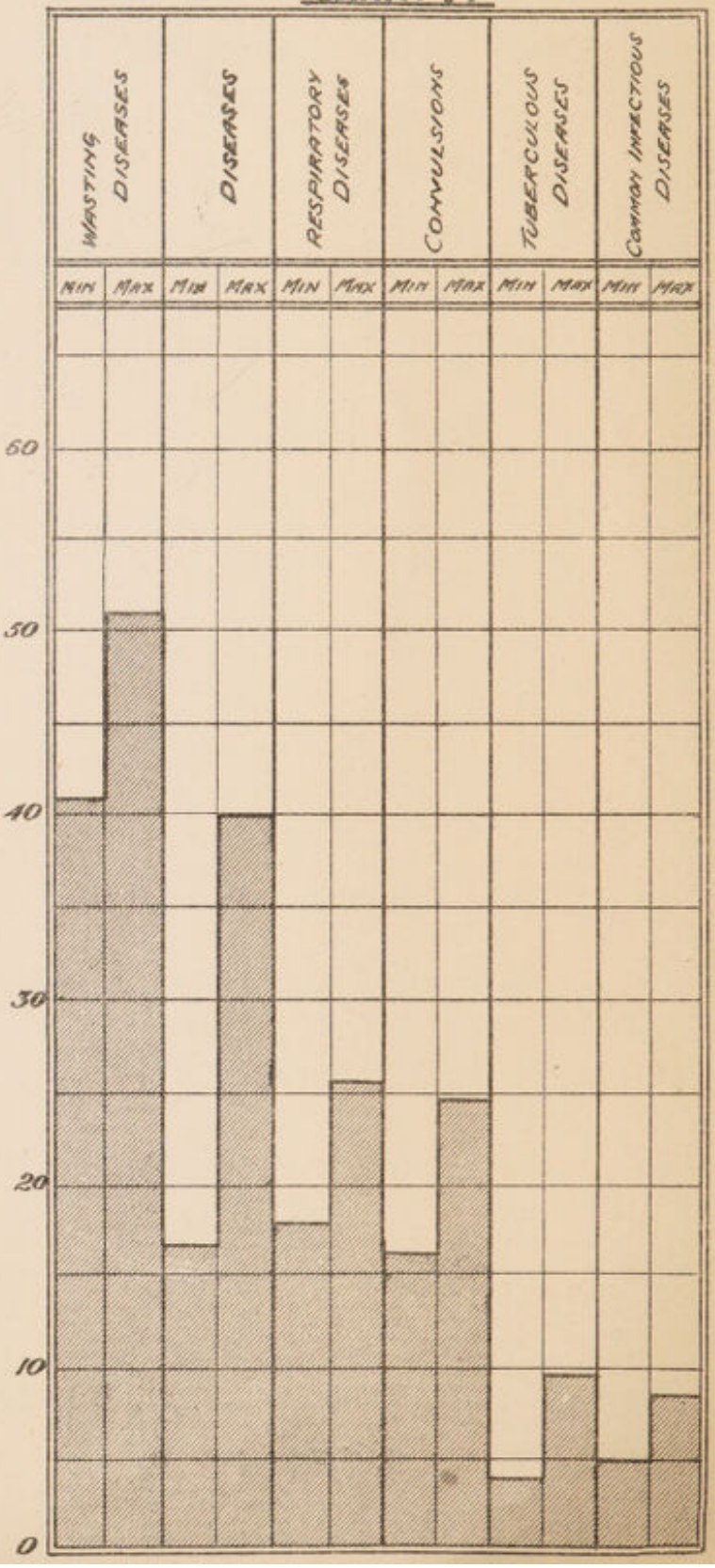
1876 TO 1905 INCLUSIVE

— CHART E. —



5 YRS OF HIGHEST AND 5 YRS OF LOWEST DEATH RATE

— CHART F. —



It should be noted that the proportion of deaths furnished by these six groups of diseases is practically the same in the maximal and minimal periods of death-rate, being 89·9% in the former and 88·5% in the latter. Hence it is evident that the influence of the remaining diseases in altering the death-rate may be excluded.

It will be observed that the years of maximal death-rate are characterised by an increase in the deaths from all these groups of diseases, but the increase is proportionally much greater in some of the groups than in others.

INFANTILE DEATH-RATES FROM PRINCIPAL DISEASES.

	Common Infectious Disease.	Diarrhœal.	Wasting.	Tuberculous.	Convulsions.	Respiratory.
Maximal 5 years	8·5	40·2	51·4	9·8	24·8	25 7
Minimal 5 years	4·9	16·4	41·1	4·0	16·4	18 0
Increase	3·6	23·8	10·3	5·8	8·4	7·7

The chief cause of the increase is thus found to be Diarrhœal Diseases which are followed, but at a considerable interval, by Wasting Diseases.

The death-rate from Diarrhœal Diseases in the maximal 5 years is two and a half times as great as in the minimal 5 years.

The principal causes of infantile death may now be considered in order of importance.

WASTING DISEASES.

These comprise—(1) Premature Birth, (2) Congenital Defects, (3) Injury at Birth, (4) Want of Breast Milk, (5) Atrophy, Debility, Marasmus.

This group is not very happily named, as "wasting," may not be marked, except in sub-group 5, and is often a prominent feature in other diseases. The vast majority of the deaths in this class are due to causes which, operating previous to birth, interfere with the proper development and vitality of the child.

The sub-group 5 Atrophy, &c., includes deaths due to feeble vitality at birth, and therefore caused by pre-natal influencrs, but many of the deaths under this heading, and more especially those which occur several months after birth are, in reality, due to the neglect, injudicious feeding, &c., of infants who were normally developed at birth.

Although only three deaths are definitely ascribed to Want of Breast Milk, there can be no doubt that many classified under Atrophy, &c., actually belong to this class.

Of the 1371 deaths from Wasting Diseases, 629 were from Premature Birth, 368 from Congenital Defects, 15 from Injury at Birth, 3 from want of Breast Milk, and 356 from Atrophy, &c.

The marked revolution in the mode of life (for life begins at conception, not at birth), which takes place at Birth, suddenly throws upon the organism a severe strain, which can only be met with complete success by the infant of normal development and vitality. Hence it is that infants ushered prematurely into the world, or exhibiting structural defect or feeble vitality, rapidly succumb within a few hours, days, or weeks of birth.

As the great majority of deaths from Wasting Diseases are of such infants, it is not surprising to find that 46%, or almost one half of them, occur under the age of one week, 65% under one month, and 83% under three months.

The sub-group Atrophy, etc., containing a large proportion of deaths not due to pre-natal causes, we should expect to find a difference in the age-incidence of the sub-group, compared with that of the remainder of deaths from Wasting Diseases.

Such is actually found to be the case, as an examination of the charts will shew.

In chart H the age-incidence of deaths from sub-groups (1), (2), (3) and (4), and sub-group (5) respectively, of Wasting Diseases, is shewn.

In the former class the deaths under three months are in enormous excess, constituting, indeed, 92% of the total deaths. The extended chart shews that this excess is largely accounted for by the deaths under one month, and those again by the deaths under one week.

The chart of sub-group (5) however does not indicate anything like the same predominance of the deaths under three months, nor do the deaths under one month, or under one week, form nearly so large a proportion of the total.

The actual proportions are as follows:—

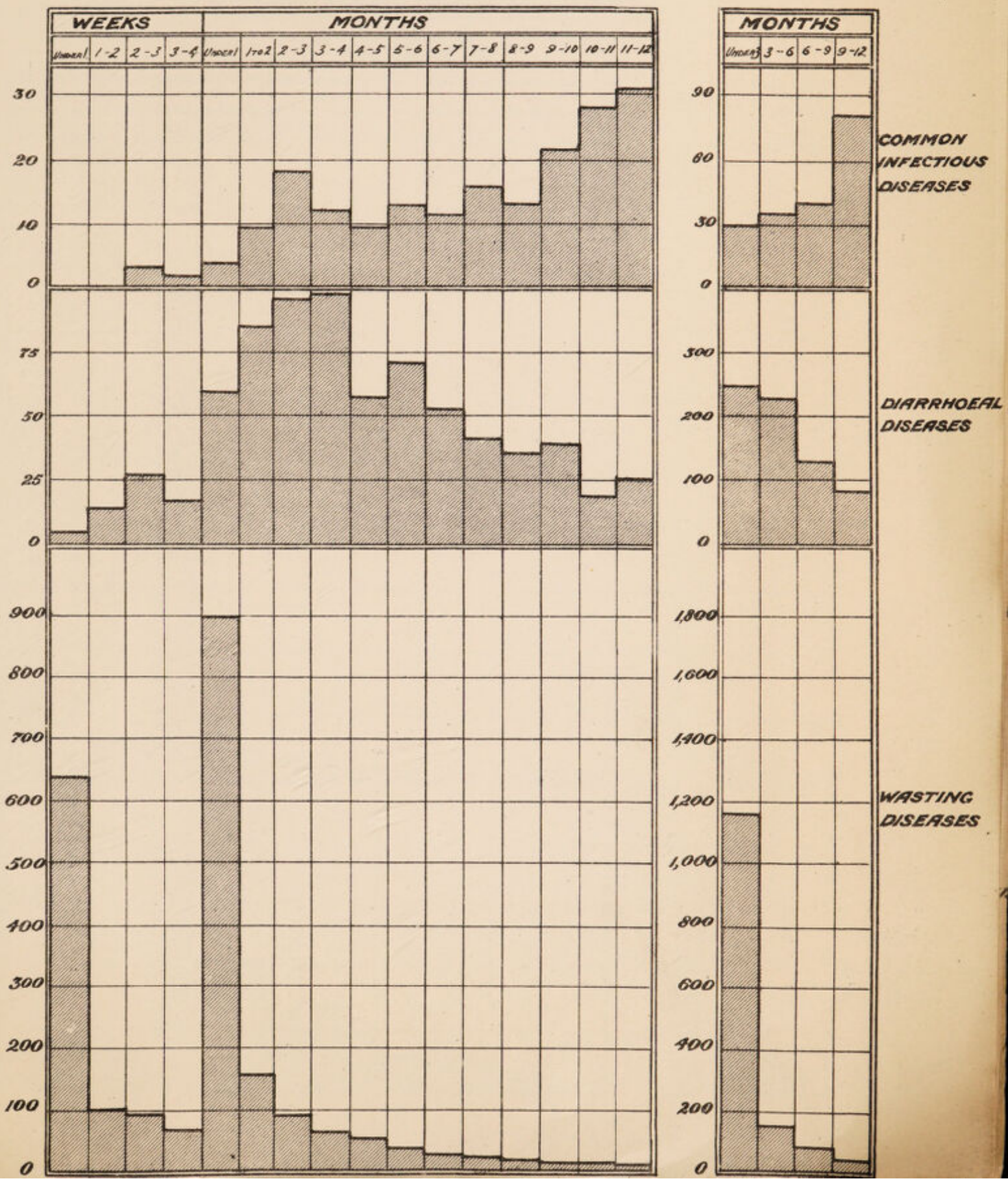
SUB-GROUPS 1, 2, 3 and 4.		SUB-GROUP 5.	
Deaths under three months ...	92%	Deaths under three months ...	55%
,, ,, one month ...	78%	,, ,, one month ...	28%
,, ,, one week ...	58%	,, ,, one week ...	11%

Of the total infantile deaths occurring within one week of birth, Wasting Diseases furnish 81%, of those within one month 69%, and of those within three months 54%.

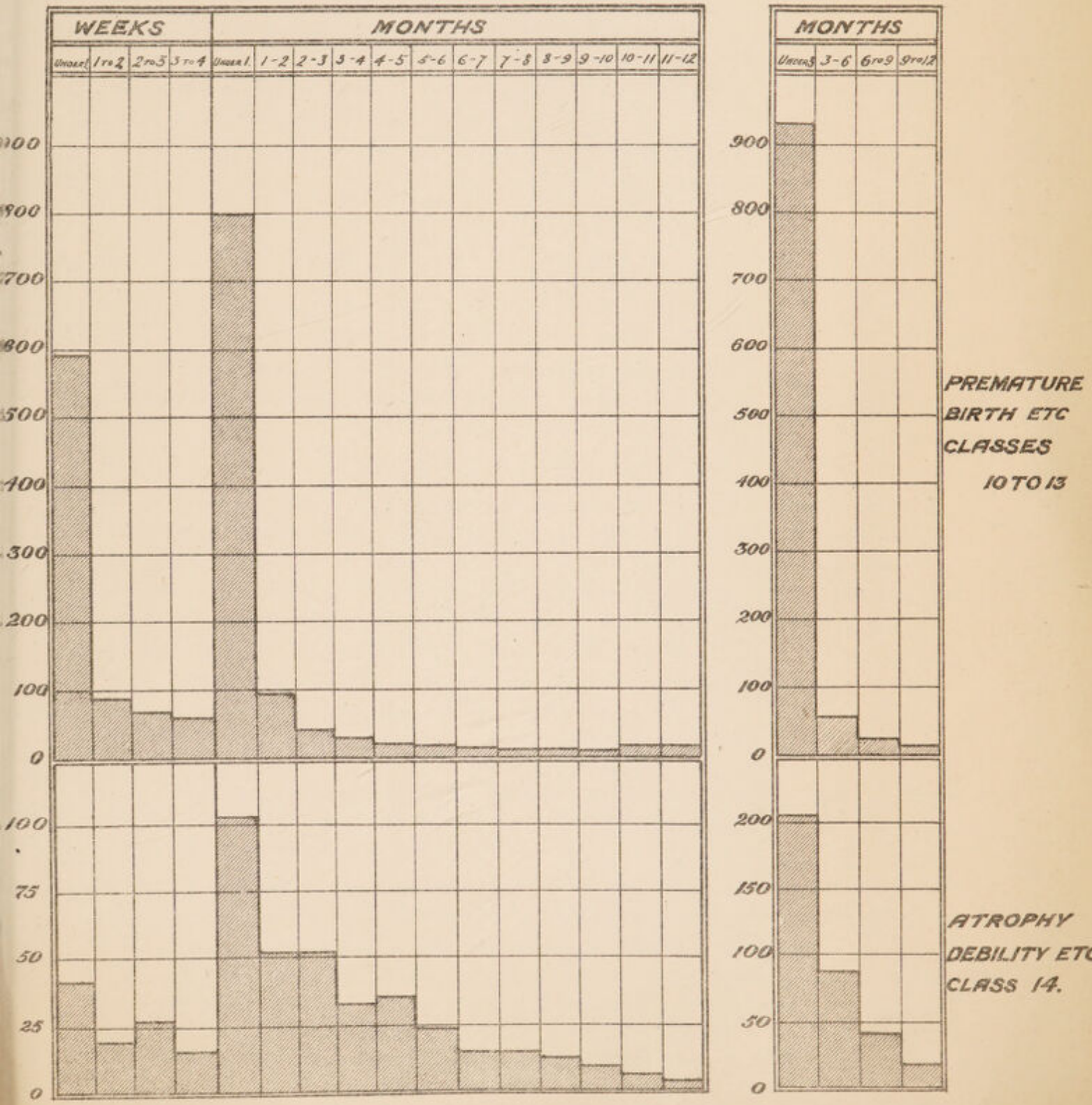
SEASONAL VARIATION.

The number of deaths from Wasting Diseases does not shew any great variation with the seasons of the year, thereby presenting a marked contrast to Diarrhœal Diseases. 23·4% of the deaths occurred in the first quarter, 22·4% in the second, 26·7% in the third, and 27·5% in the fourth.

SEASONAL VARIATION OF DEATHS
FROM PRINCIPAL DISEASES
CHART C



AGE INCIDENCE OF DEATHS
FROM PRINCIPAL DISEASES
CHART H.



The infantile death-rate caused by this group of diseases during the period 1876-1905 is practically 50 (49·9) per 1000—the death-rate of legitimate infants being 45, and of illegitimate 102.

The death-rates from Wasting Diseases in the successive 5-year periods is shewn below. It will be noted that the later periods shew an increased rate compared with the earlier ones, but there is not that progressive increase which examination of the rates for England and Wales reveals.

INFANTILE DEATH-RATES FROM WASTING DISEASES.

1901-1905	... ...	52·6 per 1,000.
1896-1900	... ...	53·1 ,,
1891-1895	... ...	57·1 ,,
1886-1890	... ...	49·7 ,,
1881-1885	... ...	42·4 ,,
1876-1880	... ...	44 8 ,,

The death-rates from these diseases in the various Wards of the Borough were:—North-West Ward, 46·5. North Ward, 52·2. Central Ward, 52·6. East Ward, 52. West Ward, 49·6. South Ward, 40·1.

CAUSES OF WASTING DISEASES.

Wasting diseases being largely pre-natal in origin their causes must be sought in the physical condition of the parents prior to the birth of the infant. The health of the prospective mother is of special importance in this regard. Syphilis, alcoholism, and debility in either parent, Tuberculosis, infectious disease, physical strain, mental shock, defective nutrition, unhygienic surroundings, in the case of the mother, may be regarded as the chief causes of premature birth and congenital defects.

Deaths from Atrophy, etc, may also be due to these causes, but many of these undoubtedly arise from improper feeding and neglect of the infant.

DIARRHŒAL DISEASES.

Diarrhœal Diseases, comprising Epidemic or Summer Diarrhœa, Enteritis and Gastritis, are various inflammatory diseases of the stomach and bowels, of which Diarrhœa is generally a prominent symptom.

Of these, by far the most important is Epidemic Diarrhœa, which accounted for 490 out of 685 deaths from this class, while Enteritis caused 145 and Gastritis 80.

Seasonal Variation.—In no other group of diseases is the influence of season so well marked as in Diarrhœal Diseases. While deaths from these diseases may occur in any week of the year, they become specially numerous at a certain period. On referring to Chart (K) it will be noted that the deaths perceptibly increase at the beginning of the third quarter, but about the middle, a relatively enormous increase rapidly occurs

which gradually diminishes in the earlier part of the fourth quarter of the year. So largely, at this period, do deaths from Diarrhœal Diseases predominate over those from all other causes, that they make a marked impression upon the annual course of the infantile mortality—a fact which is clearly brought out on comparing Charts (B) and (K).

7·5% of the deaths occur in the first quarter, 9% in the second, 65% in the third, and 18·5% in the fourth.

Age-Incidence.—Diarrhœal Diseases proved most fatal in the earlier months of life, especially during the second, third and fourth.

35·4% of the deaths occurred within three months of birth, 33·2% between three and six months, 19% between six and nine months, and 12·4% between nine and twelve months.

During the thirty years under consideration, Diarrhœal Diseases gave rise to an annual infantile death-rate of 24·9 per 1,000; the rate amongst legitimate infants was 21·8, and amongst illegitimate 59·1, or more than double that of the legitimate infants.

The death-rates in the different Wards were as follows:—

N.W.	N.	C.	E.	W.	S.
19·8	31·2	25·9	22·5	31·0	20·0

That Diarrhœal Diseases are proving increasingly fatal is shewn by the death-rates from these diseases in the successive five-year periods.

DEATH-RATES FROM DIARRHŒAL DISEASES.

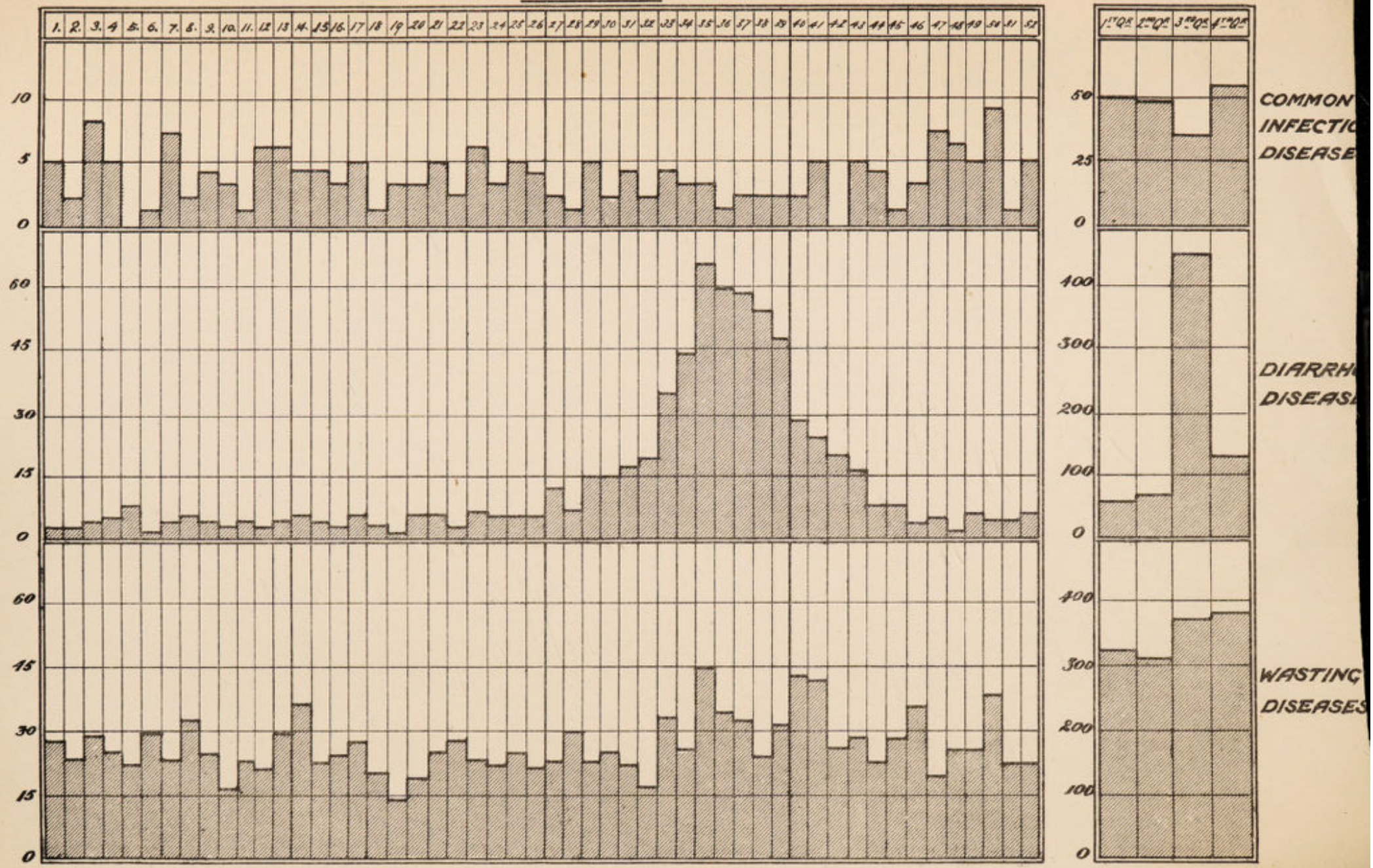
1901 1905	24·3 per 1,000	}	Average 30·1.
1896-1900	34·5 ,,		
1891-1895	31·7 ,,		
1886-1890	16·2 ,,	}	Average 19·5
1881-1885	20·0 ,,		
1876-1880	22·5 ,,		

THE CAUSES OF EPIDEMIC DIARRHŒA.

In any community, the variation from year to year, of the infantile mortality from this disease is largely governed by meteorological conditions. Diarrhœa is most prevalent and fatal during the hottest months of the year, and especially so in those years in which the summer has been unusually hot and dry.

This connection between diarrhœal diseases and hot dry weather, although marked, is not a simple one. Generally, it may be said that the increased prevalence and fatality of diarrhœal disease are more related to the temperature of the soil, than that of the air.

— SEASONAL VARIATION OF DEATHS —
— FROM PRINCIPAL DISEASES —
— CHART K. —



Formerly it was stated that the summer rise of the diarrhœal mortality did not begin until the temperature of the 4 ft. soil thermometer registered 56° F.; that the greatest mortality occurred in the week in which the earth temperature attained its maximum, and that the fall in the mortality coincided with that of the earth temperature.

To this general rule numerous exceptions have been noted. Thus, a rise in the soil temperature, early in the summer, above the limit indicated, has not been followed by an increased mortality from Diarrhœa. Similarly with respect to drought, a general connection between it and increased Diarrhœal mortality has been noted, but the exact relation has not been defined.

That heat and drought are not direct causes of Diarrhœa is evident from other considerations. Thus, the different parts of a town or district, subjected to precisely the same meteorological conditions may, and frequently do, shew widely different death-rates from Diarrhœa.

Further, Diarrhœa is closely associated with the existence of insanitary conditions. Towns with water closets, and a proper system of sewers have, as a rule, lower Diarrhœa death rates than those with privies and other insanitary conveniences. Similarly, districts in which cleansing of streets, passages and yards is imperfectly carried out, and organic refuse of all kinds allowed to accumulate, have a high infantile death-rate from Diarrhœa.

Briefly, it may be said that Diarrhœa is a filth disease, due to the ingestion of food contaminated with germs of excremental origin. The insanitary conditions referred to favour the accumulation of filth, in which these germs abound, in and around dwelling houses. Heat and drought not only vigorously promote the multiplication of such germs, but favour their dissemination by the formation of dust. This germ-laden dust may be carried by the wind, and gain entrance to vessels containing food, but there are strong reasons for believing that the house-fly acts frequently as the carrier. Flies are most common during the Diarrhœal season; they abound in organic refuse, on which they feed and in which their eggs are hatched. Experiment has shown that flies and other insects can carry germs, and it is to be remembered that the fiy which is on the manure-heap one moment may be in the milk jug the next. Milk forms an excellent medium in which germs can multiply with inconceivable rapidity.

That germ-contaminated food plays the chief part in the production of Diarrhœa is suggested by other circumstances.

Diarrhœa is very largely a disease of the hand-fed infant. The breast-fed infant not only receives the nutriment best adapted to his requirements, and heated to the proper degree, but the mother's milk is practically germ-free. There being no perfectly satisfactory substitute for the milk of the healthy mother, the hand-fed infant's wants are not completely met.

Substitutes for human milk may prove injurious from three causes :—

(1) By defective chemical composition they may be inferior in nutritive qualities on the one hand, and may set up irritation of the digestive organs on the other.

(2) The temperature at which the infant receives them is entirely at the discretion of the nurse.

(3) At all stages in their production, storage, and preparation, they may be exposed to contamination.

There can be little doubt that the increasing diarrhœal mortality of infants is largely due to the decline in the practice of breast-feeding.

CONVULSIONS.

"Convulsions" is a symptom of many diseases, and is thus a very unsatisfactory clsssification of infantile deaths. 593 deaths, or about 15 % of the total infantile mortality, were ascribed to this cause.

Seasonal Variation.—Although the deaths were most numerous in the first quarter of the year, and least in the fourth, season does not appear to have any marked influence.

Age-Incidence.—"Convulsions" proved especially fatal in the earlier months of life, 36·4 % or more than one third of the deaths occurred within one month of birth, and 56·6 % or more than one half within three months.

The total death-rate from "Convulsions" was 21·6 per 1,000; the rate among legitimate infants being 19·5, and among illegitimate 43·5 per 1,000.

The Ward death-rates were the following :—

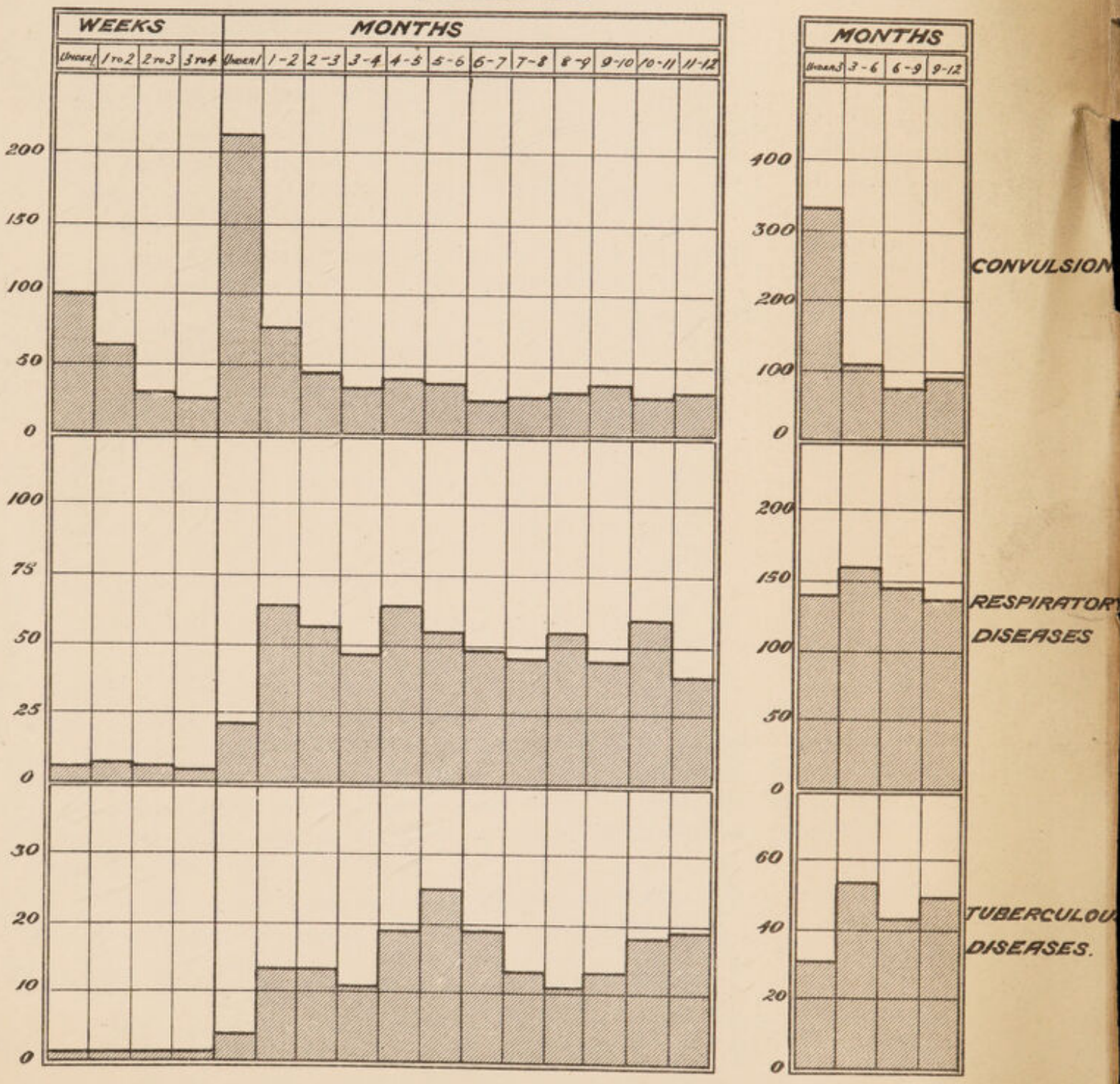
N.W.	N.	C.	E.	W.	S.
13·3.	26·8.	27·1.	25·1.	22·2.	7·6.

As will be seen from the following Table "Convulsions" is diminishing as a certified cause of death.

1901-1905	11·5 per 1,000	}	Average 14·8.
1896-1900	15·0 ,,		
1891-1895	18·0 ,,		
1886-1890	29·3 ,,	}	Average 28·2.
1881-1885	27·2 ,,		
1876-1880	28·2 ,,		

The Causes of Convulsions.—The principal diseases giving rise to Convulsions in infancy are Wasting Diseases, Diarrhœal Diseases, Meningitis, Tuberculosis and Rickets

ACE INCIDENCE OF DEATHS
FROM PRINCIPAL DISEASES
CHART J.



RESPIRATORY DISEASES.

Respiratory Diseases caused 576 deaths, of which 398 were ascribed to Bronchitis, 166 to Pneumonia, and 12 Laryngitis.

Seasonal Variation.—The deaths were most numerous in the colder months, and were least in the third quarter of the year.

Age-Incidence.—The liability of infants under the age of one month to death from Respiratory Diseases is very slight. Beyond this limit, however, the susceptibility increased, and deaths were most numerous between the ages of three and six months, after which age-period, they gradually declined.

Respiratory Diseases caused a death-rate ot 20·9 per 1,000; the rate among legitimate infants being 19·9, and among illegitimate 32·1.

Examination of the death-rates from this cause in the successive quinquennia shews a marked decline in recent years.

1901-1905	14·7	Average 16·7.
1896-1900	17·0	
1891-1895	18·4	
1886-1890	27·3	Average 25·2.
1881-1885	23·6	
1876-1880	24·7	

The various Ward death-rates were;—

N.W.	N.	C.	E.	W.	S.
16.8.	21·9.	22·3.	26·0.	20·4.	8·5.

Causes of Respiratory Diseases.—Infants are remarkably sensitive to extremes and changes of temperature, and are therefore specially liable to diseases associated with exposure to cold. Respiratory diseases are unusually prevalent and fatal in districts where overcrowding and other insanitary conditions exist. Life, in close, ill-ventilated and dirty houses, aided by conditions of general neglect, powerfully predisposes the infant to fatal respiratory disorders.

Further, diseases such as Rickets, Measles, and Whooping Cough are liable to terminate fatally in inflammation of the lungs and air passages.

COMMON INFECTIOUS DISEASES.

This group of diseases only gave rise to 184, or rather less than 5% of the total infantile deaths during the thirty years under consideration. The most fatal infectious disease in infancy is Whooping Cough, which caused 111 deaths. Next in order of importance is Measles, which accounted for 44 deaths.

SEASONAL VARIATION.—This largely resolves itself into the seasonal variation of Whooping Cough and Measles, which diseases are most common and fatal in the colder months. The deaths, therefore, were most numerous in the fourth quarter and least in the third.

AGE-INCIDENCE.—Unlike those from other groups of diseases, the deaths from Common Infectious Diseases become more numerous towards the end of the first year of life. The deaths within one month of birth are negligible, while between the ninth and twelfth month they are by far the most numerous.

The Common Infectious Diseases caused a death-rate during the years 1876-1905 of 6·7 per 1,000. In this group—and in this one only—is the death-rate greater among legitimate than illegitimate infants. Legitimate infants being much more numerous than illegitimate, are more exposed to infection.

The death-rates in the successive quinquennia were :—

1901-1905	...	5·6	Average 7·2.
1896-1900	...	8·3	
1891-1895	...	7·8	
1886-1890	...	7·3	Average 6·0.
1881-1885	...	3·5	
1876-1880	...	7·4	

and in the several Wards :—

N.W.	N.	C.	E.	W.	S.
4·4.	6·5.	10·0.	8·9.	5·1.	0·95.

TUBERCULOUS DISEASES.

This group caused 178 deaths, of which 91 were due to abdominal Tuberculosis, 40 to Tubercular Meningitis, and 47 to other forms.

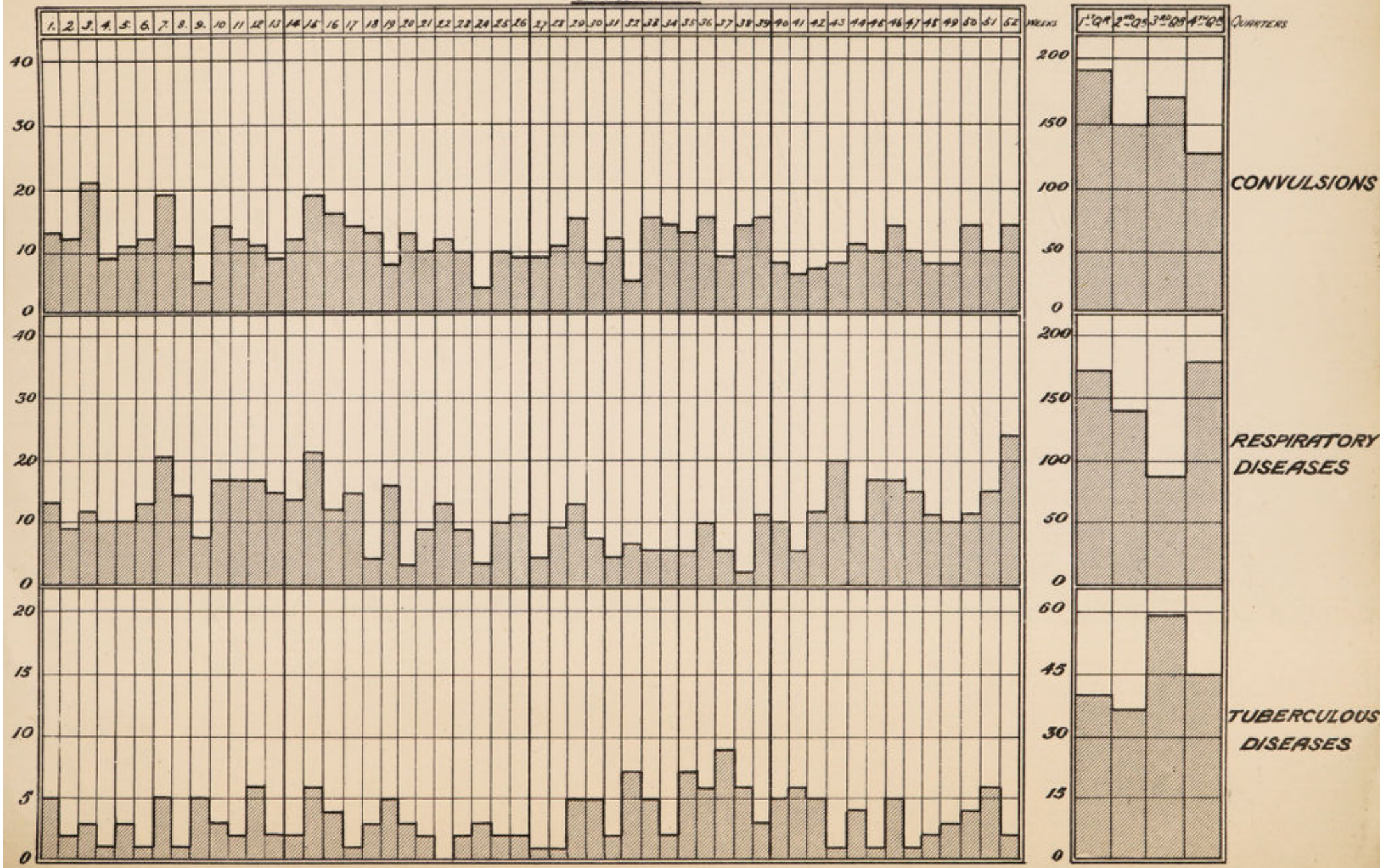
SEASONAL VARIATION.—Deaths from Tuberculosis were most numerous during the third quarter of the year, and least during the second.

AGE INCIDENCE.—The mortality under the age of one month was neglible, and under three months slight. The deaths were most numerous between the ages of three and six months, but did not markedly predominate over those at subsequent age periods.

Tuberculosis caused a death-rate of 6·4 per 1,000; that of legitimate infants being 6·0, and of illegitimate 10·8 per 1,000.

During the thirty years 1876-1905, there has been a considerable diminution in the infantile death-rate from Tuberculosis, as the following figures shew :—

SEASONAL-VARIATION-OF-DEATHS
FROM PRINCIPAL DISEASES
CHART L.



1901-1905	2·7	
1896-1900	6·2	Average 5·3.
1891-1895	7·1	
1886-1890	6·4	
1881-1885	7·5	Average 7·4.
1876-1880	8·5	

The Ward death-rates were:—

N.W.	N.	C.	E.	W.	S.
8·4.	6·8.	5·9.	7·2.	3·2.	2·8.

THE CAUSES OF TUBERCULOUS DISEASES.

Tubercle is very rarely, if ever, transmitted from parent to child, but it is none the less clear that a marked predisposition to the disease is frequently inherited. The comparative frequency of abdominal forms of Tuberculosis in infancy and early childhood suggest the likelihood of the germs having been conveyed by milk.

As at higher ages, deaths from Tuberculosis in infancy are associated with insanitary conditions, poverty and neglect.

SYPHILIS.

Although only 79 deaths were certified as due to Syphilis, it cannot be doubted that this insignificant number by no means adequately indicates the full effects of Syphilis upon the infantile mortality.

Syphilis is a prolific cause of premature birth, atrophy, and debility, and many of the deaths under these headings would have been properly assigned to this class.

Syphilis is thus not only an immediate cause of death, but by producing great constitutional enfeeblement, it predisposes to death from other diseases.

The influence upon pre-natal life is specially marked, a large proportion of still births being due to it. These, however, do not come within the scope of infantile mortality.

Syphilis is a contagious and entirely preventible disease, for the dissemination of which immorality is largely responsible. The disease is directly transmitted from either parent to the unfortunate offspring.

The apparent death-rate from this cause was 2·8 per 1,000, but there was a very marked difference between the death-rates of legitimate and illegitimate infants, the former being 1·9 and the latter being 12·6.

In no other class of deaths is the mortality of illegitimate infants so markedly in excess,

RICKETS.

This disease generally begins in the first year of life, but being chronic in duration, it may not terminate fatally until after that period. Hence its injurious influence upon the young cannot be estimated from the very few deaths (21), under one year, actually ascribed to it.

Rickets is a constitutional disease, the most obvious effects of which are noticeable in alterations and distortion of the bones. It is essentially an expression of defective nutrition, and is therefore almost entirely met with in the hand-fed infant. Unhygienic condition of life markedly favour its production. Rickety infants evince but feeble resisting power to injurious influences, and they are especially prone to death from Diarrhœa, Convulsions and Respiratory Disorders.

THE EFFECTS OF ILLEGITIMACY.

The malign influence which illegitimacy exerts upon infant life has been already shewn in the excessive death-rate from all causes of illegitimate as compared with legitimate infants.

Having now considered the principal causes of death, we are in a position to note the effects of illegitimacy upon the death-rate from each of these groups of disease.

The six principal groups of disease contribute practically the same proportion of the total deaths in each class of infants, so that the remaining diseases need not be considered in comparing the two classes. In five of the principal groups the death-rates of illegitimate infants are greater, in varying degrees, than those of legitimate. The exception formed by the group of Common Infectious Diseases is more apparent than real. The higher death-rate of legitimate infants from this class is simply due to the fact that legitimate infants are several times more numerous than illegitimate, and therefore present many more points of contact with infection. If the death-rate of legitimate infants from each of the five principal causes be represented by 1, then the corresponding death-rates of illegitimates are as follows:—

	Legitimate.		Illegitimate.
Diarrhœal Diseases	1	...	2·7
Wasting Diseases	1	...	2·2
Convulsions	1	...	2·2
Tuberculous Diseases	1	...	1·8
Respiratory Diseases	1	...	1·6

If the death-rates from Syphilis, however, be compared, the ratio is

1 ... 6·6.

CONCLUSION.

The mortality of infants stands in a close relation to the social condition of the parents, the death-rates being highest among the poorest classes, and lowest in the well-to-do sections of the community.

Poverty involves a low standard of housing, food, clothing, and education, and may be accompanied by carelessness, intemperance, and other forms of vice. The injurious effects on infant life of vice, ignorance, and neglect, find their maximum expression in the excessive death-rate of illegitimate infants.

Illegitimate infants die from precisely the same diseases as legitimate, but at much higher rates.

RECOMMENDATIONS.

The study of the foregoing pages will have made it apparent that the causes of infantile mortality are both numerous and varied, and that no single measure can therefore be relied upon to effect a marked reduction in the waste of infant life.

The problem must be attacked from all sides, and every agency which will prevent disease, protect feebleness, and promote health, must be called into play.

The severe handicap which illegitimacy places upon the infant in the struggle for existence has been amply demonstrated in the preceding pages.

The reduction of illegitimacy itself lies outwith the scope of the Sanitary Authority, and must be left to religious, moral and social influences; but the Sanitary Authority may do much to mitigate the conditions which affect injuriously the health of illegitimate and legitimate infants. Briefly, the activities of the Sanitary Authority will find ample outlet in promoting a higher standard of sanitation throughout the town, and more especially in those districts with high infantile death-rates.

Two improvements are clearly indicated: (1) the systematic reduction in number, and as soon as practicable, the abolition of privies. (2) The more frequent removal, and more efficient disposal of house and street refuse.

The pollution of the soil which has been seen to play an important part in the causation of diarrhœa, may be lessened by the abolition of privies, more frequent cleansing, and proper paving of yards and passages.

The purity of the milk supply is of the highest importance, and this should be ensured by more stringent bye-laws for the regulation of dairies and cowsheds, and by a rigorous application of the Food and Drugs Acts which deal with adulteration.

These recommendations are all covered by the powers already at the disposal of the Corporation, but other measures are of no less importance. General measures, however, must be supplemented by action regarding the particular infant.

Before any procedure respecting the individual infant can be instituted, the Sanitary Authority must be aware of the infant's existence, and in this respect the present law is gravely defective.

It has already been noted that one-third of the infantile deaths occur under the age of one month. But the law allows 42 days or six weeks to elapse before a birth need be registered.

In the case of infants dying under this age, birth and death are registered at the same time. Hence it may be said that no control can at present be exercised over the lives of one-third of the infants who die in their first year.

Obviously, a much earlier registration (or rather notification to the Sanitary Authority) of birth is a crying necessity. Several towns have in operation a voluntary scheme whereby a notification within 48 hours of birth is encouraged by the payment of a shilling fee for each notification. In Huddersfield this notification has been made compulsory by a local Act, and other towns are pressing for similar powers.

The voluntary scheme has much to recommend it and the cost involved would be trifling.

But notification of itself is of little use, and must be followed by definite administrative action.

The minimum of such would be the distribution to each person notifying a birth of a card or leaflet containing hints on the feeding and rearing of infants.

A much better plan would be the appointment of a lady health visitor, who would visit the house on receipt of the notification and give personal instruction and aid in care of the infant and domestic hygiene.

Much of the infantile mortality depends, in the last analysis, on the ignorance of parents of the simplest laws of health, and this could be best overcome by instruction from a health visitor. The benefits which would accrue to the community by the appointment of such an official would obviously not be limited to a reduction in the infantile death-rate.

Prevention being better than cure, steps should be taken to ensure that the girls now at school, the great majority of whom will be mothers in the future, receive adequate instruction in the elements of personal and domestic hygiene.

As subsidiary measures, popular lectures on hygiene should be given by the Medical Officer of Health and others to stimulate public interest in these important matters.

With the advent of summer placards should be posted calling attention to the urgent necessity of strict cleanliness being observed in connection with all vessels containing milk or other foods, and of the adequate protection of their contents from dust and flies.