A STATISTICAL STUDY OF THE MORTALITIES OF MATERNITY AND INFANCY

by

Peter Laird McKinlay M.B.,C.h.B.

A Thesis presented for the Degree of Doctor of Medicine in the University of Glasgow.

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 – 1346

C O N T E N T S.

INTRODUCTION

With a general improvement in the death rates from most causes and at most ages, it is not surprising that more attention than their numerical importance might seem to justify, is directed to those causes of mortality which deviate from the general trend. From the point of view of mere numbers, the deaths of women in England and Wales, assignable to the effects of pregnancy, in comparison with those due to other causes of mortality, are perhaps, scarcely sufficiently numerous to merit the amount of interest and efforts at control which have been directed towards them within recent years. But the problem is even from the numerical point of view of some importance, and derives further importance from its connection with other problems.

The national decline in effective fertility, and the fear engendered in some minds of depopulation, has been a means of focussing attention on the problems of the better conservation of infant life; and with the enormous decline in the infant mortality as a whole, without a corresponding amelioration of the neo-natal death rate, it is only natural that we should seek the causes of this early mortality in conditions affecting the infant at and before birth. Since undoubtedly some proportion of these neo-natal deaths are due to adverse circumstances at birth, while others may be the result of conditions of the mother during pregnancy which could be improved, we have been led to hope that by increased antenatal, natal and postnatal care of the mother, not only will the infant's chance of life be greater, but also that the mortality and morbidity among the mothers might be diminished.

There is, furthermore, the great antenatal wastage of infant life, some part of which, is within the field of preventive medicine. The stillbirth statistics for this country in more recent times, defective as they are in some respects, understate this loss to a considerable extent. Under the Notification of Births Act, only infants which have reached the 28th week of intra-uterine life are required to be notified, so that no account can be taken of the loss before that period. The following figures. -

Table I. Showing the Stillbirth (a), Neonatal (b), and (c) Remaining Death Rate under one year per 100 Registered Live Births in Various Sections of the Country.*

	Administrative Counties.			County Boroughs			Metropolitan Boroughs			England and Wales.		
	a	b	c	a	b	c	a	b	c	a	b	c
1918	2.8	3.3	4.2	3.4	3.6	7.3	2.6	3.3	7.5	3.0	3.4	5.6
1919	3.1	3.5	4.9	3.6	3.8	6.1	2.7	3.3	5.2	3.2	3.6	5.3
1920	2.9	3.0	4.3	3.5	3.3	5.8	2.6	2.7	4.9	3.1	3.1	4.9
1921	3.0	3.2	4.5	3.5	3.5	5.7	2.6	2.9	5.2	3.2	3.3	5.0
1922	3.1	3.1	3.9	3.5	3.3	5.5	2.7	2.6	4.8	3.2	3.1	4.6
1923	3.2	3.0	3.5	3.7	3.1	4.8	2.7	2.5	3.6	3.3	3.0	4.0

from the Annual Reports of the Chief Medical Officer of the Ministry of Health, show the number of notified stillbirths per 100 registered live births in various sections of the country for recent years, compared with the corresponding neo-natal death rate and the remaining death rate in infancy.

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* The neonatal deaths consist of the group of congenital debility, malformations and prematurity; the remaining deaths, the total deaths under one year less (b).

It will be seen that while there has been great improvement in the later death rate under one year, and somewhat less improvement in the neo-natal rate, the stillbirth figures show no tendency to decline. The metropolitan boroughs have the lowest rates, county boroughs the highest, while the rate for administrative counties is intermediate. When it is considered that notification of stillbirths is defective, it will be seen that the deaths of viable infants occurring before full time falls little short of the neo-natal death rate. Holland, (1922), from an analysis of 300 foetal deaths, concludes that about half of these are preventible, that of these, about 20% (of which three-quarters are due to syphilis) could be prevented by ante-natal methods alone, about 12% depend for their prevention on combined ante-natal and intra-natal methods, and about 20% on intra-natal methods alone. Omitting deaths from unknown causes, complications of labour and toxic maternal states (syphilis, albuminuria, etc.) are the main causes of foetal death, and, as will be seen later, many of the main causes of foetal are also important causes of maternal death; so that in these cases prophylaxis would reap a double benefit.

Apart from the emotional aspect of the case and the disorganisation of family life which must ensue on the death of the mother, these deaths occur for the most part in women in the period of life at which the general death rate from all causes is relatively low, and further, married women may represent a healthier set of lives than the average women of the same age, the excess of females over males at marriageable age perhaps giving rise to a selection of the fittest of the female sex.

The following figures show the ratio per cent of deaths from childbearing to deaths from all causes in the various age periods. -

	15-	20-	25-	30-	35-	40-	45-	15-50
1911-13	2.54	9.78	13.29	12.59	9.92	4.31	0.42	7.1
1921-23	1.58	8.36	12.21	12.62	10.13	4.63	0.52	6.8

These of course, give a totally incorrect appreciation of the relative importance of childbed causes to all causes, since births are not equally frequent in each of the age groups. For a true estimate of the additional risks which pregnancy entails, it would be necessary to compare the rates of mortality; but the above figures show that the consequences of maternity form no insignificant part of the total death roll in women of reproductive ages.

Again, since reproduction is a normal function of women, we are apt to believe that all deaths from causes incidental to the pregnant state are accidental, and partly because of this, such deaths are considered as eminently within the scope of preventive medicine.

Finally, it must be remembered that a death rate is only in a crude general way an index of morbidity; so that, while the death rate may be absolutely small, we must, in any consideration of the welfare of pregnant women, take into account those who, although fortunate enough to have survived the diseases and accidents which have proved fatal to others, have nevertheless been left in a chronic state of ill health, a condition which must also have its effect on the further procreation of children by these women.

The general medical aspect of the problem has been the subject of wide discussion in medical and obstetrical journals, and although it is from the clinical and bacteriological side that any further advance will probably be made, the present paper does not deal with specialised obstetrical problems, but mainly with more general and somewhat neglected factors influencing the risk to mothers in the childbearing processes.

PART I. The Influence of the Age of the Mother and Associated Factors on the Mortality Rates in Childbearing.

Hitherto, so far as I am aware, the only attempt to ascertain the death rates at ages of women in childbearing from the official statistical publications of this country, was made by Farr. (1885). In England and Wales the births, on which a crude puerperal mortality rate is built up, have not, except for 1921, been distributed according to the age of the mother or order of birth, so that the secular trend in any district and interlocal comparisons on the basis of the crude rate may lead to erroneous deductions due to variations in the age distributions of parturient women, or in the proportions of primi- and multi-parity, both of which, from their relationship to fertility in women, will influence the birth rate and possibly the maternal mortality rate, unless the liability to accident, infection, etc. in pregnancy is the same at different ages in the reproductive period and in different pregnancies; i.e. unless there is no correlation between parity and age and the incidence of disease and death among mothers.

It is generally recognised that the ordinary method of stating the death toll as the number of maternal deaths from any or all causes per 1000 births is a near approach to the accurate measurement of the risks incidental to pregnant women. Other denominators, such as the total female population within the limits of the childbearing ages, or married women within the same group, have been used; but since childbearing is confined mainly to married women, and since women of different ages are not at the same risk of having a baby, these, at the

best, are but rough approximations to the actual numbers at risk of death from childbearing.

The fact that the denominator should contain still births in addition to live births and that a deduction should be made for multiple births to arrive at the number of confinements, was recognised by Farr. For example, in his remarks on puerperal deaths, he states. - "The exact danger of childbirth to the mother is found by dividing the number of mothers who die by the number of childbearings. Now, excluding the stillborn, the number of childbearings is obtained by reducing the births in the proportion of 1 to 0.9902; but, taking the stillborn into account, the proportion of liveborn children must be as nearly 100 to every 102,531 mothers bearing children in the year." But even with this the limit of accuracy has not been reached. Certain causes of maternal death are those in which the products of conception are thrown off before reaching the age at which they would be included as births. In most cases of ectopic pregnancy, all cases of abortion, some eclamptics, and in other diseases such as hyperemesis gravidarum, labour ensues before the 28th week of pregnancy, and consequently these cases escape notification as births. At present, however, with the vital statistics available, any such refinement is impossible, and the number of livebirths, or the sum of the live and still-births must be used as the most accurate measure of the number of females exposed to the risk of dying from causes incidental to pregnancy. In the present study, I have only used the total livebirths in calculating the rates, since still-birth figures were not available for all the periods studied, and, since these form only some 3% of all births, the resulting

inaccuracy will not be very considerable.

But, apart from the fact that the exposed to risk cannot be truly measured by the registered births, there attaches to the puerperal death rate as stated per 1000 births all the inconveniences of a crude rate of any kind; and great significance cannot be attached to such as a method of comparison, either in time or space, until some at least of the chief influential variables, such as age, have been eliminated. Thus in comparing different localities in the same or different epochs, in which the age distribution of potential mothers is divergent, some allowance must be made for this difference to correct as far as possible for the effect of the inverse correlation of fecundity and age.

The method adopted by Farr to ascertain the dangers of death by childbearing in women of different ages was as follows: From the Swedish returns of 1831, he calculated the probable proportion of women, in decennial age groups from 15-55, who bear children within the year; and by applying the figures so obtained to the female population of England in 1851, in the corresponding age groups, he determined the probable number of them who became mothers during that year. Here, of course, the main sources of error in applying the probability of a woman of a given age, bearing a child within the year in one country to the female population of another country, is the difference in the proportions of married and unmarried, in the two countries; but actually the annual average number of births for the seven years period 1848-54 which he was studying was 603,045; the probable number of pregnancies given by the calculation 609,845 - an excess of only 1.13%; and the mean annual number of births, corrected for multiple births

and stillborn children, would represent nearly 609,845 childbearings.* From these figures the death rates in decennial age groups from Metria and other accidents of childbirth were calculated, and these demonstrated the higher mortality at the extremes of reproductive life.

The birth rates in Sweden and England and Wales at that period had not declined to any appreciable extent, but now the position is quite different.

In the present study, as a standard of female fecundity at ages, the data of Australia, given by Knibbs (1917), for the period 1907-14 for women between the ages 15-50 years have been used, since the limits will include all but a negligible proportion of the births and also of the deaths of mothers in childbearing. From the figures given, the nuptial fertility rates, expressed as the ratio of the number of legitimate births per 1000 married women, have been calculated for the seven quinquennial age groups, and these are given on Table 2.

Table II. Showing the Fertility Rates (Absolute and Relative) of married Women aged 15-50 in Australia (1907-14) with those of Sweden (1891) for Comparison.

	Absolute Fertility		Relative Fertility.	
	Australia	Sweden	Australia	Sweden
15-	481	518	1.0000	1.0000
20-	398	451	.8275	.8707
25-	305	375	.6337	.7239
30-	227	312	.5198	.6023
35-	160	250	.3333	.4826
40-	70	142	.1456	.2741
45-	8	20	.0166	.0386

* Using the factor for correction previously given, the calculated number of childbearings is 1.38,6 in defect of the actual number.

From this it is clearly seen that fertility progressively declines with increasing age of the mother. If now we proceed in a manner akin to that of Farr, and apply these fertility rates to the existing age constitution of the married female population of England and Wales in 1911 and 1921, the probable numbers of legitimate births found are, for 1911, 918745, and for 1921, 973489,* while the actual mean annual numbers of legitimate births for the triennia 1911-13 and 1921-23 are 840,898 and 760,930 - the excess in the estimates being 9.26% and 27.93% respectively. Obviously some other method of allocating the births to the quinquennial ages groups must be adopted.

1. First Method of Distributing Births to Age Groups of the Mother.

The procedure first adopted was as follows:

From the figures of the absolute fertility of women at ages, the relative fertility has been calculated taking women of 15-20 as unity.(Table 3 Col.2.)

Table III. Showing the first method adopted to distribute the births to the age groups of married women(1921 Census figures)

Age	1	2	3	4	5
15-	31145	1.0000	31145	.015009	104589
20-	459789	.8275	380475	.183359	1277725
25-	920986	.6337	583629	.281265	1959975
30-	1059538	.5198	550748	.265417	1849540
35-	1089287	.3333	363059	.174966	1219238
40-	1035109	.1456	150712	.072631	506124
45-	919123	.0166	15257	.007353	51239
			2075025	1.000000	6968430

* Incidentally it has to be noted that from these figures the number and age constitution of the married female population at the last two censuses is such that, assuming equal reproductive capacity in the women at both periods, the legitimate birth rate in 1921 should have been 6% in excess of that in 1911; so that the fall which has occurred in the birth within that period is not the result of changes in the married female population - a point which has already been brought out by Brownlee (1922) and Yule (1920).

The actual numbers of married women living in each quinquennial age group (Col.1.) are multiplied by their appropriate fertility ratio (Col.2.) giving a hypothetical number of married women of equal reproductive capacity (Col.3.). The total births in the period 1915-23 (6,968,430) distributed to the quinquennial age groups in the proportion which each of these bears to the total population (Col.4.) are given in Col.5. These births, then, form the denominators on which the death rates at ages are calculated.

2. Possible Sources of Error in the Method Adopted of Distributing Births.

Before proceeding further it will be as well to point out the objections to the methods adopted here. The results are no doubt based on much that is hypothetical, and may be open to serious objections.

(1) The Decline in the Birth Rate.

In the first place, it has to be noted that, in the method adopted of distributing the births to the quinquennial age groups, the fertility factors used to weight the absolute numbers of married women, are based upon the experience of Australia before the war, since when, as in most other countries, the birth rate has progressively declined. This raises the question as to the effect which such a fall will have on the fertility of the various age sections of parturient women, relative one to another. To what extent the decline in the birth rate is due to the various factors suggested such as postponement of marriage till later in life, an actual diminution in the fertility of the population at large, wilful prevention of conception, or some other factors is still a matter for discussion. It would appear, however, that, of the factors

mentioned, the only one likely to affect the relative values of these factors is contraception. A racial phenomenon such as a decline in reproductive activity would be very unlikely to affect any special section of the reproductive period more than another; so that while the absolute fertility would be lowered, the feritility of any age group relative to another would remain the same. So too with postponement of marriage. This would result solely in a diminution in the proportion of younger married women, but would not influence the relation between the different age groups, and it has been shown previously that the age constitution now is more favourable to a high birth rate, than it was 10 years previously. On the other hand, restriction of the size of the family, depending as it does so much on the individual, introduces a factor, the influence of which it is difficult to measure. Economic circumstances, for instance, might play some part in restraint to procreation, and, as these are generally not most favourable in early marriages, one might expect it to result in a diminution in the fertility of younger women with a relative (and perhaps an absolute) increase in the later ages. But against this can be placed the fact that early marriages are more common in the lower social classes and it is among these that contraceptive measures are least used. For any proper consideration of the question, it would be necessary to compare the fertility rates at ages in women of the same country through a period of years with a changing birth rate. Unfortunately, it has not been possible to obtain a comparative series of fertility rates for one country, but in the following table are collected some fertility data for different countries at different periods, and from these the relative fertilities have been calculated to compare with the factors used in this table.

Table 4. Showing the absolute and Relative Fertility Rates in Quinquennial Age Groups of Women in Different Countries.*

	Absolute Fertility.							Relative Fertility.						
	15-	20-	25-	30-	35-	40-	45-	15-	20-	25-	30-	35-	40-	45-
Edinburgh & Glasgow 1855	50.00	41.79	34.64	26.56	20.39	8.04	1.27	100	84	69	53	41	16	3
Alsace & Lorraine 1872	46.5	56.3	46.3	38.8	28.2	-	-	100	121	100	83	61	-	-
Norway. 1874-76	41.3	57.9	43.0	36.0	30.0	18.1	3.3	100	140	104	87	73	44	8
Finland 1880-81	37.95	40.59	35.69	32.15	26.12	15.75	2.68	100	107	94	85	69	42	7
Brunswich 1880-81	58.1	45.4	34.7	26.8	19.8	8.1	1.1	100	78	60	46	34	14	2
Denmark 1880-89	71.50	49.37	40.50	31.15	22.98	11.39	1.3	100	69	57	44	32	16	2
Berlin 1887-90	50.34	45.55	33.60	22.50	14.50	6.03	.74	100	90	67	45	29	12	1
Buda Pest 1889-92	42.8	35.8	29.2	20.6	14.7	5.9	.7	100	84	68	48	34	14	2
Sweden 1891	51.81	45.14	37.53	31.18	25.04	14.23	2.00	100	87	72	60	48	27	4
General Average	47.35	45.87	37.24	28.53	22.41	9.73	1.45	100	97	79	62	47	21	3
Australia 1907-14	48.1	39.8	30.5	22.7	16.0	7.0	.8	100	83	63	52	33	15	2
Aberdeen 1911	50.0	37.4	32.5	20.6	14.5	6.9	.8	100	75	65	41	29	14	2

* The Aberdeen figures are from the Annual Report of the M.O.H. Aberdeen(1916-21). the Australian from Knibbs, the remainder from Korosi.)1894)

Apart from the interesting international differences in fertility which are apparent in the statistics for the earlier years, there is evidently little to be objected to in the method adopted of weighting the numbers of women according to fertility. There is no apparent correlation between reproductive activity as measured by the birth rate and the fertility of women of different ages relative one to another. Certain it is that the fall has not specially affected the young women of 15-20. The tendency, if anything, is the other way. Comparing Sweden (1891) with a crude birth rate of 28.3, Australia (1907-14) with 27.4 and Aberdeen (1911) with 24.5 per 1000 population, the fertility of women over 20 seems to have declined more than that of the younger women of 15-20.

From figures published in the Annuaire International de Statistique (1916-17 and 1925) the following table

Table V. Showing the Absolute and Relative Fertility of Married Women of Different Ages in France in the Periods 1896-1905 and 1906-13.

Age Period	Absolute Fertility		Relative Fertility	
	1896-1905	1906-13	1896-1905	1906-13
15-	437.6	439.8	1.0000	1.0000
20-	343.0	311.7	.7838	.7087
25-	247.1	187.3	.5647	.4259
30-	168.6	139.7	.3853	.3176
35-	109.8	88.6	.2509	.2015
40-	46.7	36.1	.1067	.0821
45-	7.3	4.0	.0167	.0091
15-50	153.7	126.6	.3512	.2879

has been prepared to compare the effects of the declining birth rate on the fertility at ages of women in France. Unfortunately the rates are inaccurate, since, in the tables giving the births by age of the mother, no distinction as to legitimacy of the birth is made, and in the table reproduced here the fertility

rates are the total (i.e. legitimate and illegitimate) birthrates in terms of married women only. This point must be borne in mind in making the comparison here, since if there was any great change in the proportion of illegitimacy in the two periods, the fertility rates of the younger married women would be specially affected. The two periods 1896-1905 and 1906-13 are not of equal length; but it would be worse than useless to include the war years since, on investigation, it was found that in the beginning of the war there was a great drop in the proportion of births from the youngest mothers, due probably to the younger men going first on active service; while later in the war the decline spread to the later years of reproductive life. So far as the comparison is sound, however, we find that there was a decline of 21.4% in the birth rate of married women of 15-50 within the two periods; that the decline did not affect the youngest age group at all, while relatively and absolutely the fertility of the women in the later age periods declined.

I have recalculated a series of rates using the fertility factors of Sweden in 1891 as weights, to compare with those given later, but there is no essential difference in the final results as to the age distribution of the death rates - certainly none which is great enough to alter any argument which might have been based on the previous results; and further, it is also apparent that the effects of a diminishing fertility is not the explanation of the great fall in the death rate in younger women (which will be discussed later).

2. Illegitimate Births.

A more serious objection, however, is that all the births, irrespective of legitimacy or otherwise, have been

distributed only according to the proportions of married women between the ages of 15-50; so that the small number of legitimate births from mothers outside these limits, and all the illegitimate births are being wrongly distributed. The legitimate births which occur without these limits are probably so few as to be negligible, but it is not so with the illegitimates, which form some 4-5% of all live births, and which are born of mothers of entirely different age distribution from those of married women. In the period 1915-23, 5.19%, in 1911-13, 4.48% and in 1921-23, 4.57% of all the births were illegitimate; so it is necessary to enquire how far this factor will change our rates of mortality. In the following table

Table VI

Showing the Illegitimate Births Rates per 1000 Unmarried Women Aged 15-50, in Australia (1907-14) and Aberdeen (1911)

Age	Australia	Aberdeen	Australia	Aberdeen
	Absolute Rate		Relative Rate	
15-	8.66	14	100	100
20-	17.73	27	205	193
25-	15.53	24	179	171
30-	13.59	18	157	129
35-	12.14	17	140	121
40-	6.05	7	70	50
45-	1.09	-	13	-
15-50	12.39	19	-	-

the illegitimate birth rates in terms per 1000 unmarried women in quinquennial age groups are given for Australia (1907-14) and Aberdeen (1911)* The proportion of illegitimate births was for Aberdeen 10.64% (inclusive of 14 births from widowed women, this was raised to 10.95%) and for Australia 5.74% of the total births. Only a small proportion of illegitimate births occur in widowed women, so that this factor can be neglected. From the

* From the Annual Report of the Medical Officer of Health of Aberdeen (1916-21)

absolute rates the relative rates have again been calculated taking, as standard, the rate for unmarried women 15-20. It is interesting to note that, irrespective of the differences in the actual rates of illegitimacy, the distribution of the relative values shows a very close similarity. For this reason, the assumption that the proportional distribution of ex-nuptial fertility in England and Wales is the same as that given by the Australian data will probably not be far from the truth. To estimate the difference produced when account is, or is not, taken of the legitimacy or otherwise of the births, the total births have been redistributed as follows. -

Table VII. Method of Distributing Births to Quinquennial Age Groups of Women.

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
15-	31,145	1.0000	31,145	.0150	99,431	1,743,891	1.0000	1,743,891	.2604	89,475	188,906
20-	459,739	0.3275	330,475	.1834	1,214,714	1,237,151	2.0473	2,532,819	.3773	129,671	1,344,385
25-	920,986	0.6337	583,629	.2813	1,863,320	664,192	1.7933	1,191,096	.1771	60,853	1,924,173
30-	1059,538	0.5198	550,748	.2654	1,758,332	394,465	1.5693	619,034	.0926	31,805	1,790,137
35-	1089,287	0.3333	363,059	.1750	1,159,112	300,533	1.4018	421,287	.0628	21,587	1,180,699
40-	1035,109	0.1456	150,712	.0726	481,165	247,127	0.6986	172,643	.0258	8,875	490,040
45-	919,123	0.0166	15,257	.0074	48,712	208,847	0.1259	26,294	.0040	1,378	50,090
			2,075,025	1.0000	6,624,786			6,707,064	1.0000	343,644	6,968,430

I = Age periods
II = Married female population at quinquennial age groups.
III = Relative nuptial fertility (age 15-20 = standard).
IV = (II and III) Married female population at ages weighted, according to their fertility.
V = Proportions which each weighted age group bears to the total weighted population at reproductive ages.
VI = Legitimate births distributed to the age groups.
VII - XI = Distribution of illegitimate births to the age groups of unmarried women.
XII = Sum of legitimate and illegitimate births at ages.

3. Second Method of Distributing Births to Age Groups of the Mother.

Legitimate births alone are assigned to the various age groups in the proportion which the weighted numbers of married women at ages bear to the total. Illegitimate births are distributed in a similar fashion according to the proportions of unmarried women living at quinquennial age groups, after weighting the numbers of unmarried by their relative ex-nuptial fertility.* The sum of the legitimate and illegitimate births at each age are now used as the number exposed to risk, and the rates were recalculated for all causes of death. The results deduced by the two methods are given below (Table).

	15-20	20-25	25-30	30-35	35-40	40-45	45-50
1st Method	72.76	32.97	33.21	37.00	51.70	63.80	75.72
2nd Method	40.28	31.34	33.83	38.23	53.39	65.89	77.46
Ratio of 2nd to 1st.	.55	.95	1.02	1.03	1.13	1.03	1.02

It is quite apparent that the first method, by apportioning too few births to the earlier ages, has overestimated the death rate in women of 15-20. The probably more correct method gives a rate 45% lower in females of 15-20, 5% lower

* It is of interest to note, as further evidence that this is probably a fairly close approximation to the accurate distribution of the illegitimate births, that, by this method, the proportion of exnuptial births assigned to each of the age groups agrees very well with the figures calculated from the New Zealand Official Year Book, giving the illegitimate births in age groups of the mother for 1924, which are as follows . -

	15-	20-	25-	30-	35-	40-	45-
England and Wales	26.0	37.7	17.7	9.3	5.3	2.6	0.4
New Zealand	23.3	35.9	18.8	11.6	7.2	3.2	0.0

for females 20-25, and 2-3% higher for older women. Thus, the death rates calculated by the original method must be multiplied by these ratios for a closer approximation to the true risk of death of mothers of different ages of reproductive life.

In view of the rather drastic changes which occur when these two different methods are employed, the rates of mortality at ages which are given subsequently are those which have been calculated by this second method, since this is more likely to be nearer the truth.

In the Annual Report of the Registrar-General 1922 (**Text.** p.137-140) is described the first attempt in the course of these official publications to classify births according to the age of the mother. The classification was an indirect one, the information not being obtained from the birth register, but from the Census schedule. The following extracts suffice to show the method adopted (see p.137). "One of the questions on the Census schedule asked, in respect of each married man, the number and ages of all his living children and stepchildren under the age of 16, and where the man was enumerated on the same schedule as his wife, which was the case with about 93 % of the husbands, the replies enabled children of all ages under 16 to be related to their mother, the latter being also fully described on the schedule. From the information so obtained the ratio

$$\frac{\text{Number of children under 1 year of age}}{\text{Total number of married women.}}$$

was formed for various ages of wives, and this, in view of the fact that children less than a year old represent survivors of the births which occurred in the 12 months immediately proceeding the date of the Census, has been adopted as the basis of the fertility curve in respect of married women at

ages one-half year less than at date of enumeration. The ratios were modified by a constant factor, so that when multiplied by the total married women enumerated at the several ages, the products should aggregate to the number of legitimate births registered in the calendar year 1921. Further (p.139). "A reservation should, perhaps, be added in regard to the basic fertility rates derived from the Census data. As stated above, the children enumerated as belonging to the several classes of married women include step-children, and possibly adopted children, and these in the present analysis will have been related to married women of a possibly different age constitution from that of their own natural mothers. Again, the children under one year of age at the date of the Census, will have been on average about six months old, and will accordingly only represent that portion of the births of the preceeding year, which survived the comparatively high mortality operating in the first months of life, while further, the married women for whom the facts were forthcoming represent only a sample, though a very large one, of the total married women of the several ages in the whole population. Altogether it is believed that the defects are not important, and that the final modification of the rates by means of the constant factor referred to succeeds in providing a substantially accurate picture of the 1921 incidence of fertility among married women."

In the case of ex-nuptial fertility, (p.140) "the age factors adopted have no foundation in either the Census or Registration Records available in this department. The rates adopted have, in the absence of any better authority, been based on those used by the Government Actuary, and the Ministry of Health, in the assessment of the maternity risk, and benefit to unmarried women for the purpose of National

Health Insurance. The rates were obtained from the basic rates by constant factor modification, so as to produce, when multiplied by the appropriate numbers of single and widowed women, the number of illegitimate births registered in the calendar year 1921." The present part of the study was begun in ignorance of these estimates for this country, but the procedure adopted in obtaining these fertility rates shows that at best they are but approximations to the truth, more especially in the case of ex-nuptial births; so that with any of the standards of fertility at present available, the distribution of births must always leave some margin of error, and unless there is some great divergence in the results given by the two methods, it will not be justifiable to recalculate the rates on the basis of this experience, which, being for a single year, and that immediately succeeding "the climax of the temporary spurt in the birth rate which followed demobilisation," may be no more representative of the true state of affairs in this country, in the periods studied, than the rates originally used. Comparing, however, these figures

Table VIII. England and Wales. - Legitimate and Illegitimate Natality by Age of Mother, 1921.

Age last Birthday	Legitimate Births per 1000 married women	Illegitimate Births per 1000 spinsters & widows	Relative Legitimate Fertility	Relative Illegitimate Fertility.
15-	447	7.65	1.0000	1.0000
20-	359	15.14	.8031	1.9791
25-	268	8.71	.5995	1.1386
30-	197	0.78	.4407	.1020
35-	131	-	.2931	-
40-45	32	-	.0716	-

with those of Australia, it will be noted that in the case of legitimate fertility, the age group 15-20 is relatively higher in the 1921 than in the 1907-14 figures, again suggesting that

the fall in the birth rate is affecting least of all the first quinquennium of reproductive life. In the case also of illegitimate fertility, the 15-20 age group is more prolific relative to the succeeding age groups in the English than in the Australian figures. With the English fertility rates as weights, the death rates at ages from all causes in child-bearing have been recalculated. These with their respective ratios to the results deduced when the Australian figures were used, are given below,

Table IX. Showing (A) the Death Rate per Million Births from all Puerperal Deaths 1915-23 calculated on the Fertility Rates for England and Wales 1921 with (B) the Ratio of these Rates to those calculated on the Australian Fertility Rates 1907-14.

Age Group	15-	20-	25-	30-	35-	40-45
A	3253	2775	3145	4004	5403	11184
B	.81	.89	.93	1.05	1.01	1.70

It will be noted that while the rates for the first three quinquenna are diminished (the first quinquennium most of all) and the succeeding ages increased, the general trend of the mortality curve remains unaltered. Accordingly, the differences in the two measures of fertility do not seem to be sufficiently great to interfere with any of the conclusions to be drawn from those obtained by using the Australian fertility rates.

4. The Value of Age-Specific Death Rates.

Age-specific death rates are of practical importance in ~~the~~ various ways. There is, for instance, the purely statistical consideration that the variations in the ages of parturient women may explain some part of the variations in the puerperal mortality rates in different places; and a set of mortality rates at ages for the whole country could form the basis for the standardisation of the crude rates in different districts.

From the medical side these derive some consideration, not only with regard to their evident bearing on the question of prognosis (which, however, would be more accurately assessed by a Case mortality rate), but also in that they may help to throw some light in a general way, on the relative importance of the etiological factors of the several groups of pathological conditions in pregnant women, where several predisposing or causative factors exist. In any disease, for example, there will be one or more factors which account for the general level of the death rate, and these, or some other additional phenomenon, may lead to a specific type of age distribution. Several of the morbid states associated with pregnancy result in some instances from congenital, in others, from acquired conditions, and, a priori, if the former were prepotent etiologically, we should expect the death rate to decrease with age, whereas if acquired conditions be the result of previous child-bearings, the death rate should increase with age. But here, it must also be remembered that pregnant women are subject to the same law of mortality as non-pregnant women. The increase in the death rate with advancing age from causes apart from those peculiar to the pregnant state within the limits of

reproductive life, although probably representing in some part a preventible loss of life, is also indicative of the general ageing of the tissues, which any additional physical strain must quickly reveal; and child-bearing, although physiological, is undoubtedly a great strain on the maternal functions. The whole metabolism of the mother has to undergo readjustment in pregnancy. Gross changes have been evidenced in the circulatory, excretory, endocrine, and other systems of the body, and biochemical changes in the blood serum, as shown by Aberhalden's test, seem to indicate the presence in the maternal blood of toxic substances and, in most women, the development of a defensive mechanism. Although apparently not absolutely diagnostic of pregnancy, since a positive result has been obtained in some morbid processes in non-pregnant women, the serum reaction of pregnancy is generally supposed to be the result of absorption into the blood of an antigen derived from the foetal elements of the placenta and the reaction of the host by the formation of a specific anti-substance. It is quite probable that the capacity of the mother to adjust herself to the novel conditions which a pregnancy entails, will determine to a great extent the chance of a favorable termination. The necessary widespread alterations of function may be hindered by deviations from the normal healthy state, and with increasing age of the mother adjustment to accommodate a developing ovum may become progressively more difficult.

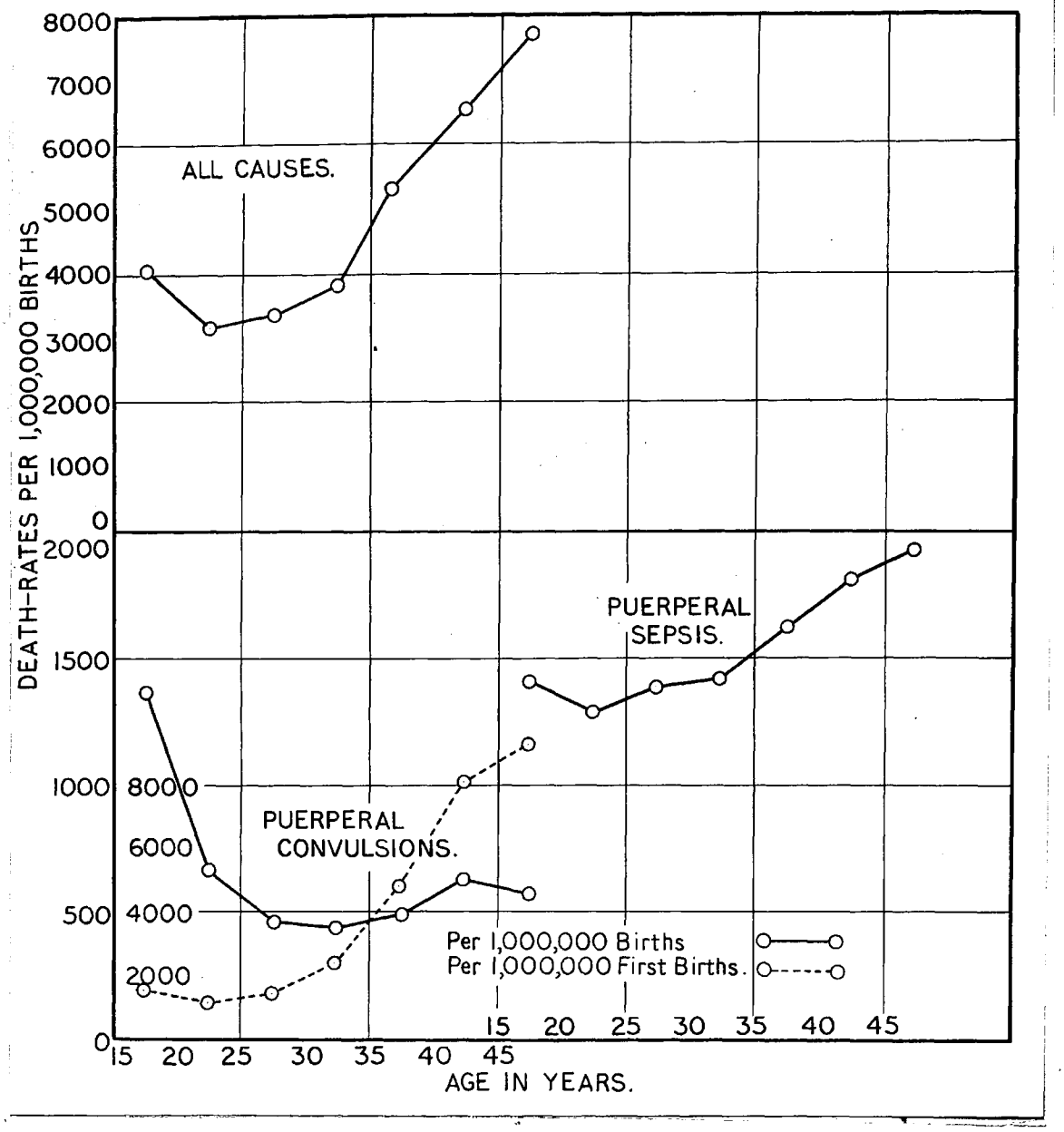
Finally, and probably most important of all, is the fact, that mortality rates at ages may serve as a guide to where efforts of control are chiefly required. While it is difficult to share the intense optimism of those who hope by

sufficient care of the mother before, at and after, parturition to elimate ~~death~~ entirely the maternal mortality, there is no doubt that certain causes of death are eminently amenable to organised medical effort in the present state of our knowledge. Practically all deaths from eclampsia, and many from accidents in the processes of birth are in this category. The absolute magnitude of the death rate at any age will serve to indicate the periods of greatest risk to a woman to child-bearing, and, other things being equal, where medical efforts at control are likely to meet with the maximum degree of success. Unfortunately, however, even although it is glibly stated that all maternal deaths in child-bearing can be prevented, it is not quite clear that in this case other things are equal, unless we further assume that it is equally easy to combat the loss of life in women of different ages.

5. Death Rates at Ages from Various Cause Groups.

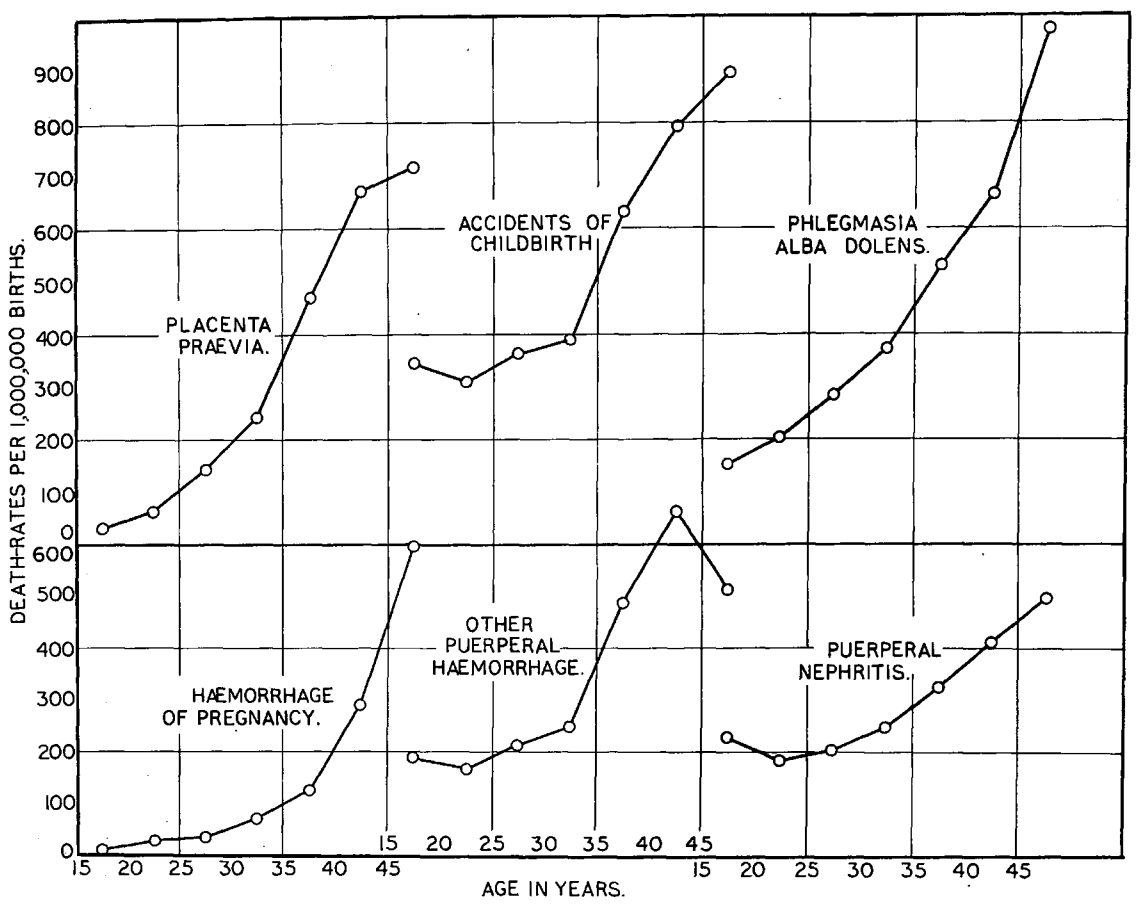
For the general consideration of the age distribution of mortality from the various cause groups of death, the rates have been calculated from the experience of England and Wales in the nine years period 1915-23. Prior to 1915 the deaths from placenta praevia and"other puerperal haemorrhage" were grouped together as "puerperal haemorrhage," and since these are quite distinct conditions, it is desirable to consider them separately. Apart from this, the annual number of deaths from some of the causes of maternal mortality is too small to give stable death rates at ages. Since the total registered livebirths in the period 1915-23 were 6,968,430 and the maternal deaths 28,248, this is probably sufficient to calculate death rates which at least will not be subject to violent fluctuations.

DIAGRAM Ia.



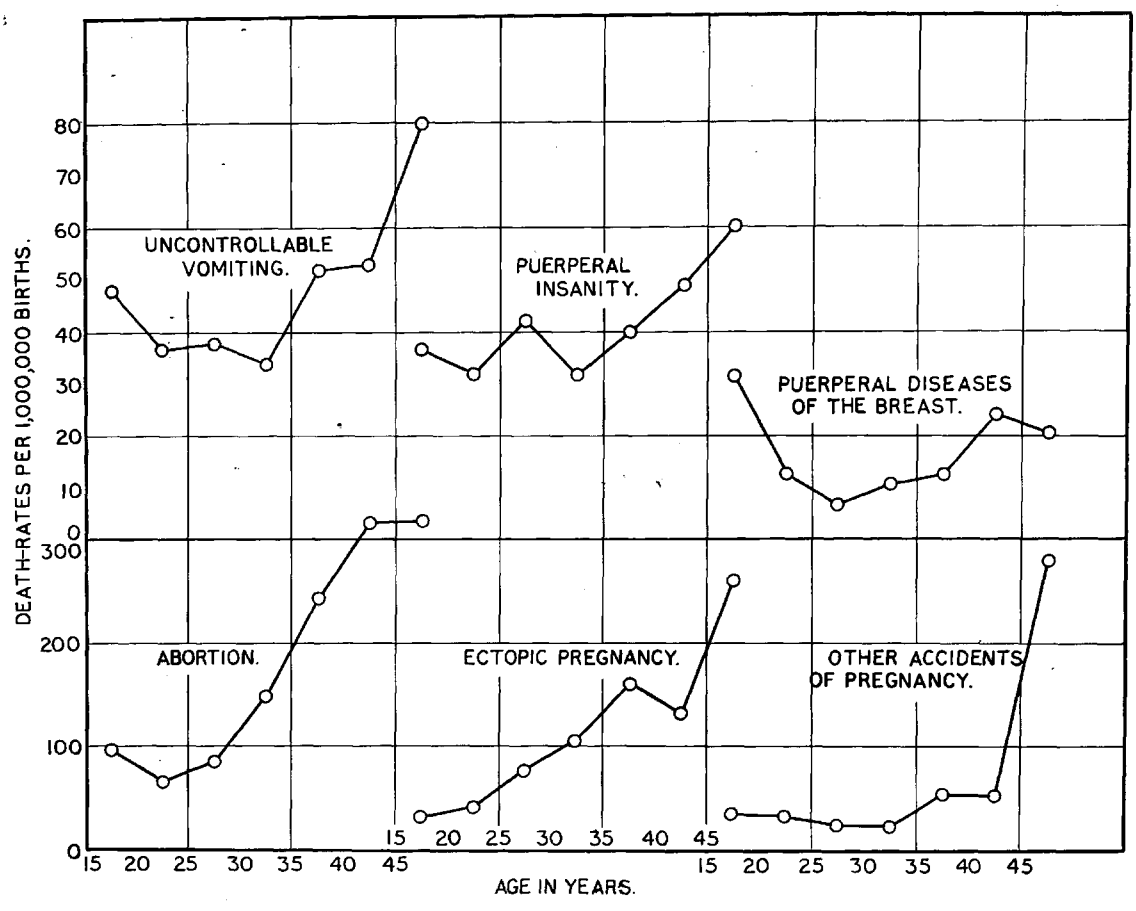
Death-rates at ages from the several causes of maternal death.

DIAGRAM Ib.



Death-rates at ages from the several causes of maternal death.

DIAGRAM Ic.



Death-rates at ages from the several causes of maternal death.

The necessary data with regard to the age distribution of married and unmarried women were obtained from the Census Reports for 1911 and 1921, and the births and maternal deaths from the Annual Reports of the Registrar-General.

The mortality rates at ages from the various causes of death are shown on Table 10 and in Diagrams Ia-e.

Table 10. Showing the Death Rates at Ages per Million Births from the Several Groups of Causes of Puerperal Deaths in England and Wales 1915-23.

	15-	20-	25-	30-	35-	40-	45-	15-50-
Abortion	95	65	85	148	242	318	319	142
Haemorrhage of Pregnancy.	11	25	38	73	126	290	599	91
Uncontrollable Vomiting.	43	37	38	34	52	53	80	41
Ectopic Pregnancy	32	42	79	106	160	131	260	96
Other accidents of Pregnancy.	37	34	25	25	55	63	279	36
Placenta Praevia.	32	61	144	241	472	677	719	247
Other Puerperal Haemorrhage.	190	167	216	252	490	663	519	295
Accidents of Childbirth.	349	316	366	398	639	798	898	445
Puerperal nephritis.	228	187	202	251	327	414	499	251
Puerperal convulsions.	1366	666	473	444	498	635	579	543
Phlegmasia Alba Doleus.	159	205	288	378	530	661	978	364
Puerperal Insanity.	37	32	42	32	40	49	60	38
Puerperal Diseases of the Breast.	32	13	7	11	13	24	20	12
Puerperal Sepsis.	1413	1236	1378	1429	1630	1822	1937	1453
All Causes.	4028	3134	3383	3823	5339	6589	7746	4054

The causes of death can be primarily grouped in two broad categories (a) those which increase gradually from the beginning till the end of reproductive life, and (b) those in which the rate, starting from a high value in young women, declines to a minimum at ages 20-30 and thereafter gradually increases. Group (a) includes haemorrhage of pregnancy, placenta praevia, ectopic pregnancy, phlegmasia alba dolens etc. and other accidents of pregnancy. Group (b) includes all the other causes of death. These groups could be subjected to a second process of subdivision according to the relative risk

of death at each age. In the first group, for instance, the slope of the line representing the increasing risks with advancing age, varies in different cases, and in the second, while the limits of reproductive life are subject to a higher mortality than the intervening ages, there is a difference in the relation between young and old mothers. In puerperal convulsions, for example, mothers at the beginning of life have a much higher death rate than those at the end; while in the other causes of mortality included in this group, older mothers have a higher death rate than the younger.

6. General Factors influencing the Age Distribution of the Death Rate.

The type of age distribution of any cause of maternal mortality will no doubt suggest correlated etiological factors, but with only national statistics available, an examination and discussion of the influence of local conditions in the pelvic organs, is obviously impossible, so that only general conditions which have some influence can be considered.

(1) Primiparity. It has been shown by various writers, among whom may be mentioned Matthews Duncan (1866) and Coghlan (1898), that first births are much more dangerous than all other subsequent births up to the ninth or tenth, and thereafter the risks are again multiplied in subsequent deliveries. The effect of this on the death rate as a whole has been discussed by Greenwood and Stevenson (1924) who came to the conclusion that the decline in the birth rate with the consequent increased percentage of primiparae cannot account for a great part of the puerperal mortality rate. The proportion of first births to the total births varies greatly at different ages of the reproductive period. The figures published for New Zealand (1924) give the following percentage distribution

of primiparity at ages (legitimate births only)

15-	20-	25-	30-	35-	40-	45-
85	56	33	18	10	3	6

The results given by Duncan and Coghlan show that if the death rate in first births be taken as unity, subsequent pregnancies bear the following relations. -

No. of Pregnancy	1	2	3	4	5	6	7	8	9	10& over.
Duncan	1.00	.62	.73	.48	.63	.43	.61	.93	.53	.46
Coghlan	1.00	.53	.66	.57	.74	.75	.73	.87	1.21	1.24

The figures available for births after the tenth are small, so that the ratios are subject to a high probable error. Families of over ten are not common at the present time. Considering then only the relation of first births to all subsequent births up to the tenth, the death rates are in the ratio of 1.46 to 1 for Coghlan's, and 1.62 to 1 for Duncan's data. This will allow of a crude correction being made in the age distribution of the death rate for the excessive dangers in primiparity. For example, the death rate from all causes in the age group 15-20 is 4028 per million births; of this, 85% occured in primiparae, and, if these had not been subject to any excessive risk over other parturients, the death rate would be reduced to $604.20 + \frac{3423.80}{1.62} = 2679$ per million births (taking the figure by Duncan). A similar process can be applied to the remaining age groups. The results of this are as follows . e

15-	20-	25-	30-	35-	40-	45-
2679	2614	2943	3542	5129	6331	7563

By this crude approximation it is seen that, apart from the excessive dangers of primiparous births, there is still a tendency for the mortality to be higher in the earlier age group than in the next two quinquennia and thereafter to increase steadily till the end of reproductive life. Thus primiparity is not the sole cause of the skewness of the age distribution of the death rate.

(2) The General Death Rate from all causes in the Child-bearing Period.

The second question is that of the general health of the mother. The death rate from all causes of death within the limits of reproductive life increases gradually with age - there is no rise in the 15-20 age group; so that it would seem improbable that this would have any effect on the form of the age distribution of the death rate from puerperal causes. This, however, will depend on whether the mothers at different ages form a random sample of the total female population or not. Thus it is necessary that some consideration be given to the even more complex problem as to whether the selection of married women at different ages is a random one, and, if not, whether the process of selection varies in the different age groups. There can be no doubt that the general health of a woman will influence in some degree the risks consequent on maternity. Conscious or unconscious selection of the healthier of the female sex for wives will, in general, result from a preponderance of females over males at the reproductive ages; so that we should expect to find that the death rate in married females was less than that of the unmarried. This is, however, only partially true.

Evidence of Adverse Selection of Younger Married Women.

(a) With respect to differences in the Death Rates.

In the following table II.

Showing the Death Rates per 100,000 from All Causes in Married & Unmarried Women with the Ratio of the Married to the Unmarried Death Rates for the Period 1915-23.

	15-	20-	25-	30-	35-	40-	45-
Married.....	426	406	456	485	542	612	764
Unmarried	318	377	451	512	565	697	894
Ratio of Married to Unmarried.	1.34	1.38	1.01	.95	.96	.88	.85

are collected the mean death rates per 100,000 for the period 1915-23 of married and unmarried women from all causes, along with the ratio of the death rates of married to those of unmarried females. It will be seen that, from all causes, the death rates in the first three quinquennia of reproductive life are higher in married than in unmarried women, and that the difference is greatest in the first age group and gradually diminishes, until at 30-35, married women have a lower death rate; and this continues till the end of reproductive life./ But Since the majority of the births occur in married females, and since fertility diminishes with increasing age, these younger women, especially married women, are exposed to the special risks of the pregnant to a greater degree than others. It seems expedient, therefore, to compare the mortality rates from causes apart from those special puerperal deaths. But maternal deaths in childbearing are not given with distinction as to civil state of the mother. The method that has been adopted, therefore, is to assign the maternal deaths to married and single women in the proportion which legitimate and illegitimate births bear to the total births in the several age groups. The validity of the procedure will depend on the relation between the puerperal mortality rates in single and married mothers. Coghlan (1898) has produced evidence that, age for age, the former have a higher puerperal mortality rate than the latter, so that, if this be true for England and Wales,* the number of deaths

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* A comparison of the crude rates of death of married women per 1000 legitimate births and unmarried women per 1000 illegitimate births is an incorrect statement of the true relative risk, and cannot, of itself, be taken as evidence of a higher force of mortality in unmarried mothers, since illegitimates are in the main first births, and the mothers are generally young, and possibly selected.

deducted from the total married female deaths will be too small, and, of course, the resulting death rate from all causes less childbirth will be too high. In the following table

Table 12. Showing the Percentage of Illegitimate to Total Births in the Several Age Groups for the Period 1915-23.

15-	47.36
20-	9.65
25-	3.16
30-	1.78
35-	1.83
40-	1.81
45-	2.75

are shown the percentages of illegitimate to the total births in the different age groups which result from the method adopted of distributing the births in age groups.

Deducting now the deaths due to childbearing causes from the total deaths in married and single women according to the proportions of legitimate and illegitimate births in the several age groups, the death rates from all causes less puerperal have been calculated, and are shown in the following table 13.

Table 13. Showing the Death Rates per 100,000 from All Causes less Puerperal in Married and Unmarried Women, with the Ratio of the Married to the Unmarried Death Rates for the Period 1915-23.

	15-	20-	25-	30-	35-	40-	45-
Married	283	314	380	415	479	577	759
Unmarried	316	373	447	509	561	695	894
Ratio of Married to Unmarried.	.90	.84	.85	.82	.85	.83	.85

The results of this process show that at all ages married women have a lower death rate than unmarried, but that the difference between these is least of all in the first quinquennium. And it is to be noted that the fallacy inherent in the distribution of the maternal deaths to the

two groups will weigh more in favour of the view that the married women of the 15-20 age group are a much less well selected sample of the total population than those of the subsequent years, since, assuming that a higher illegitimate maternal mortality holds for England and Wales, too few deaths have been assigned to single women, and consequently the death rate from all causes less childbirth is higher than the true value. The resulting ratio of married to unmarried (0.90) puts the actual position of young married females in a too favourable light. The above results, therefore, lead to the conclusion that, while in general married women are a healthier set of lives than single women, the young married women of 15-20 have not the same relative advantage as older married women.

(b) With respect to Differences in Social Class.

That this relative disadvantage of young mothers is possibly the result of differences in the reproductive habits of the different social strata of the population is evidenced by the following results. The correlation between the proportion which married women of 15-20 bears to all married women between 15-50 and social status, as measured by the number of rooms per person, is (from the Census figures for 1921) for Administrative Counties (with associated County Boroughs) = $-.6389 \pm .054$; and for Metropolitan Boroughs = $-.6970 \pm .066$

Thus where social conditions are lowest, where over-crowding is at its worst, there the proportions of the youngest married women are highest.

A similar result is obtained by taking other indices of social status, such as the number of domestic servants per 100 families, the proportion of the population living more than two in a room, or the crude death rate from all forms of Tuberculosis.

For Metropolitan Boroughs (1921) the results are as follows .-

Correlations between the proportion of married women 15-20 to all married women 15-50, and	
Proportion living more than two per room	.7331 ± .049
Domestic servants per 100 families	-.3217 ± .132
Crude death rate from Tuberculosis	.6854 ± .068

Additional, and probably more direct, evidence of the manner in which the proportion of younger married women is related to social class is afforded by the following figures,* which give the proportion of all marriages occurring between the ages of 15 and 20 in three groups of social status (as evidenced by the occupation of the husband) .-

Social Class**	% of Marriages between the ages 15 and 20 years
Upper and Middle Classes	5.8
Skilled Workmen	12.4
Unskilled Workmen	17.4

It may be taken then as proved that early marriages are proportionately more common in the lower social classes of the country, and, allowing for the probability that even in this restricted part of the community a certain amount of sexual selection may go on, it is nevertheless true that, considering the relation of the mortality in married and unmarried women

* From Table 29 of the Fertility of Marriage Report 1911. Part II, which contains much fuller evidence on this point.

** For the exact composition of these and other social classes, see Table 28a of the Annual Report of the Registrar General for 1911.

in the country as a whole, the young mothers of 15-20 are an adversely selected sample of the total female population at that age as regards their general health.

(3) An Optimum Period for Reproduction

With regard to this, the possibility that the age distribution of the death rate may simply represent the fitness of women of various ages to become mothers, no available information can confirm or refute such a suggestion; but a hypothesis such as this should, in my opinion, be reserved as a last resort, and only given serious weight when the trend in the death rate in childbearing fails to be explained in any other manner. As described above, allowance has been made, as far as possible, for the excessive risks incident to a primiparous birth, but even so, there still remains a slight excess in the death rate of mothers in the first quinquennium of reproductive life. How much of this excess in the death rate would be removed if it were possible to eliminate the affects of the adverse selection with respect to their general health, as measured by the general death rate to which these mothers are subject, and the social and economic class to which they belong, it is not possible to predict at present; but, if after doing so, the excess in the death rate still remained at this age, there might then be some reason for believing that the trend of the mortality rate with age was at least in part representative of an optimum period for procreation. Part of the evidence on which the belief in a climax in the reproductive life of women is based is unsound; the remainder is open to other, possibly more likely explanations. For instance, Duncan (1866) postulates a climax in fecundity, the evidence presented in favour of this being the birth rates

at ages of women without respect to civil state. The birth rates of women, married, single and widowed together, increase from the 15th up to the 29th year and then gradually fall. But the birth rates calculated as the number of legitimate births per 1000 married women of given ages has already been shown to decline steadily from the beginning till the end of reproductive life. No doubt, part of this high reproductive activity in early life is artificial, some of the marriages being from necessity ("forced" marriages, due to antenuptial conception) and others (in the present state of affairs) from the lack of knowledge among younger women of the methods of contraception. Still the majority of fertility rates at ages shows a gradual decline in reproductive capacity from the commencement of reproductive life till the menapause.

The other point which Duncan produces in favour of this hypothetical optimum is the skew regression on the age of the mother of the weights and lengths of the offspring at birth. The weights and lengths of babies increase with the age of the mother up to about the 25th. - 30th. year, and the infants born of older women are lighter and shorter than those born to mothers of 25-30 years of life. But so many possibilities exist which might explain these observations (among others, the duration of pregnancy, variations in the feeding of the mother during pregnancy, the effects of inheritance, etc.) that it seems needless to postulate a climax in reproductive life. Further, as I have shown elsewhere (1926), the inferiority of the infants born of the youngest mothers remains only for a short period of life. By the end of the first year the weights and lengths of the offspring showed a steady decrease with increasing age of the mother. Accordingly the evidence would lend support to the view that but little stress

should be laid on the doubtful immaturity of women of 15-20 as a factor in the production of the higher death rate at that age compared with those of the immediately subsequent age groups.

These two general conditions, primiparity and varying intensities of selection of married women at different ages, have thus a possible causal relationship with the observed age distribution of puerperal mortality in general. If we could assume that these were wholly responsible for the higher death rate in the first quinquennial age group compared with the two immediately subsequent groups, it would follow that in a population of women selected at random as regards their general health and dissociated from the excessive dangers of primiparity, the death rate in maternity should follow the age distribution of females in general from all other causes of death, i.e. a death rate gradually and steadily increasing with age; and, further, will raise some doubt as to whether the age distribution of the conditions included in the first group - group (a) - are influenced to any significant extent by these factors, and consequently our attention will be specially directed to the effects of other conditions, possibly local, such as those in the uterus and adnexa.

It is impossible from the figures available to say how far each of these causes of death is dependent on local abnormalities in the pelvic organs and how far on the general health of the mother. Some of the suggested local etiological factors are possibly only accidental associations of the various conditions, while the real causal factor may be a general condition of the mother, which, varying with age, may be correlated with the incidence of local pelvic

phenomena. This is given some support when we consider the number of concomitants suggested as having some bearing on the liability to a particular condition, often without any attempt at forming a control series of observations. Just as in general medicine where the number of suggested remedial agents for a particular morbid state is often in inverse ratio to the individual therapeutic value of each of these, so too possibly in obstetrics the number of suggested etiological factors may have a high negative correlation with the amount of exact knowledge. The mere occurence of, say, fibroid tumours of the uterus along with post-partum haemhorrage is no proof of an etiological relationship between the two conditions; and it is precisely in such cases where associated pathological states afford a reasonably sound explanation of the occurence of some untoward event that faulty generalisations are sometimes made. Only a complete and impartial statistical investigation is calculated to throw much light on such subjects.

When we examine group (b) with respect to the relation between the death rates in the youngest and oldest women, it will be seen that puerperal convulsions is the sole instance in which the oldest mothers are subject to a lower rate of mortality than the youngest. This group, which is composed almost entirely of eclampsia, is of further interest in that the minimum death rate occurs at a later period in life than in the other diseases included in this group (b). The death rate drops steadily from the beginning of reproductive life until it reaches its lowest value in women of 30-35, and thereafter it increases again in later life, but never attains the high value of women of 15-20.

As is well known, however, eclampsia is almost solely confined to primiparae. The estimates of various writers give the proportions of cases occuring in first births as

anything from 70% and upwards. It is quite clear then that by basing the deaths from convulsions on the number of primiparae instead of total births, we shall arrive at a clearer conception of the true mortality of this condition at different ages of life. Using the figures previously given for the proportions of first births to all births in the quinquennial age groups in the New Zealand data as a rough guide to the numbers actually occurring in England and Wales, the probable numbers of primiparae in each of the quinquennial periods have been estimated, and from these the death rates per 1000 first births have been calculated, and are shows on Table II and Diagram Ia.

Showing the Death Rates at Ages from Puerperal Convulsions calculated in terms per 1,000,000. First Births for the Period 1915-23.

	15-	20-	25-	30-	35-	40-	45-
Death Rate per Million Births	1366	666	473	444	498	635	579
Death Rate per Million First Births	1607	1135	1443	2445	4826	8116	9337

The results show that the death rate of eclampsia is very much greater in older than in younger primiparae, and apart from a slightly higher rate in the first as compared with the immediately succeeding quinquennium, the risk of eclampsia increases steadily with age.

The exact origin of eclampsia is uncertain. The weight of present opinion is in favour of the view that it is a toxic condition, the source of the toxic bodies being certain elements of the developing ovum. It is interesting to note that there exists a close analogy between eclampsia and toxic and infectious diseases in general. Recovery from infection is associated with a development of immunity, the period during which this persists, however, differing in different diseases. Insome, smallpox for example, the

duration of immunity following attack is long, often lifelong, while in cases like influenza and pneumonia the period of susequent immunity is short - it is even questioned by some whether it exists at all, but it is clear that recovery must be associated, even in these diseases, with some period of immunity, however transient, if recovery is to occur at all. Further the period of greatest liability to infectious disease is usually early in life, and cases are much less frequent as age advances, but the fatality rate becomes greater as age advances. In pregnancy there is evidence that foetal elements pass into the maternal blood stream, and it is also known that extracts of normal tissues possess toxic properties. Emboli consisting of plugs of chorionic cells have been found in the lungs and other viscera of women who have died while pregnant, and the serum reaction of pregnancy seems to indicate that there is in pregnancy usually a formation of antibodies to some antigen. Obata, (1919) studying the effects in mice of intravenous inoculation of extracts of normal and eclamptic placentae, and the capacity of normal and eclamptic serum to neutralise these, has shown that both normal and eclamptic placental extracts produce similar symptons on inoculation although with the latter a smaller dose is required. He further has shown that the sera of normal women do not differ from those of eclamptic women, and that the poisonous properties of the sera are not in excess during the eclamptic fit. The important result, however, was that the power of eclamptic serum to neutralise the toxic effects of injection of placental extracts is decidedly less than normal during the seizure, and by the fourth or fifth day of the puerperium the normal titre of the serum had been restored. The author concludes

that eclampsia is an intoxication by a placental poison made possible by a weakening of its normal capacity of neutralisation on the part of the maternal blood. The results of his work would suggest that the development of eclampsia in a pregnant woman was due not so much to differences in the placentae themselves as to differences in the capacity of women to react to an antigen common to both women who do and those who do not develop eclampsia. Aberhalden's reaction shows that there is some antibody formation which is peculiar to normal pregnancy, and it would be interesting to find if this reaction is equally distinct in eclamptic women. Again, the results of the present study have shown that the fatality of this condition is highest in elderly primiparae, and Brownlee (1906) has brought forward some evidence for the belief that the high case mortality at the older ages in certain infectious diseases is due, not to variations in the virulence of the organisms infecting these cases, nor to a want of resistive power in the tissues themselves, but to a greater inability to produce certain bodies at certain times.

7. Factors modifying the Mortality Rates from Puerperal Causes within Recent Years.

Within recent years the crude maternal mortality rate has not declined; but various changes are occurring among the female reproductive section of the community which are not favourable to a declining death rate. The tendency if anything is in the opposite direction.

1) The fall in the birth rate results in an increased proportion of primiparous births with its attendant increased chances of death for the mother.

2) There has been, besides, a change in the age constitution of married women between the last two censuses. The mean age of married women between 15-50 is, for 1921, 30.11 years, and, for 1911, 30.78 years - an increase of about half a year.

But when the age groups are weighted according to their fertilities, the mean ages of the weighted distributions are, for 1921, 30.75, and, for 1911, 30.78 years, i.e. the average ages are practically identical. The distributions at ages however, are somewhat different. The following figures show the proportions of married women living at the several age groups (weighted according to their fertilities) at the two censuses . -

	15-	20-	25-	30-	35-	40-	45-	15-50
1911	1.03	17.05	29.28	28.27	17.27	6.48	0.62	100.00
1921	1.50	18.33	28.13	26.54	17.50	7.26	0.74	100.00

(These figures really give the proportions of the total legitimate births which come from mothers of these ages.) There has been apparently a slight increase in the percentage of probable mothers in the first two and last three quinquennia, with a corresponding defect in the intermediate age periods. Slight as is this change, it is certainly in the direction of causing an increase in the crude maternal mortality rate.

3) The selective character of the birth rate, again, might have become more intense within the periods studied; but, on investigation this does not appear to be so. On table 12 are shown the correlations between the legitimate birth rate and the social status of the district for (a) the 52 counties of England and Wales excluding London, and (b) the 28 metropolitan Boroughs of London in the 2 periods 1911-13 and 1921-23.

Table 12 Showing the Correlations between the Crude and Corrected Birth Rates and Social Status.

(a) 52 Counties excluding London.				
Index of Social Status	Crude Birth Rate		Corrected Birth Rate.	
	1911-13	1921-23	1911-13	1921-23
% Population living more than 2 per room	.5253 ± .063	.6556± .053	.3749± .080	.3245± .084
Rooms per Person	-.7923± .035	-.8109± .032	-.4008± .073	-.2772 .086

(b) 28 Metropolitan Boroughs of London.

% Population living more than 2 per room.	.5652± .037	.6178± .079	.6131± .080	.7144± .062
Number of Domestic Servants per 100 Families.	-.8061± .045	-.8172± .042	-.6739± .070	-.6722± .070

The crude legitimate birth rate is calculated per 1000 of the total population. The corrected birth rate is one which removes the objections pertaining to the crude rate, in that it is calculated in terms of the female population living at reproductive ages (15-50) and makes allowance for the varying fertility at different ages by weighting each age group according to its relative nuptial fertility, so that variations in the proportion of females of ages 15-50 to the total population and difference in the age distribution within the reproductive female population itself are eliminated by the use of this corrected birth rate. These results show that at each of the two periods and in the two widely different sets of administrative units of the country, there is a well-defined relation between social and economic status, and the height of the birth rate. Further it is seen that in counties the correlation is reduced by almost 50% when variations in the proportion of females of reproductive ages, and in the age constitution of this class of females, are eliminated, but that these factors are of no great importance in the metropolitan Boroughs, the correlations given by the crude rates in this instance being of the same magnitude as those given by the ~~crude~~ corrected rates. Thus it is clear that both in counties and in Metropolitan Boroughs, the birth rate is still strongly differential, the greater proportion of the total births being recruited from the lowest classes of the community.

The correlation between the decline in the birth rates

within the decennium and social status are given on Table 13, (a) and (b).

Table 13. Showing the Correlations between the Decline from 1911-13 to 1921-23 in the Crude and Corrected Birth Rates and Social Status.

(a) 52 Counties excluding London.

	Crude	Corrected.
Index of Social Status.	$\frac{1921\text{-}23}{1911\text{-}13}$	$\frac{1921\text{-}23}{1911\text{-}13}$
% Population living more than 2 per room.	-.0964± .093	-.0942± .093
Rooms per Person	.2692± .087	.1931± .090

(b) 28 Metropolitan Boroughs of London

% Population living more than 2 per room.	-.2852± .117	.1925± .123
Number of Domestic Servants per 100 families.	.3654± .110	-.0604± .127

In two cases the correlations are significant with regard to the size of the probable errors. Both of these are with the crude birth rates. When allowance is made for the two objections mentioned with respect to this rate, there is no relation between the decline which has occurred and the social class of the district. All the correlations are insignificant.

The decline which has occurred in the birth rate of the country within the past decennium, therefore, has affected the different social classes to approximately the same extent.

Still with the above two factors antagonistic to a declining mortality - a lower birth rate, and a change for the worse in the age constitution of mothers - it is possible that changes may have occurred in the death rates at some ages, but that these have been obscured by using a crude rate of mortality.

8. The Effect produced by the Declining Birth Rate on the Crude Rate of Mortality from Puerperal Convulsions.

To illustrate the fallacy that might occur from the use of crude rates, and from taking no note of the age or parity of the mother, a good example is that of eclampsia - a feature associated almost exclusively with primiparity. The group puerperal convulsions is almost entirely composed of eclampsia and, expressed in the usual manner, the rate was in 1911-13, 549 per million births; in 1921-23, 485 per million births; that is, there was a decrease of 12% in the decennium. But the fall in the birth rate of necessity results in a rise in the proportion of first births, so that the denominator in the first period is too lenient relative to that in the succeeding period. I have attempted to estimate the effect of this in the following manner. Taking the 28 registration states of the Births Registration Area (U.S.A.) in 1923, in which the notifications of birth require a statement of the order of birth (Delaware and Massachussetts do not require this information, and had to be excluded), the proportion of first born children (x) was calculated for each state and correlated with the crude birth rate (y). The following are the constants deduced. -

$\bar{x}$ = 27.6107% first born children.

$\bar{y}$ = 22.5679 births per 1000 total population.

σ_x = 2.9766% first born children.

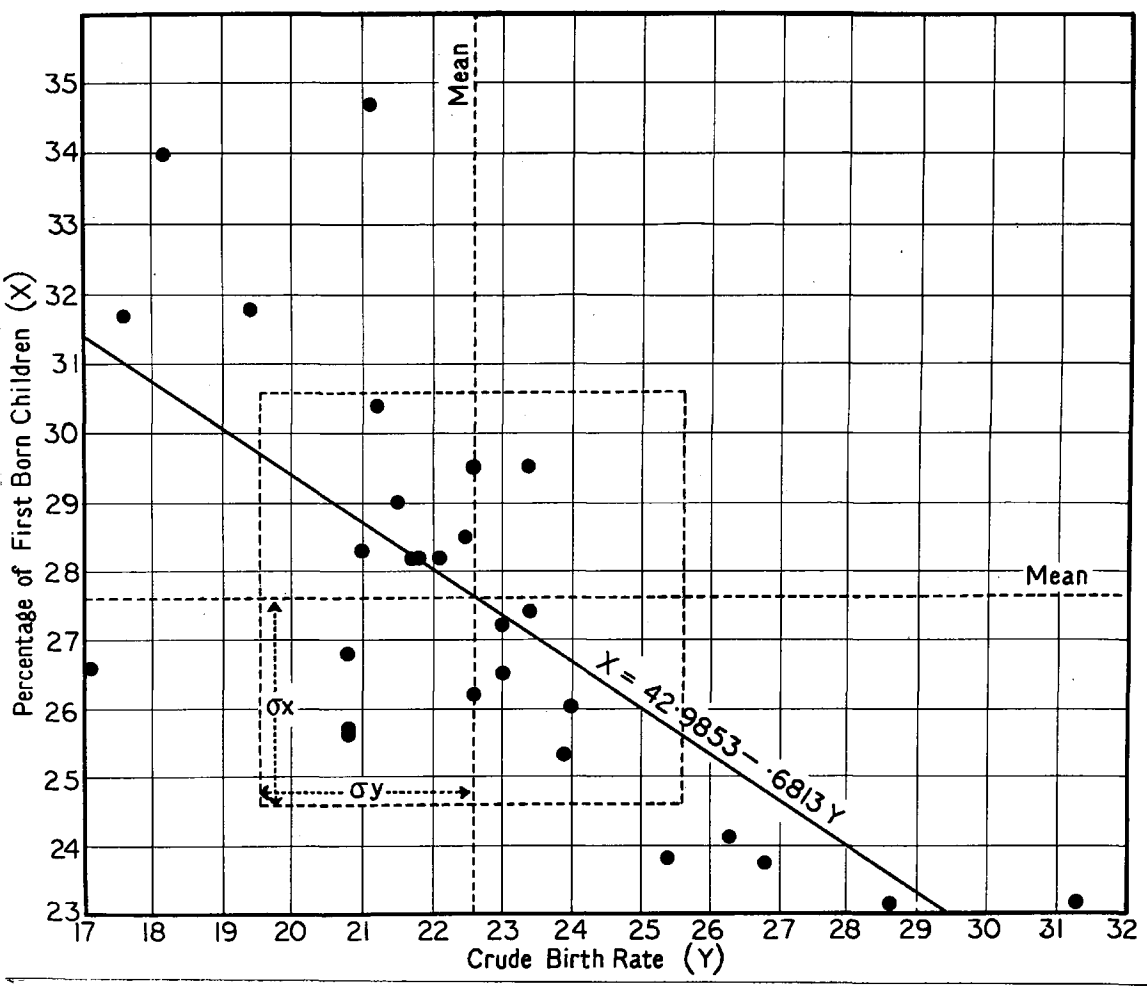
σ_y = 3.0492 births per 1000 total population.

$$r_{xy} = -.6979 \pm .065$$

Connecting these two variables by a simple regression equation of the first order we find that ;-

Probable % of first born children = 42.9853 - .6813 x Crude birth rate. In other words, a fall of 1 per 1000

DIAGRAM 2.



Showing the regression of the proportion of first-born children on the crude birth-rate.

population in the crude birth rate corresponds on the average to an increase of 0.6813% in the proportion of first born children, with a standard error in prediction of 2.13%. From the accompanying diagram (Diagram 2), it will be seen that the fit is by no means very good, but that a straight line is likely to be as good for prediction within the range of the observations as any curve of higher order.

Applied to the statistics of England and Wales, this simple relationship will allow us to form a rough general estimate of the number of primiparae in the two triennia. In 1911-13 the mean crude birth rate was 24.03 per 1000 population which, substituted in the above equation gives a probable proportion of first born of 26.6137%. Similarly for 1921-23, a crude birth rate of 20.83 corresponds to a proportion of 23.7938% . The total births in 1911-13 was 2,635,765; so that of these 701,475 were first born. In 1921-23 the total births was 2,059,768; so that 687,328 of these were first born. Assuming that all the deaths in the group puerperal convulsions were eclamptic, and that these in turn all occurred in primiparae, the above figures give rates of 2064 and 1685 per million first pregnancies in 1911-13 and 1921-23 respectively; that is, there has been a decrease of 19% in the death rate - a decrease over 50% greater than that estimated by using all births as the denominator. Even this, however, is unduly pessimistic. We have already shown that eclampsia is much more common in, or more fatal to older primiparae, and the decline in the birth rate has apparently not affected young women to the same extent as the older ones, so that in addition to the increased amount of primiparity the mean age of primiparae is probably higher than in 1911-13; so that

Table 14. Showing the Death Rates at Ages per 1,000,000 Births in England and Wales for the Periods 1911-13 (a) and 1921-23 (b) with the Percentage Ratio of the 1921-23 death rate to that of 1911-13 (c) from the several groups of Causes of Death.

	15-	20-	25-	30-	35-	40-	45-	15-50
Abortion (a)	74	65	93	101	236	235	440	124
(b)	98	46	76	138	195	320	233	125
(c)	132	71	82	137	84	136	53	101
Ectopic Pregnancy	19	46	51	86	133	181	126	82
	16	41	94	128	170	184	233	111
	84	89	184	149	128	102	185	135
Other Accidents of Pregnancy	186	80	89	138	319	494	377	169
	114	127	100	141	308	433	372	131
	61	159	112	102	97	88	231	107
Puerperal Haemorrhage	408	279	337	528	1049	1446	1760	576
	244	214	371	495	924	1365	1168	561
	59	77	110	94	88	94	66	92
Other accidents of Childbirth	408	262	295	365	619	946	1195	411
	195	325	345	364	581	736	930	414
	48	124	117	100	94	78	78	101
Puerperal Sepsis	1615	1564	1246	1302	1506	1650	1509	1361
	1368	1195	1254	1295	1559	1736	2500	1354
	85	88	101	99	104	108	166	100
Phlegmosia Alba Dolens	408	249	289	347	656	807	1132	400
	114	199	265	419	547	736	1279	377
	28	80	92	121	83	91	113	94
Puerperal Insanity	37	33	33	40	61	12	63	39
	49	31	32	31	37	53	58	34
	132	82	97	78	61	442	92	87
Puerperal Nephritis	390	184	183	184	269	355	503	215
	179	162	163	214	303	356	523	218
	46	88	92	117	113	100	104	101
Puerperal Convulsions	2840	682	464	409	438	572	745	549
	1189	594	436	395	461	499	639	485
	42	87	94	97	94	87	85	88
All Causes	6386	3249	3082	3499	5330	6698	7859	3922
	3566	2933	3140	3621	5084	6469	8429	3839
	56	90	102	103	95	97	107	98

when allowance is made for this, the decline would be still further magnified. This result, therefore, leads to the conclusion that in certain cases a crude rate of mortality leads to erroneous deductions.

9. Changes in the Mortality Rates from Puerperal Causes at Ages within Recent Years.

The births having been distributed to the different ages of mothers in a manner which we have reason to believe is fairly accurate, the death rates at ages for the two triennia 1911-13 and 1921-23 have been calculated. These are given on Table 14. It is impossible with the figures available to dissociate the influence of age and parity of the mother, and this is a point of some importance not only with regard to the etiology of pathological conditions in childbearing, but also, as has been shown, in comparing the death rates at different epochs when both age of the mother and the average degree of parity are changing concomitantly, as is happening at the present time in connection with the declining birth rate. The only method which would give absolutely satisfactory results is a comparison between women of equal age and varying parity and vice versa; but a consideration of the relation between the age-specific death rates in 1911-13 and 1921-23 has thrown some light on the subject. It is to be specially noticed that while the general crude maternal mortality rate shows practically no change in the decennial interval, in all the chief causes of death there has been a great reduction in the death rates at ages 15-20. The great majority of these women are almost certainly primiparae, so that we are really comparing the rates in a group of women of approximately the same age and parity - and the death rate has apparently been reduced by half in the decennial interval. It might here be objected

again that the method of computing the death rates by age of mother may have assigned too few or too many births to these mothers, since we do not know how the fall in the birth rate has affected the actual fecundity at various ages in the women of England and Wales. But this cannot possibly account for the whole of this enormous decrease, since if there had been no actual decrease, if the apparent drop was solely due to erroneous methods of graduation, then twice as many births as actually did occur have been alloted to women of 15-20 in 1921-23 as compared with 1911-13. No doubt there may be some error in apportioning the births and too many given to the premier age group relative to what were given in the previous triennium - this can be well understood if the fall in the birth rate had specially characterised young mothers - but the previous comparison of fertility rates at ages for different countries at different periods has shown that this is certainly not the case. If the decline in fecundity of women in ages 15-50 in England and Wales has affected the various age groups in the manner in which the above comparison would seem to indicate, then we have in the latter triennium actually underestimated the number of births to be assigned to women of 15-20. The method thus has overestimated the death rate at that age relative to the corresponding group in the preceeding triennium, and consequently has obscured some of the decrease in the intervening period. Accordingly, I am inclined to believe the amelioriation is a real one, and not due to fallacies connected with the methods of distributing births.

While there is also a change for the better in the rates for women of 20-25, in which group about 20% of all the

births occur, there is no unequivocal evidence of any significant divergence of the rates at the other ages for 1921-23 from those in the preceeding years.

10. The Possible Cause of the Changes in the Mortality Rates at Ages.

The possibility of explaining this significant decline in the mortality of younger mothers is limited by the available data. The increase in the attention (antenatal, natal and postnatal) given to mothers, improvements in the general sanitation of homes, advances in the further provision of hospital accommodation for necessitous cases in confinement, and improvement in the general health of parturients would all require consideration. But to assign any value to the efforts specially directed towards mothers (i.e. obstetric control) it will be necessary, in view of the restriction of the improvement in maternal mortality to the younger ages, to show that these efforts have been in the main confined to these ages. Improvements designed to ameliorate the condition of the people in general, (not specially the mother) such as improvements in general hygiene, would operate selectively on some ages more than others, provided that a greater part of the deaths at these ages is the result, directly or indirectly, of unhygienic conditions, i.e. if a greater part of these is preventible.

At present I have not had access to any data sufficient or suitable for the evaluation of the effects of these factors, but it is possible to enquire what changes, if any, have occured in the health of women in different civil states in these two periods.

In the following table

Table 15. Showing the Death Rates in Married and Unmarried women in 1911-13 and 1921-23 with the percentage decline within the Period, and the Ratio per cent of the Married to the Unmarried Death Rate (All Causes).

Age	Married		Percent Decline	Unmarried		Percent Decline	Married Death Rate ; Unmarrie	
	1911-13	1921-23		1911-13	1921-23		1911-13	1921-d 23
15-	630	411	35	264	257	3	238	160
20-	387	343	11	239	304	-5	134	113
25-	338	355	9	325	343	-6	119	103
30-	452	388	14	423	386	9	107	101
35-	592	462	22	533	447	16	111	103
40-	734	551	25	700	605	14	105	91
45-	944	721	24	992	815	18	95	88

are collected the mortality rates at ages of married and unmarried women from all causes for the two triennia which have been studied. It will be seen that at most ages there has been an improvement in the health of both sets of women, but that this has specially been so in the case of married women. Consequently the ratio of the death rate of married to unmarried has declined significantly within the period. In the first quinquennium the greatest difference is apparent. The ratio of 238% in 1911-13 has declined in the intervening ten years to 160%. Similarly, but to a much less significant extent, the ratios have declined in the later ages. But the enormous decline in childbed causes must have contributed in some degree to this result; so that, in a manner similar to that employed before, the puerperal deaths have been deducted from the married and unmarried in the proportion of the illegitimate to the total births at each age, and the death rates recalculated for all causes less those pertaining to pregnancy. The results are given in the following table.

Table 16. Showing the Death Rates in Married and Unmarried Women in 1911-13 and 1921-23 with the Percentage Decline within the Period and the Ratio per cent of the Married to Unmarried Death Rate (All Causes less Puerperal).

Age	Married		Percent	Unmarried		Percent	Married death rate % of unmarried.	
	1911-13	1921-23	Decline	1911-13	1921-23	Decline	1911-13	1921-23
15-	363	230	23	266	256	4	136	110
20-	275	254	3	293	301	-3	94	84
25-	277	275	0	320	340	-6	86	81
30-	308	319	-4	372	383	-3	83	83
35-	419	400	5	468	444	5	89	90
40-	611	516	16	716	603	16	85	86
45-	905	716	21	1031	814	21	87	88

It will be seen that, although childbed causes have contributed in great part to the difference, there is still apparent a very definite amelioration in the general death rate of married as compared with unmarried women within the decennium. Further it will be noted that the greatest improvement is in the 15-20 age group, somewhat less in the next, still less in the third quinquennium, while in the last four quinquennia there is no significant change in the relationship. To what degree this result should be credited to the opportunity given by the loss of male lives in the war for a better selection of the fittest of the females for marriage, or to other causes, such as changes in the age at marriage in the different social classes, is not a point which need concern us here. Certain it is that there has been a great change for the better in the health of young mothers apart from the risks of maternity.

That there is some relation between general health and the risks of dying in childbed can scarcely be doubted. The curve of puerperal mortality when corrected for primiparity shows a close parallelism with the general mortality curve of women at these ages except in the first quinquennium of reproductive life, and it has been shown that these young mothers are a selection from the lower social classes in which, as is well known, the general health is below that of the average.

The result of the above comparison would therefore appear to strengthen the assumption that the childbed mortality was determined to a great extent by the general state of wellbeing of the

parturient, and similarly that the improvement in the type of young mothers has been the main factor which has determined the great decline in maternal mortality at the younger ages within the past decennium.

The possibility, however, that the relationship between the maternal mortality rate in childbearing and the death rate from all other causes in women of those ages may not be indicative of a correlation with health must not be overlooked. There are two other quite probable explanations which might equally suffice in interpreting the above results; -

(a) That the real correlation is with some special disease or group of diseases, or

(b) That the variations in the maternal death rate is correlated with variations in the availability of skilled medical assistance, and consequently might show special relationship with causes of death dependent mainly on such a factor.

If the separate groups of causes of death had been given with respect to civil state, the solution would be simple, in view of the varying degrees of amelioration of the death rates at the separate ages in married and unmarried women which have occurred within the past decennium. But since the requisite data are not available, the only other means of elucidating the problem is by the method of correlation.

Summary and Conclusion.

In the present paper an attempt has been made to devise a method of determining the mortality rates at ages from the causes of death in childbearing. The comparisons which it has been possible to make to determine what factors might vitiate the results obtained lead to the conclusion that the second

method described is fairly near the truth. The numbers of married and unmarried women of different ages are weighted by their relative nuptial and exnuptial fertility respectively, and the legitimate and illegitimate births are distributed to the quinquennial age groups in the proportions which each weighted group of married and unmarried females bears to the total weighted married and unmarried female population within the limits of reproductive life. The resulting births at ages form the denominators on which to calculate the mortality rates from causes of death in childbed at the various ages.

By distributing all births irrespective of legitimacy or otherwise in the proportion only to the married female population at ages, the death rates at younger ages are greatly over-estimated.

From the figures collected it has been impossible to demonstrate conclusively any constant change in the relative fertility of women of different ages, coincident with the decline in the birth rate, but the evidence available would suggest that the procreativity activity of the youngest married women becomes relatively greater than that of older women as the birth rate falls. It has been shown that the mortality from all causes in childbearing follows this course;- beginning with a high value in the age group 15-20, the rate drops to a minimum in the second quinquennium of reproductive life and thereafter gradually increases with age.

The main components of the total death toll follow the same distribution with age. These have been classified as Group (b) But other less important causes of death show rates which gradually increase with age from the commencement.of the reproductive period (classified as Group (a)).

The high death rate in young mothers cannot be wholly accounted for by the excessive dangers of primiparity. Evidence has however been submitted, that these young women are on the average a less healthy sample of the total female population at that age, and that, apart from primiparity and adverse selection, the general deathrate of mothers from childbed causes probably follows the same law of mortality as women in general from all other causes of death. Eclampsia is much more common in young women, but this is solely due to the greater number of primiparae at these ages. Estimated in terms of first births, the death rate increases rapidly and steadily with age, subject to a small exception in the first quinquennium, which may possibly be a consequence of [illegible] unfavorable marital selection at that age.

There has been a decline of nearly 50% in the puerperal mortality in young mothers of 15-20 and a smaller decrease in the second quinquennium; but there is no evidence of any improvement at the later ages. These phenomena have been brought into relation with the change which has taken place in the death rate from all other causes in married women at these ages, as the youngest group of married women are now in a much better position, as regards their death rate from all causes other than those connected with childbearing, relative to that of the unmarried of the same ages, than they were in the preceeding triennium. No correspohding improvement has taken place in the relative mortalities from all other causes in older women within the childbearing ages. The results of this investigation strongly suggest that the general state of the mother's health is a factor of great importance in determining the height of the mortality rate in pregnancy.

PART II. The Degree of Association between the Mortality Rates in Childbearing and Certain Influential Factors.

In the previous section (Part I) it has been shown that there exists some connection between the age of the mother and her chance of dying in childbed. This age distribution is also to a certain extent related to the death rate from all other causes in women of those ages. The present section is an attempt to measure the influence of these two variables in the production of geographical variations in maternal mortality.

1. The Influence of Variations in the Age Constitution of Women on the Mortality Rates in Childbearing in the Administrative Counties (with associated County Boroughs) of England and Wales.

Since the age distribution of the death rate from all causes in childbearing is not linear, and since the proportion of illegitimate to the total births varies in different parts of the country, a coefficient of correlation between the mean ages of married women and the maternal mortality rate will not suffice to determine how far variations in the age constitution of mothers are associated with variations in the rates of mortality. The only method which appears to fit the problem is to calculate an age-standardised rate of mortality for different districts. The arithmetical work involved in this process is somewhat laborious, as, the rates being calculated on total births, it requires first of all that for each county the births be distributed to the age groups of mothers. The method adopted is that previously described (See Table 7). Legitimate and illegitimate births are now summed for each age group, and the mortality rates which would have occurred in each county,

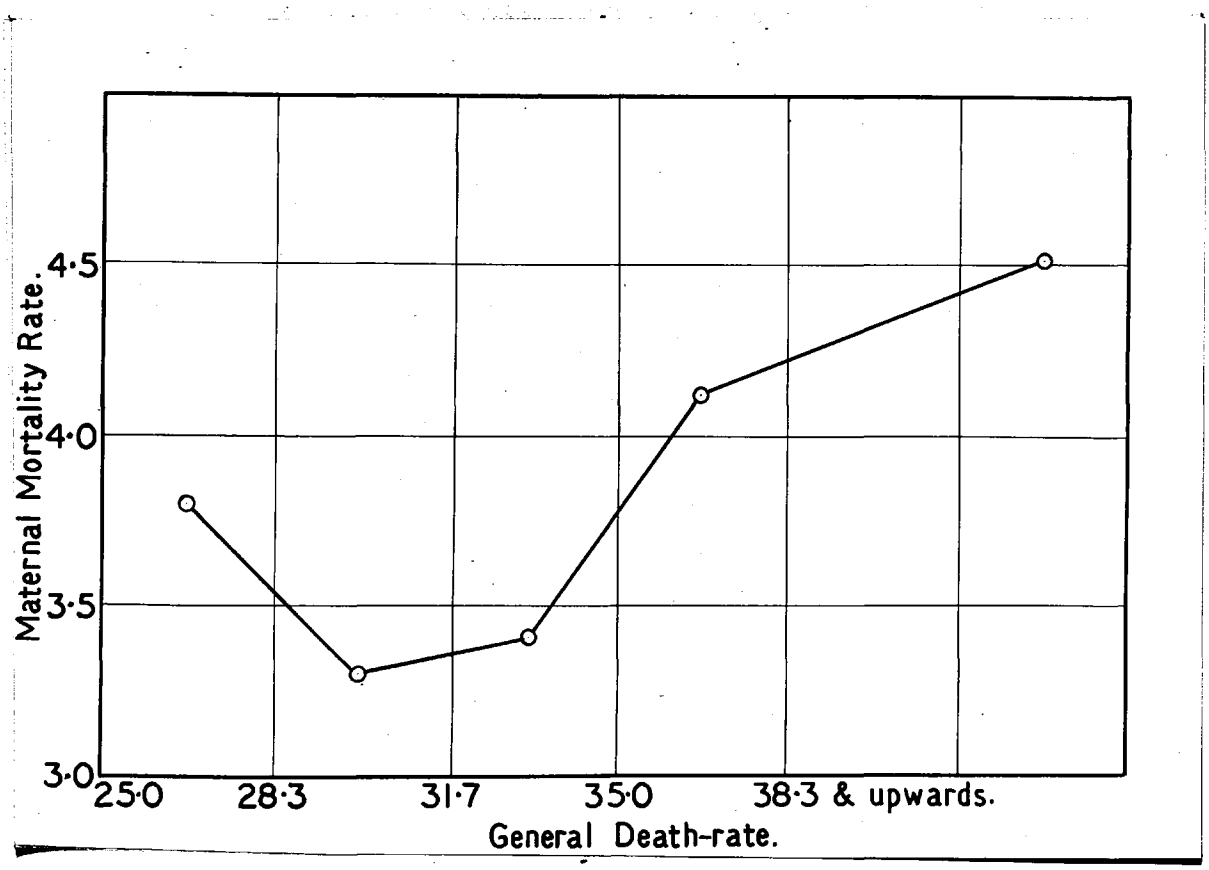
had the death rates at ages been the same as those of the country as a whole, calculated by applying the death rates of England and Wales to the births at each age, and the expected deaths divided by the total births. The death rate of the standard population divided by the expected death rate of the county furnishes a factor for correction which, when in excess or defect of unity, denotes the existence of a female reproductive population constituted with respect to danger of death in childbearing favourably or adversely respectively. (The method, after the distribution of births is effected, is that known in the Registrar-General's reports as the "indirect" method of standardisation). The factors for correction are given in Appendix. This process has sufficed to demonstrate one point. In no case is the correcting factor sufficiently divergent from unity to make any difference in the crude rate per 1000 births. Hence we are entitled to conclude that, in spite of the fact that the age of the mother has already been shown to be an important factor in determining her chance of dying in childbearing, the variations in the age constitution of the female population of the counties of England and Wales are of negligible importance as factors in the production of the geographical variations in maternal mortality. This, of itself, is of some value. One of the influential factors, and one moreover not amenable to efforts of administrative control, can thus be eliminated from the further consideration of inter-local variations.

2. The Influence of Variations in the Death Rates (from all Causes less those pertaining to Childbirth) in Women, of Reproductive Ages on the Mortality Rates in Childbearing.

Beginning first with a general review of the country as a whole, the death rate per 1000 women of ages 15-45 from all causes less childbirth and the mortality rates from childbed causes per 1000 births, have been calculated for the counties

of England and Wales (Appendix). The births and deaths on which the rates are based are the figures for the triennium 1921-23. The general death rate has been calculated on the Census population of 1921. No attempt was made to extrapolate from the population enumerated at the last two Censuses for the female population at the mid-point of the triennium. Several of the counties have been grouped together to eliminate as far as possible, violent fluctuations in the rates which might otherwise occur solely from the small size of the sample afforded by some of the geographical counties when taken singly. In this way the 55 counties of England and Wales have been reduced to 43. Further, the rates are crude rates - no allowance has been made for the varying age and civil constitutions of the several subdivisions of the country. It is improbable in view of the high variability of the actual crude rates that the variations in age constitution will have much effect on the conclusions reached, and further it is to be noted that the trends of the two mortality rates with age are, except for a rise in the childbearing mortality at the quinquennium 15-20, practically similar, both increasing with age thereafter; so that correction for age will change both variables practically to the same extent. Hence, in view of the fact that differences in age are of negligible importance in the case of the maternal mortality in childbearing, it is not at all likely that corrections for age will make any substantial difference in the general death rates from all the causes at those ages. The correlations deduced from the crude data will, therefore, not be changed to any significant extent by this refinement.

DIAGRAM 3.



Showing the average maternal mortality rates for districts graded according to general death-rates of women of child-bearing ages.

The observations on the 43 counties have been claculated from a grouped correlation table. The following are the constants deduced -

Table 17.	Mean	S.D.	C.V.
1. Maternal mortality Rate per 1000 Births.	3.7314	0.7156	19.18
2. Death Rate All Other Causes per 1000 Females. 15-45	3.3275	0.4366	13.12

$r_{12} = .4202 \pm .085$

$\eta_{12} = .6983 \pm .053$ $\qquad \frac{\sqrt{N}}{.67449} \cdot \frac{1}{2}\sqrt{\eta^2 - r^2} = 2.71$

Both correlation constants, the coefficient and the ratio, have been worked out. The coefficient r_{12} is solely a measure of the tendency of the two variables to increase or decrease concomitantly. It fails when the relationship between the two cannot be at least approximately represented by a straight line equation. The correlation ratio (η) is a measure of the degree of association between two variables irrespective of whether the regression is linear or not. In this case a priori reasoning is insufficient to determine the linearity or otherwise of the regression, and both constants have therefore been deduced.

It will be seen that the variabilities of the mean rates of mortality differ very significantly. Both absolutely and relative to its mean value, the dispersion of the maternal death rate is greater than that of the general death rate of women of that age. While higher degrees of variation cannot safely be taken as representing wider and more hopeful fields for administrative measures (the death rate reduced to a minimum will exhibit fluctuations in different parts of the same country due to etiological variations wholly outside human control) the childbearing mortality is generally represented as pre-eminently avoidable, so that this variability of about 20% gives some appreciation of how much this preventable loss of mothers differs in different parts of the country.

The coefficient of correlation $r_{12} = 0.4$ is quite significant with regard to its probable error, and, although this cannot be considered a high correlation, yet it shows that the inferences drawn from the previous section are quite justified. There is definitely some association between the two rates of mortality. But as will be seen from the value of η compared with r, the regression of childbearing mortality on the death rate from the causes - the tendency of maternal mortality to follow the remaining death rate - is not satisfactorily represented by the correlation coefficient. The test for the significance of the difference between η and r (Blakeman, 1905) shows that the regression significantly departs from linearity. So that in this case the association is such that, with a decline in the general female death rate, the childbearing mortality also declines up to a point, after which further decline in the general death rate is associated with an increase in the maternal mortality. This will be seen more clearly from the following figures; - and Diagram 3,

Table 18. Showing the mean Rates of Maternal Mortality for Corresponding Rates of Mortality from All Other Causes in Women aged 15-45.

General Death Rate	Maternal Mortality Rate
26.7	3.80
30	3.30
33.3	3.41
36.7	4.12
41.7	4.51

showing the mean rates of maternal mortality for corresponding values of the general mortality from all other causes.

This skewness of regression of the childbed mortality on general mortality is extremely interesting, mainly in view of the fact that it suggests further methods of research. The most probable explanation would appear to be that the true regression is a linear one (there is no obvious reason why it

should not be so), but that the relationship is upset by the intervention of some selectively acting variable or variables. At the period studied, both rates of mortality were being subjected to a multiplicity of influences acting for the most part to a different degree in different places. To take one, probably the most important, instance, namely the provision of hospital accommodation and the availability of skilled medical assistance in confinement. This differs greatly in different parts of the country, and, if such were available where it is most required, in places, that is, where the mortality rate among mothers in childbearing is highest, then if this is of any value as a means of lowering the death rate, the correlation between the two rates of mortality will be watered down. This explanation seems all the more probable when it is noted from the above figures that in counties with the lowest rates of mortality from all other causes (and these districts are mainly rural in character) the rate of mortality from childbed causes is significantly greater than in the districts with somewhat higher rates of general mortality. It is only when the general death rate reaches a higher level that the maternal mortality follows in its wake.

3. The Distribution of Institutional (Maternity) Accommodation in Relation to the Mortality in Childbearing.

It will be noted that the explanation given for this non-linearity of regression depends on the assumption that hospital accommodation is to a large extent determined by the pre-existing rates of mortality in childbed. The assumption seems reasonable, but the following results lend emphasis to the belief that such is the true state of affairs. In a Report on the Provision of Midwifery Service in the County of London, Dr.J.Lane-Claypon (1917) published

the proportion of in-patient to the total births for the 28 Metropolitan Boroughs in 1915. This may serve as a rough index of the distribution of lying-in accommodation available in these boroughs, and the coefficient of correlation between these figures, and the rates of mortality from childbed causes will show how these two variables are related to one another. The coefficients obtained were; -

Correlation between the proportion of births occurring in lying-in homes and

1. death rate from puerperal fever per 1000 births = 0.4577 ± .113.
2. death rate from other causes in parturition per 1000 births = 0.1716 ± .125

(The rates for puerperal fever and other causes of maternal death are based on the births and deaths occurring in 1914-16).

The results show that, with each of the two cause groups of death, there is a small positive association, significant, however, only in the case of puerperal fever and lying-in accommodation, and insignificant with the remaining death rate in parturition. That is, the greater the proportion of mothers attended in a maternity hospital, the greater, on the average, is the mortality rate from childbed causes. Even the most sceptical as to the value of maternity institutions for the care of parturient women as a means of lowering the death rate from causes connected with reproduction could scarcely regard this result as an illustration that institutional treatment is worse than useless. At their lowest value these can do no harm, and the correlation seems, therefore, to be simply an expression

of the fact that in London at least, hospital accommodation is provided for pregnant and parturient women where the need for such institutions is greatest. And that this is in a general way what obtains all over the country, seems not an unreasonable proposition.

On general grounds it may be said that the hospital provision for complicated midwifery cases is much better in urban than in rural districts. The subdivision of the country recognised in the Registrar-General's and the Census Reports will therefore provide a means of determining the effect of this factor on the mortality rates in childbirth. Grouped in order of the availability of skilled medical assistance in delivery, London, with an expert obstetrical service and with relatively little distance between its outlying boroughs, and the nearest lying-in home forms an admirable control series. The amount of hospital accommodation and the proximity to skilled obstetrical care is such that it would not be surprising if the differences in the mortality rates which would otherwise occur were levelled out. County Boroughs, being mainly large towns, will come next on the scale, while Urban and Rural Districts will be placed last. The distinction recognised in official statistical reports between urban and rural districts is by no means a complete one, the classification of these being often a matter of history or simply of convenience, and having but little relation to the total population or the real character of the district. Many of the so-called "urban" districts are but little more than small rural villages with total populations of under 5000 inhabitants widely scattered over a considerable stretch of land; whereas some "rural" districts have gradually grown,

until at the present time they form what would otherwise be urban districts of some magnitude, but which are still "rural for registration purposes. In the aggregate, however, this division affords suitable ground for comparison, probably not so much between themselves as with the aggregation of County and Metropolitan Boroughs.

If the explanation given previously has a share in determining the magnitude of the correlation and the type of the regression, then we shall expect in these sub-samples of the country, that the correlation will be lowest in Metropolitan Boroughs, somewhat higher in County Boroughs, and higher still in Urban and Rural Districts. Again, since the mortality among mothers in childbed has been the object of ever-increasing efforts to diminish or eliminate, the correlation between the two variables, we are studying, should be less diluted by the effects of these efforts, the further we go back in time. We have now, therefore, two methods of attempting a solution of the problem; -

(a) by determining the magnitude of the association in different parts of the country which are known to differ with respect to the amount of skilled assistance available, and,

(b) to compare the results for the same places at different epochs.

Beginning with (b), the following are the results for the 43 counties of England and Wales in the triennia 1911-13 and 1901-03.

Table 19.

		Mean	S.D.	C.V.
Maternal Mortality Rate per 1000 Births	1901-03	4.3291	.8835	20.52
	1911-13	3.3244	.7695	20.12
Death Rate All Other Causes per 1000 Females 15-45	1901-03	4.5349	.6602	14.56
	1911-13	3.7229	.5297	14.23

	r_{12}	η_{12}	$\frac{\sqrt{N}}{.67449} \cdot \frac{1}{2}\sqrt{\eta^2 - r^2}$
1901-03	.5701±	.6329±	1.336
1911-13	.3594±	.5862±	0.850

Although the mean rates and the absolute variabilities of the mortality in childbearing are somewhat lower in 1911-13 than in 1901-03, the relative variabilities of both rates are the same in the two triennia, and are also not significantly different from the value found for 1921-23. The mean and standard deviation of the rates for 1921-23 are only slightly lower than those for the two preceeding triennia.

The coefficients of correlation are both greater than that found for 1921-23; and, although the difference is not significant with regard to the probable error, the value registered for 1901-03 is greater than that for 1911-13. In view of the insignificance of this difference, it would be unsafe to base any conclusion on this, unsupported by additional confirmatory evidence. This will be given later.

As will be seen from the values of η, and the criterion of the significance of the difference between η and r, the regression in both instances shows no significant departure from linearity.

One point of distinction between 1901-03 and the other two triennia must be noted. Prior to 1911 a difficulty is introduced in the returns of births and deaths. These occuring ~~without~~ outwith the normal place of residence since 1911 have been redistributed to the place where they belong. Prior to that, deaths and births were attributed to the place where the event actually occurred. How this will affect the value of the coefficient between the two variables studied is uncertain. Provided that each county had its own maternity hospital to which the complicated labours occurring within the county were sent, no difficulty would be introduced. But if the assumption be true that lying-in homes are mainly in the district which have high maternal death rates, then the non-distribution of these

births and deaths would apparently not affect the correlation by decreasing it. Rather would its value be enhanced, because of the cases of dystocia from any cause tending to drift into the already unhealthy district for confinement. In the absence of exact knowledge of the course of events, therefore, little weight can be given to any difference found between the results found before and after 1911.

But the assumption that the lowness of the coefficient for the latter triennium (1921-23) was the result of dilution by the effects of the varying degrees of medical attention etc., seems to be borne out to a certain extent by the coefficient for 1911-13, although judging from these results alone, we should come to the same conclusion as is already suggested by an examination of the mean rates of mortality, namely, that but little advance has been made within that period in the efforts at elimination which have been directed against maternal mortality.

Before proceeding to an analysis of the coefficients in the sub-groups of the country, some consideration must be given to the difference in the relative importance of various

cause groups of death in maternity and the degree to which each of these can be controlled by the provision of skilled medical attention.

4. The Difference in the Relative Importance of Various Cause Groups of Maternal Mortality in Different Parts of the Country.

The mortality rates in childbearing in the subdivisions of the country differ widely in the proportions which the various groups of causes of death bear to the total, and, since some of these may be more amenable to treatment, prophylactic or curative, than others, some information may be got by comparing the rates of mortality from the separate causes of death in different districts, and the relative importance of those in the total death rate will provide an estimate as to how far we may hope for further reduction from increased medical care of the parturient women.

The percentage which each of the various causes bears to the total deaths in the main subdivisions of the country in the two triennia 1911-13 and 1921-23 are given in the following table.

Table 20. Showing the Relative Importance of Various Cause Groups of Maternal Mortality in the Triennia 1911-13 and 1921-23.*

	London	County Boroughs	Urban districts	Rural districts	England & Wales
Accidents of Pregnancy	11.03 9.98	10.18 12.07	9.22 11.10	8.54 8.63	9.56 10.84
Puerperal Haemorrhage	10.72 11.66	15.07 13.62	14.39 14.47	16.09 15.01	14.64 14.02
Other accidents of child birth	8.25 9.01	10.35 10.13	11.18 11.90	10.29 10.83	10.45 10.78
Puerperal Fever	47.42 47.71	35.84 38.67	32.94 31.81	29.71 29.45	34.55 35.22
Puerperal Albuminuria & Convulsions	14.43 13.94	18.71 16.04	20.14 18.39	21.48 22.96	19.45 18.27
Phelgmasia Alba Dolens etc.	7.22 6.97	8.68 8.13	11.11 10.97	12.09 11.92	10.16 9.79
Puerperal Insanity and Disease of the Breast.	0.93 0.72	1.17 1.33	1.01 .86	1.80 1.15	1.22 1.08
χ^2	93.4752 85.3480	17.4830 41.4462	17.5940 32.3259	50.7025 77.4007	

The question arises whether these distributions can really be regarded for practical purposes as similar. If so, then no difficulty will be introduced from this reason in the interpretation of the coefficients involving the total maternal death rate. If not, however, some attempt must be made to determine if possible the degree to which the incidence of these several cause groups of death is influenced by the two factors, the general health of women of childbearing age, and the provision of hospital accommodation and skilled medical care.

The distributions in each division in the two triennia have been tested against the frequency occurring in the rest of the country by means of the χ^2 test (Pearson,1911). What is wanted is the probability that the distributions are really more

* The values given first in each group are for 1911-13. The figures for 1921-23 are given below these for 1911-13.

divergent from one another than might reasonably be expected to be due to the play of mere chance. The formula used for this purpose was that generally adopted, namely,

$$\chi^2 = \sum_1^s \left\{ \frac{NN'\left(\frac{f_p}{N} - \frac{f'_p}{N'}\right)^2}{f_p + f'_p} \right\},$$

where f_p and f'_p are the frequencies in each group of death, N and N' the total number of maternal deaths in any aggregate of districts and the remainder of England and Wales respectively, and $\sum_1^s$ denotes summation of like quantities from 1 to s.

From this the probability that the two samples are undifferentiated, or that for all practical purposes they can be regarded as a random sample of the whole country, can be determined. The values of χ^2 are given at the foot of each of the distributions. The magnitude of χ^2 itself may be used as an index of how far the distributions are divergen for a given number of classes (in this case, seven). The higher the value of χ^2 the greater the probability that the two distributions compared are really divergent one from another. The lowest value in this series is for County Boroughs in 1911-13, in which the value of χ^2 is 17.4880. For $n' = 7$ and $\chi^2 = 17.4880$, the corresponding value of $P = 0.0078$. The odds against this, the nearest approach to the distribution of the rest of the country, being a random sample of the total distribution of causes of maternal mortality is, therefore, more than 127 to 1. Accordingly it may safely be taken that this, and the remaining sub-divisions of the country, are totally different samples when each is compared with the remainder of England and Wales. The striking feature of the distributions is that, as we pass from

Town to country, the proportion which deaths from puerperal fever bear to the total diminishes greatly. In London, nearly one half of all the maternal deaths are from puerperal fever, whereas in Rural Districts less than one third are from this cause. Apart from accidents of pregnancy which in the first triennium follow the same course as puerperal fever, and in 1921-23 are somewhat different, London having a lower proportion of deaths from this cause than County Boroughs or Urban Districts, all other causes of death become relatively more important as we pass from town to country districts. But a comparison of the percentages of each of the cause groups in different parts of the country, will not help in determining which are determined by either of the factors we are investigating, the proportions being dependent to some extent on the number of the remaining deaths, since the totals in all groups of districts must be the same (100%). For example, if we could subdivide the deaths into two categories, preventible and unavoidable, and compared the percentages of each of these groups in parts of the country differing in the degree to which the preventible deaths could be circumvented, then although the death <u>rate</u> from non-preventible causes, remained the same in the sub-divisions, the relative importance of these would be lowest in places where the preventible deathrate was at its height. Hence it is of importance also to compare the <u>rates</u> of mortality for the different causes of death in the several sub-divisions of the country.

4. The extent to which the Various Causes of Maternal Mortality can be Controlled by Hospital Provision and Medical Assistance.

A comparison of the rates of mortality will enable us to determine whether or not each individual group follows the same course as the death rate from all causes in women of childbearing ages. The death rates from the chief cause/ groups of death in the four main subdivisions of the country in the two triennia 1911-13 and 1921-23 are given on Table 21. along with the death rates from all causes less parturition in women aged 15-45.

Showing the Death Rates per 100,000 Births from Various Cause Groups of Maternal Deaths in the Main Subdivisions of England and Wales for the Two Periods 1911-13 and 1921-23,* along with the Death Rates per 100,000 Women 15-45 from All Causes less those connected with childbearing.

	London	County Boroughs	Urban districts	Rural districts
Accidents of	32	40	38	36
Pregnancy	29	43	44	35
Puerperal	31	60	60	68
Haemorrhage	34	54	57	61
Other Accidents	24	41	46	43
of childbirth	26	40	47	44
Puerperal	138	142	136	125
Fever	139	153	126	119
Puerperal	42	74	33	90
Albuminuria & Convulsions	41	63	75	93
Phlegmasia Alba	21	34	46	51
Dolens, etc.	20	32	44	48
Puerperal	2	4	3	6
Insanity	1	4	3	4
Puerperal	0.3	0.9	0.9	1.1
Diseases of the breast	0.7	1.0	0.3	1.1
All Causes of	290.5	396.5	413.7	419.9
Maternal death.	290.6	394.6	396.8	404.3
Death Rate of	338	451	365	360
Women 15-45	343	377	335	330

To appreciate more easily the positions of each of these subdivisions, the following table, showing the

* The values given above in each instance relate to 1911-13, those given below are for 1921-23.

mortality relative to London, is also given.

Table 22

Showing the Mortality Rates from the Several Groups of Maternal Deaths, and the Rates from All Causes of Death less those connected with Childbearing in Women 15-45 in the Subdivisions of England and Wales relative to London.

	London	County Boroughs	Urban Districts	Rural Districts
Accidents of Pregnancy	100	126	119	112
	"	164	152	121
Puerperal Haemorrhage	"	192	191	217
	"	158	169	179
Other Accidents of childbirth	"	171	193	180
	"	153	180	167
Puerperal Fever	"	103	99	91
	"	110	91	86
Puerperal Albuminuria & Convulsions	"	177	199	215
	"	136	135	229
Phlegmasia Alba Dolens, etc.	"	164	219	242
	"	153	214	237
Puerperal Insanity	"	154	133	267
	"	307	229	257
Puerperal Diseases of the breast	"	300	300	367
	"	143	43	157
All Causes of Maternal death	"	136	142	145
	"	136	137	139
Death Rate of Women 15-45	"	116	94	93
	"	110	93	96

Taking London as the standard (100), the general death rate for County Boroughs is 16% higher, Urban Districts 6% lower, and Rural Districts 7% lower than London in the first triennium. In the subsequent triennium (1921-23) the relative position of the aggregates are unchanged, but the divergence from one another is much less, County Boroughs being only 10% above London, and Urban and Rural Districts only 2% and 4% lower respectively. Before proceeding further, however, we must determine whether this position is to any significant extent influenced by variations in the age distribution and civil constitution of the women in these districts. Taking the death rates by age and civil state for England and Wales as the standard, these have been applied to the existing age and civil constitutions of the

populations of the sub-groups, and the death rate of England and Wales divided by the "expected" death rate of the district. The following are the correction factors for age and civil state; -

	1911	1921
London	1.0029	1.0024
County Boroughs	1.0042	1.0037
Urban Districts	1.0030	0.9993
Rural Districts	0.9862	0.9931

It will be seen that none of the districts are influenced to any significant extent by the variations in age distribution and civil constitution of the female population at reproductive ages. The relative positions of the aggregates of districts as given by the crude rates of mortality therefore remains unaltered.

With respect to the degree of hospital provision etc, the order may be taken as that already given.

Thus, in any comparison, if the mortality rate is in the main determined by the level of the general health of the women of the district, the relative positions of the sub-groups of districts should be the same as that of the death rates from all causes less childbirth; whereas if chiefly determined by the availability of skilled assistance, the rate should increase as we pass from London through County Boroughs to Urban and Rural Districts.

The mortality rate from all causes of death in child-bearing shows a tendency to follow the course which would be expected if it were in the main determined by the lack of skilled medical assistance, the rates being highest in Urban Districts, lower in County Boroughs, and lowest of all in the Metropolitan Boroughs. In the latter triennium, although the relative positions have not changed, the rates

are less divergent from one another than in the previous triennium. With the separate groups of causes of death, it will be seen that the distributions of accidents of pregnancy and puerperal sepsis follow that of the general death rate from all other causes, whereas in the remaining groups of causes of maternal mortality, the position is apparently determined to a much greater extent by the amount of skilled assistance available. In the case of accidents of pregnancy, although the general trend of the death rates shows a similarity with the death rate from causes other than parturition, yet the death rate in places other than London is relatively much higher than is the general death rate in women. Apparently the height of the death rate from accidents of pregnancy is not solely to be explained by differences in general health. With puerperal fever the general trend of the death rates and their relative sizes are very closely parallel with the general death rate. With regard to other causes of maternal death, differences are also noticeable. The two groups, puerperal, albuminuria and convulsions and phlegmasia alba dolens, are in rural districts more than twice as high as in London, and the general tendency from rural to highly urban districts is downwards. The difference between the aggregates in the case of accidents of birth is much less than these two groups. Puerperal haemorrhage in the first quinquennium was twice, in the second 1.79 times as high in rural districts in London.

From these figures the following conclusions may be drawn.

The general level of the death rate from puerperal fever appears to be more determined in the aggregate of districts by the level of the general health of women of childbearing

ages, and is apparently little, if at all, affected by the state of obstetrical supervision.

The mortality from accidents of pregnancy, although to some extent related to the general death rate, is also affected by other factors, possibly the lack of medical attention. The magnitude of the death rates from the remaining causes of death appear to be more determined by the proximity to skilled assistance, although the effect of this factor on the relative height of the death rates differs. The rates from albuminuria and convulsions and phlegmasia alba dolens seem to be most affected by the provision of adequate obstetrical assistance, whereas the rates from puerperal haemorrhage and accidents of births show less striking differences, and there is a suggestion that the latter group is tending to follow the trend of the death rate in women from all causes less parturition. Unfortunately it is not possible to give a quantitative value to the varying degrees of medical assistance in these four groups of districts, hence it is impossible completely to demonstrate quantitatively the effects of this factor; but if it be permissible to assert that the greater the proportional difference in the death rates in the parts of the country with the worst and best hospital accommodation, medical assistance, etc., the more is that cause of death affected by these factors, then the cause groups of maternal mortality can be placed in the following order with regard to the degree of success likely to attend further medical efforts at control; -

(1) Phlegmasia alba dolens.
(2) Albuminuria and convulsions.
(3) Puerperal haemorrhage.
(4) Accidents of birth.
(5) Accidents of pregnancy.
(6) Puerperal fever.

5. The Differences in the Correlations in Different Sections of England and Wales.

The second method by which it may be possible to demonstrate the effect of variations in the medical attention afforded to pregnant and parturient women on the magnitude of the correlation between the maternal mortality rate and the general rate in women of reproductive ages remains now to be considered.

As explained above, the coefficient should be lowest in London, rising somewhat in County Boroughs, and reaching its height in Urban and Rural Districts. Also, provided that the increased interest in the mortality in childbearing has produced an effect by diminishing those causes which are amenable to control, the coefficients should be higher in 1911-13 than in 1921-23.

In the following table are collected the coefficients deduced for these four subdivisions of the country at the two periods.

Table 23. Showing the Coefficients of Correlation between the Maternal Mortality Rates and the Death Rates from All Causes less those connected with Childbearing in Women 15-45 for the Main Subdivisions of England and Wales in 1911-13 and 1921-23.

	1911-13	1921-23
London	-.2208 ± .121	-.5978 ± .081
County Boroughs.	.4174 ± .064	.1643 ± .072
Urban Districts.	.6331 ± .062	.3924 ± .087
Rural Districts.	.3914 ± .087	.3970 ± .087

Considering first of all the results for the latter triennium, it will be seen that the coefficient for Rural Districts is highest, that for Urban Districts slightly, but insignificantly, lower; whereas the correlation for County

Boroughs, although positive in sign, is insignificant with regard to the probable error involved, and in London there is a fairly high negative and significant correlation. In the Metropolis, then, the incidence of deaths in childbed occurs in districts with otherwise low death rates. It may be of interest to note, at this point, that a similar relationship holds in Metropolitan Boroughs between the mortality rate of infants in the first day of life and the general death rate in women aged 15-45. The following correlations show that, although positively related to the maternal mortality rate, the death rate of infants under one day shows a significant negative correlation with the general death rate of women of childbearing ages ; -

Correlations between the Death Rate of Infants under One Day per 1000 Births and	
(1) Maternal Mortality Rate	.5347 ± .091
(2) Death Rate, Females, 15-45	-.4635 ± .100

Although it is to be expected that increasing hospital provision and medical care among the poorer and less healthy classes would bring about a levelling of the death rates in the different sections of the community, and consequently would tend to obscure the original correlation between these two factors, it is evident that there is some excess wastage of maternal and infant life among the better classes of the community in London. This might easily be attributed to such conditions as an increased resort to artifidal methods of hastening normal delivery or the greater proportion of first births in the upper classes due to the selective character of the birth rate; but it is clear that in an investigation such as this, it is impossible to isolate the various factors which might contribute to the result. The conclusion can only be stated, and the explanation left to others with more detailed

information of the districts, or until statistics are available concerning some of these possible causes.

Apart from this rather unexpected result, the coefficients for the different samples of the country agree in magnitude with what would be expected on general grounds, assuming that hospitalisation and proximity to skilled assistance were factors of any moment. Similarly the results for the preceeding triennium differ in the sub-samples. In this case the coefficient for London, while still negative in sign, is now reduced to insignificance with regard to its probable error. County Boroughs now show a significant positive relationship, and Urban Districts give a somewhat higher value. The one exception is the result for Rural Districts, in which the correlation is lower than that for Urban Districts and also less than the corresponding value for the subsequent triennium.

Comparing the 1911-13 results with those for 1921-23, we see that in each case except in Rural Districts the coefficient has diminished within the decennium. Rural Districts would thus appear to form the only exception to what was to be expected. In those districts the number of deaths in some of the places is very small and the rates may therefore be subject to somewhat large fluctuations, due to random sampling. For instance, the Rural Districts of Westmorland in 1911-13 with 2127 births, one death from puerperal fever and 11 deaths from other causes in pregnancy and parturition, has the lowest general death rate, and the highest mortality rate in childbirth. Omitting this case, the coefficient was recalculated, giving a value of 0.43 ± . instead of 0.39 when this small county was included; and it is tempting to refer this divergence from the expected to

this cause. Still the same argument would hold for 1921-25, and by excluding apparent exceptions to the general rule, the value of the coefficient would be increased. In this way, we could, by conscious selection, change the results to suit any particular explanation.

But if we examine the differences in the coefficients for the two triennia with regard to the probable errors involved, it will be seen that none of the observed differences attain the conventional criterion of significance (3 × probable error). Taking the probable error of the difference in the coefficients as the square root of the sum of the squares of the individual errors, the following table shows the differences and their probable errors; -

	Differences	Difference / Probable Error
London	.3770±.1464	2.57
County Boroughs	.2531±.0969	2.61
Urban Districts	.2407±.1066	2.25
Rural Districts	-.0056±.1228	0.05

County Boroughs show the most significant difference with regard to the error involved; but the difference in the London coefficients does not seem to be much less significant. In Urban Districts it is doubtful if the difference can be regarded as substantial, but in Rural Districts the difference is certainly insignificant.

Thus it is again evident that no great change has taken place in any of the districts within the decennium. In three or four instances the coefficients agree with what a priori reasoning would lead us to expect; but it seems doubtful if any great significance can be attached to any of them.

Now it is clear that if any change for the better has occurred among parturient women in any of the districts as

the results of increase in medical attention of any description within the decennium, the effect of this should be manifest in the proportions which the various groups of causes of death bear to the totals. Evidence has already been produced to show that these cause groups are affected to different degress by efforts of medical control; so that by testing the frequency distribution in each district at the two triennia, it should be possible to discover if any change has occurred. Any schemes for the amelioration of the accidents and diseases peculiar to pregnant and parturient women will, if success attends these efforts, lead to a diminution in the proportional frequency of those cause groups which have been shown to be most amenable to medical supervision.

Consequently the frequency distribution of the causes of death have been tested in the country as a whole and in each of the subgroups of districts in the two triennia. The following table shows the values of χ^2, with the corresponding probabilities that the distributions are really divergent from one another.

Table 24. Showing the Significance of the Differences in the Frequency Distributions of the Causes of Maternal Deaths in Childbearing in the Triennia 1911-13 and 1921-23.

	χ^2	P	Odds.
London	1.4841	.9537	0.05 to 1
County Boroughs	19.3825	.0036	276.8 to 1
Urban Districts	9.2526	.1612	5.2 to 1
Rural Districts	5.0072	.5429	0.84 to 1
England and Wales	15.2515	.0186	52.8 to 1

For England and Wales as a whole, the odds against the two distributions being alike are 53 to 1. While it is

doubtful if this may be regarded as a significant divergence, an examination of the differences in the two distributions shows that puerperal fever and accidents of pregnancy account for a slightly higher proportion of all the maternal deaths in the latter triennium, with a corresponding defect in the proportions from all other cause groups, except accidents of ~~pregnancy~~ birth which have remained stationary. The differences, therefore, while small and of somewhat doubtful significance, indicate a slight diminution in the relative importance of causes of death which are apparently most amenable to control. The most hopeful sign is the diminished prominence of puerperal albuminuria and convulsion, in spite of the continued fall in the birth rate.

In the subdivisions of the country there have been no significant changes in the proportion of deaths from the several cause groups in London or in Urban and Rural Districts. The odds in favour of the differences being of any significance are too small to place any importance on what slight changes have taken place in these distributions. With County Boroughs, however, the odds are 277 to 1 against the periods having similar distributions, and this must be regarded as significant. Here again there is an increase in the proportion of deaths from puerperal fever and accidents of pregnancy and a defect in the proportions due to other causes.

The natural corollary would appear to be that an increase in the medical attention afforded to pregnant women, is not the sole explanation of the differences found in the coefficients at the two periods. Although the difference in the coefficients found for County Boroughs seems to have the

greatest claim to significance, and it is in these places that the differences found in the frequency distributions of the causes of death are really significant, the differences in the Metropolitan coefficients with no corresponding change in the proportional frequency of the cause groups of death require some other explanation. As suggested, there are possible causes, such as increased manual interference in normal deliveries in the upper classes, or the selective birth rate, both of which would result in an increased prominence of precisely those causes of death which can be controlled (e.g. accidents of birth and eclampsia); but, as has been said, no statistical evidence has yet been produced in such a form as to allow of testing this suggestion. Certainly such changes, if they had occurred within the decennium, might account for the differences in the coefficients and also for the similarity of the distribution of causes of death. In the case of Urban and Rural Districts, the values of the coefficients and the frequency of the cause groups of death warrant the conclusions that no great advance has been made in the control of puerperal mortality in these parts of the country within recent years.

6. The Relationship between the Death-Rate from All Causes less childbirth in Women of 15-45 and the Two Separate Groups of Causes of Maternal Deaths.

(a) Puerperal Sepsis, and
(b) Other Accidents and Diseases of Pregnancy and Parturition.

Complete details of the separate causes of death in childbearing are not available for separate places in official reports. These are only given for England and Wales as a whole and separately for London, the aggregates of County Boroughs, Urban and Rural Districts. These figures have already been considered.

In the separate districts maternal deaths are classified into the two groups,

(1) Puerperal sepsis, and
(2) Other accidents and diseases of pregnancy and Parturition.

Group (1) therefore consists of several separate conditions alike, only in the respect that they are all due to infective processes and all occur post-partum.

Group (2) is a more heterogenious lot, consisting as it does of all the remaining conditions liable to cause death in pregnant and parturient women, consisting therefore of diseases differing in etiology, in the time of occurrence within the period between conception and the end of the puerperium, and in the success attendant on prophylactic or curative measures extended towards their elimination. Although from a comparison of the rates of mortality in different districts it would appear that the general level of the death rate from this group bears a negative association with the amount of care expended on pregnant women, the relatively slight differences in the rates for the three aggregates of districts other than London

suggest that there may be other factors of importance in influencing the variations in these rates. The relationships of each of these two groups with the general health of women have therefore been investigated separately.

The results are given below for Counties in the three triennia 1901-03, 1911-13, and 1921-23,

Table 25. Showing the Correlations (Coefficients and Ratios) between the Death Rates in Women 15-45 and the Death Rate from Puerperal Fever in the Counties of England and Wales.

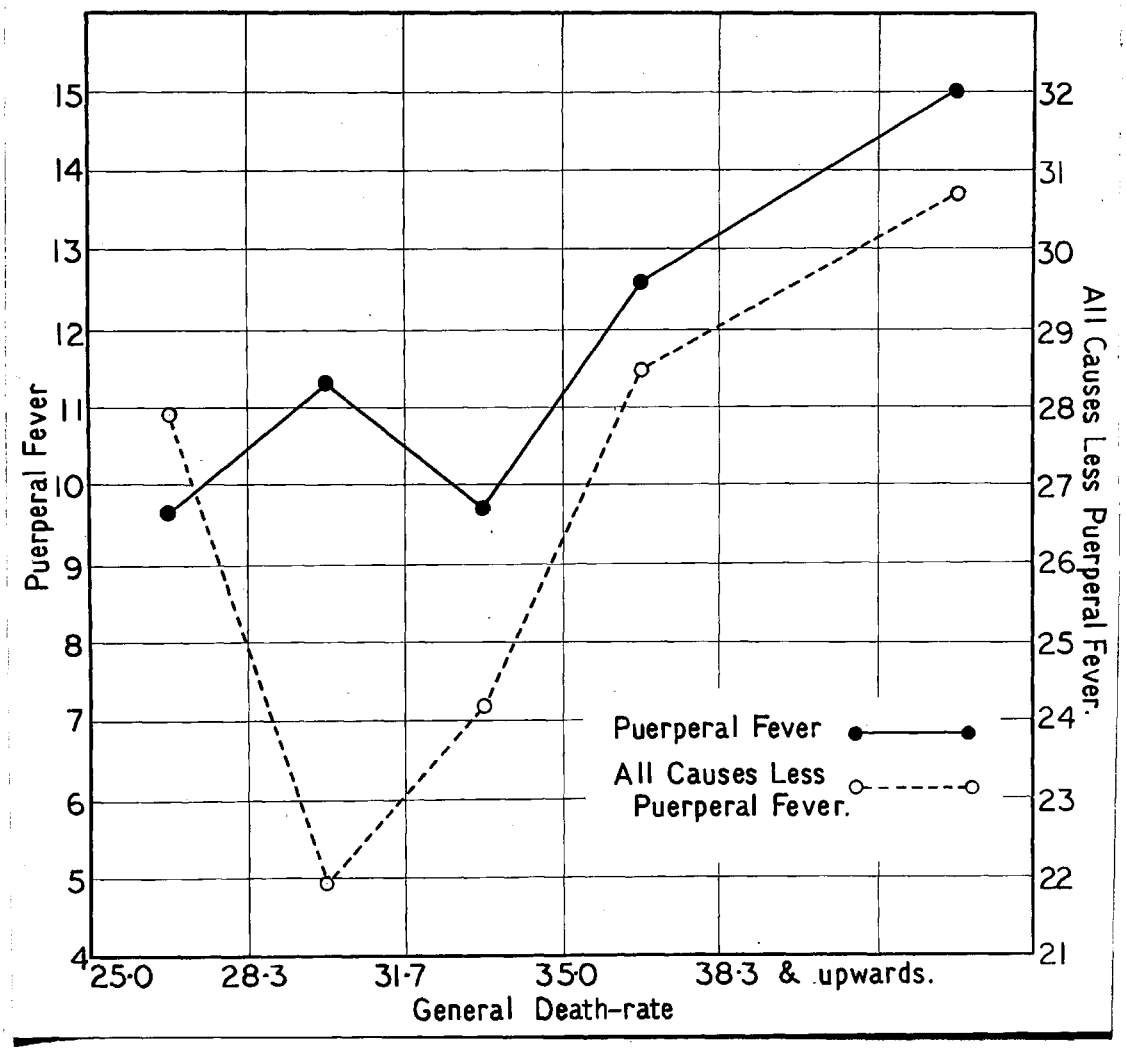
	r	η	$\sqrt{\frac{N}{.67449}}\frac{1}{2}\sqrt{\eta^2-r^2}$
1901-03	.6937 ± .053	.7504 ± .045	1.33
1911-13	.2947 ± .094	indeterminate	-
1921-23	.3717 ± .089	.4901 ± .078	1.55

Table 26. Showing the Correlations (Coefficients and Ratios) between the Death Rates in Women 15-45 and the Death Rate from Diseases and Accidents of Pregnancy and Parturition a apart from Puerperal Fever in the Counties of England and Wales.

	r	η	$\sqrt{\frac{N}{.67449}}\frac{1}{2}\sqrt{\eta^2-r^2}$
1901-03	.3374 ± .091	.4456 ± .032	1.42
1911-13	.4837 ± .079	.4886 ± .073	0.34
1921-23	.3045 ± .093	.6304 ± .062	2.63

In the case of counties there is no uniformity in the series of correlation coefficients, and it is impossible to detect any definite trend for either of the two groups and any constant difference in the magnitude of the coefficients for these two separate groups of diseases. In the first two triennia, a comparison of the values of η and r shows that neither with puerperal fever nor with other causes is the regression non-linear. But in 1921-23 a difference is noticeable. Puerperal fever shows a linear regression on the general death rate of women, whereas with other causes the criterion of the significance of the difference of η and r shows that the regression is substantially skew.

DIAGRAM 4.



Showing the average rates of mortality from, (1) puerperal fever and, (2) other causes of death in childbearing, for districts graded according to the general death-rates of women of childbearing ages.

The following table and Diagram 4 showing the mean rates of mortality from puerperal fever and other causes in parturition brings out this very clearly.

Table 27. Showing the Mortality Rates from Puerperal Fever and Other Diseases and Accidents of Pregnancy and Parturition per 10,000 Births for Corresponding Values of the General Death Rate in Women from All Causes Less Childbirth.

Death Rate in Women 15-45	Puerperal Fever	Other Diseases in Childbearing.
26.7	9.67	27.92
30.0	11.36	21.96
33.3	9.73	24.20
36.7	12.60	28.50
41.7	15.00	30.75

The death rate from puerperal fever increases steadily, apart from minor insignificant fluctuations, as the general death rate of the women of these districts increases, whereas, other causes of death in parturition follows a different course, the healthiest districts having higher rates of mortality than the less healthy, but after a certain point the two rates of mortality increase together. This type of regression is very similar to that already found for the total death rate in childbearing. These results therefore tend to confirm the suggestion already made, that puerperal fever is not affected to any significant extent by the proximity to skilled medical assistance, whereas the remaining causes of death are dependent on this factor.

With the sub-divisions of the country, it is possible to detect a fair degree of uniformity in the results.

Table 28. Showing the Coefficients of Correlation between the Death Rate in Women 15-45 from All Causes less childbirth and the Death Rate from Puerperal Fever per 1000 Births.

	1911-13	1921-23.
London	.0570 ± .127	-.3791 ± .109
County Boroughs	.1808 ± .075	.0782 ± .074
Urban Districts	.2134 ± .098	.3055 ± .093
Rural Districts	.1914 ± .099	.3744 ± .088

Table 29. Showing the Coefficients of Correlation between the Death Rate in Women 15-45 from All Causes less Childbirth and the Death Rate from Diseases and Accidents of Pregnancy and Parturition apart from Puerperal Fever.

	1911-13	1921-23
London	-.3111 ± .115	-.4378 ± .103
County Boroughs	.4725 ± .060	.1187 ± .073
Urban Districts	.9446 ± .011	.3270 ± .092
Rural Districts	.4203 ± .085	.3649 ± .089

The coefficients are, in both groups of diseases, lowest in London, somewhat higher in County Boroughs and highest of all in Urban and Rural Districts. For Puerperal fever the coefficients for 1921-23 are lower in London and County Boroughs than those for 1911-13; but the reverse is true of the results for Urban and Rural Districts. None of these differences with respect to the size of the probable error are significant however. Other accidents and diseases of pregnancy and parturition show uniformly lower correlations in 1921-23 than in the preceeding triennium, but, as the following figures show, these differences can only be regarded as significant in County Boroughs and Urban Districts, and wholly without significance in London and Rural Districts.

Table 30.

	Difference	$\frac{\text{Difference}}{\text{Probable Error}}$
London	.1267 ± .154	0.82
County Boroughs	.3538 ± .095	3.74
Urban Districts	.6176 ± .093	6.66
Rural Districts.	.0554 ± .123	0.45

The magnitude of the coefficients for other diseases and accidents of pregnancy and parturition are, irrespective of sign, in all instances equal to, or higher than, the values registered for puerperal fever. This result is evidently not in accord with what would be expected from the general

comparisons made previously. It would have been predicted from these that the puerperal fever death rate would show a closer association with the general death rate in women at that age than would other causes of death in parturition, but it must be concluded from these results that much more can be hoped for in the reduction of the mortality in child-bearing by concentrating our efforts on deaths from causes other than puerperal fever. It must be insisted on, however, that the number of deaths from childbed causes on which these rates are based is small, especially so when the total deaths are subdivided into the two groups, puerperal sepsis and other causes, and it is worthy of note that the correlations between puerperal fever and the general death rate in women of 15-45 when counties are considered is higher than any of the coefficients for the subdistricts in 1911-13, and is equal to the highest coefficient deduced for any of the subgroups in the succeeding triennium. While rates based on small numbers may be expected to give coefficients fluctuating to some degree solely from their errors of sampling, and that these, therefore, will be raised or lowered from their true value, a comparison of the coefficients deduced for the two cause groups of maternal death shows that this factor is of greater importance with the results for puerperal fever, than with the remaining causes of death. The more reliable death rates (from the point of view of numbers) for the administrative counties with their associated County Boroughs, give coefficients for puerperal fever higher than, or equal to, any deduced for the subgroups of the country, in which the rates must be based on smaller numbers; whereas with the rates for other diseases and accidents of pregnancy and parturition, in which the number of deaths on which the rates

are calculated, even in the subdivisions of the country, are much greater than the deaths from puerperal fever, the coefficients for administrative counties both in 1911-13 and 1921-23, lie between the highest and lowest values registered in the subdivisions of the country. It is therefore, probable that, if a longer series of years had been taken, the correlations with puerperal fever would show larger and more stable values.

Evidently, however, puerperal fever presents a problem of greater magnitude than other causes of death in childbed. The variability exhibited by the two rates of mortality is, relative to their mean values, of equal degree, but the results so far deduced show that with both influential factors, the general health of women and the adequacy of the medical supervision extended to the pregnant woman, the remainder of the deaths in childbearing show much closer relationships than does puerperal fever.

What is probably not so apparent is why there should be such a close relation between deaths other than those from septic infections and the general death rate of women. Considering accidents of birth, for example, a large part of these is the result of pelvic deformities, in the main a late result of rickets in childhood or adolescence, so that it does not seem unreasonable to expect a correlation between rickets in childhood and the general level of health at later ages. With eclampsia, reasons have already been given for considering that this may in some degree be determined by the height of the general death rates at these ages. When the mortality rates at ages are based upon the probable number of primiparous births at each age, the regression on age is almost identical with that of the rate from all causes of death (apart from deaths in childbearing) in women

of reproductive ages.

7. The Interpretation of the Relationship between Maternal Mortality and the General Death Rate of Women of Childbearing Ages.

The question finally arises; - is the correlation with the genefal death rate of women at reproductive ages to be taken as indicative of an association with the health of women in these districts, or is it simply an expression of the fact that maternal mortality is a preventible death rate and will thus show a stronger relationship with deaths which, given reasonable medical and surgical care, could be entirely eliminated; or finally, is it the result of the prevalence of certain special diseases, predisposing to accidents and diseases during childbearing? These questions can only be answered in a general way. In the first place there is no disease group affecting women aged 15-45 which, on medical grounds, can be said to specially predispose to calamity in reproduction.

Table 31. Showing the Relative Frequency of Causes of Death in Women aged 15-45 for the Period 1921-23

Cause of Death	% Frequency
Infectious diseases	5.8
Tuberculosis	34.0
Cancer	7.8
Rheumatic Fever	1.2
Diabetes	1.2
Diseases of the Circulatory System . .	10.2
Diseases of the Respiratory System . .	8.0
Abdominal Diseases	3.1
Renal Diseases	3.0
Pregnancy and Parturition . .	8.4
All Other Causes	17.3
All Causes	100.0

As will be seen from the frequency distribution of cause groups of deaths in women of 15-45, tuberculosis is by far the most important defined cause group at that age, followed

in order of importance by diseases of the circulatory system and deaths assigned to childbearing causes. The relation between puerperal sepsis and the prevalence of infectious epidemic diseases will be discussed later; but apart from this group, there is no cause group of death which can be said to have any direct bearing on the mortality of women in childbed.

Apart from special diseases, the remaining questions cannot be satisfactorily answered by investigating national statistics. The only method which could do so is a case-record investigation. But some attempt must be made, even although we have no definite index of health, nor is there available any exact index of the state of the medical or hospital provision in a district. What has been done is to take (1) the death rate from tuberculosis (all forms) in women of 15-45 years as a death rate which is, a priori, a better index of general health than the death rate from all causes other than those peculiar to the pregnant woman, and (2) the death rate from appendicitis per 1000 total population as the nearest approach in official statistics to a death rate eminently preventible by early diagnosis and proper treatment. Objections can be freely offered to the use of this as an index, the chief ones being that we are neglecting that variations in the appendicitis death rate may be more due to the prevalence of local etiological factors than to the medical and surgical services available, and secondly that the provision of general hospitals, where cases of appendicitis are chiefly treated, may not correspond to the distribution of maternity hospitals and other obstetrical services. Still the results may be of some value. A positive correlation in this instance would lead to the belief that the correlations found with the total death rate in women

Table 32. Showing the Correlations between (1) Total Maternal Mortality Rate, (2) Puerperal Fever, (3) Other causes of Death in Pregnancy and Parturition, (4) Crude Death Rate Tuberculosis in Women 15-45, (5) Death Rate Appendicitis per 1000 total population, and (6) Death Rate from Violence apart from suicide in Women 15-45 in the two Triennia 1911-13 and 1921-23.

	London		County Boroughs		Urban Districts		Rural Districts		Counties	
	1911-13	1921-23	1911-13	1921-23	1911-13	1921-23	1911-13	1921-23	1911-13	1921-23
r_{14}	-.347±.112	-.600±.082	.192±.075	-.085±.074	.470±.080	.170±.100	.330±.091	.195±.099	.548±.072	.196±.099
r_{24}	-.022±.127	-.406±.106	.083±.077	-.153±.073	.227±.098	.131±.101	.295±.094	.162±.100	.374±.088	.141±.101
r_{34}	-.408±.106	-.408±.107	.253±.073	-.050±.074	.671±.057	.153±.100	.296±.094	.160±.100	.450±.082	.181±.099
r_{13}	.306±.115	.062±.127	.185±.075	.317±.075	-.035±.103	.115±.102	.352±.090	-.054±.102	.174±.100	.219±.098
r_{25}	.131±.125	.019±.127	.095±.077	.110±.074	.108±.102	-.193±.099	.064±.102	-.385±.088	.190±.099	-.456±.082
r_{35}	.280±.117	.063±.127	.178±.075	.336±.065	.049±.102	.338±.092	.355±.090	.090±.102	-.057±.102	.446±.083
r_{16}	-.039±.127	-.043±.127	.188±.075	.232±.070	.025±.103	.288±.094	-.115±.102	-.171±.100	.223±.098	.085±.102
r_{26}	.062±.127	-.029±.127	.060±.077	.119±.073	-.050±.102	.307±.093	-.061±.102	-.195±.099	.179±.099	.195±.099
r_{36}	-.093±.126	-.028±.127	.187±.075	.172±.072	.087±.102	.176±.100	-.140±.100	-.055±.102	.161±.100	-.002±.103

was simply an expression of the association with the preventible deaths whereas, an insignificant or negative correlation must, of necessity, leave the question unanswered. As a control series, the death rate from violence, apart from suicide, in women of 15-45 has been taken as being probably independent of health and in no way related to hospital provision and medical assistance - in fact, a chance-determined phenomenon.
Table 32. contains the results of this part of the investigation.

Comparing the correlations between the tuberculosis mortality rate and the maternal mortality rate with those previously deduced by using the total death rate less parturition in females 15-45, it will be noted that most of the coefficients are slightly reduced in magnitude, but that the same differences between the coefficients for the separate aggregates of districts and in the two periods are noticeable. A similar statement can be made with regard to the two subgroups of causes of maternal death, puerperal fever and other accidents and diseases of pregnancy and parturition. The coefficients are now in some instances reduced to insignificance, having regard to the size of the probable errors, but here, as in any other investigation, uniformity in a series of statistical coefficients, is of much greater import in demonstrating a true association, than is the discovery of large individual coefficients or a series of highly fluctuating values.

Examining now the results of using the suggested index of preventible deaths. For the 43 counties, a positive correlation in both triennia results with the total maternal mortality rate, that for 1911-13 being slightly lower than for

1921-23. Turning to the individual groups of districts, it will be seen that there is no suggestion of uniformity in the results. The most significant feature is the finding for County Boroughs. As already shown, there has been in this group a decrease in the proportion of preventible deaths since 1911, yet the coefficient for 1921-23 is about twice as high as that for 1911-13. Similarly with London. Whatever significance can be attached to the differences in the proportions of the various groups of causes of puerperal deaths, the correlations with the mortality from appendicitis, if we could regard them with any confidence, show the entirely opposite tendency.

Puerperal fever for counties shows a high negative and (statistically) significant coefficient of correlation with appendicitis, and the remaining groups of maternal deaths an equally high positive one in 1921-23. The same objection can be raised by comparing the coefficients in the two triennia. The coefficient with causes other than puerperal fever has actually become negative, and with puerperal fever, positive. Similarly in the subdivisions of the country, there is not the slightest evidence of uniformity. The attempt to discover a quantitative association with preventible deaths and the childbearing mortality has therefore failed. A much more exact measure of medical and obstetrical facilities will be required before this problem can be solved.

The coefficients registered for the control series do not call for any comment. They are all insignificant in magnitude.

Thus, apart from the diminution in the size of the coefficients, the uniformity in the series with both the total death rate and the tuberculosis death rate in women aged 15-45 when correlated with the childbearing mortality rate,

suggests strongly that the association is really one with the general health of women.

Puerperal Sepsis. The bearing of these results on the genesis of puerperal sepsis, is a fairly obvious one. So far, iatro-mathematical methods have not been extended to this cause of death, to attempt a quantitative evaluation of any of the various supposed etiological factors, and we still have to be guided by the personal opinion of authorities, both with regard to the genesis of this condition and in administrative measures for its prevention. Only a complete and impartial statistical investigation will throw much light on the subject. The results of the campaign against sepsis in lying-in women are sufficiently meagre to raise a healthy spirit of scepticism as to the correctness of accepted opinion on the subject.

That the distribution of mortality with age obeys a definite law, is reasons sufficient to believe that some general influence is the predominating factor determining the chance of death from infection by pyogenic organisms. The statistics of this disease, or rather group of diseases, are likely to be objected to on the grounds that they are homogenious neither clinically nor bacteriologically. There are apparently several types of puerperal infection, but these can be considered as comprising two broad categories, the sapraemic and the septicaemic. Since we are considering the statistics of death alone, it can probably be regarded as a compact group of diseases in the sense that, bacteriologically, sapraemia is anaerobic, and chinically, is not dangerous to life; septicaemia is pyogenic in origin (or in some rarer instances due to specific organisms, e.g. Bacillus diphtheriae) and has a high fatality rate. The objections, therefore,

while admissible in the case of notifications of the occurrence of the disease (these depend on what the practitioner chooses to include as puerperal fever), are not so pertinent in the case of deaths.

In considering the varying liability to succumb to puerperal infection, some importance, evidently, must be ascribed to the resistance of the parturient herself - her immunity, natural or acquired to sepsis; and with the numerous possible sources of infection, both exogenous and endogenous, in both those who do, and those who do not, develop sepsis, it is probable that individual differences in resistance are among the most important determinants in the mortality from this condition. Colebrook (1926) has shown that there is no general tendency of the killing power of the blood to be decreased during labour or in the puerperium; but that in puerperal septicaemia, the bactericidal power of the patients' serum is enormously reduced, in some cases to only 40% of the normal.

The figures dealt with in this study, it must be remembered, relate to deaths only, not cases; and we are considering only the risks of <u>dying</u> from sepsis. That an aseptic technique and abstention as far as possible from vaginal examination decrease the liability of developing chinical sepsis may be inferred from general principles. The question is, however, chiefly, *why* some women die and others recover, and why women obviously exposed to contamination do not develop recognisable sepsis, and others, in whom there have been no obvious sources of contamination, develop and die from sepsis. The development of sepsis is not confined to those who are subjected to vaginal

examination or manipulation, nor to those delivered instrumentally, nor to those who practice coitus during pregnancy. Sepsis is known to occur in puerperal women apart from all extraneous sources of contamination. For instance, the London Committee appointed by the Section of Obstetrics and Gynaecology of the Royal Society of Medicine, prepared a report (1924)* on 247 cases of puerperal sepsis. Of these, 25% presented none of the usually accepted etiological factors. The labours in these cases were normal, no vaginal examination had been made by the doctor or midwife, and no sources of autogenetic infection were found. The report of a committee of the North of England Obstetrical and Gynaecological Society (1924)* contained an analysis of 154 cases of puerperal sepsis. Of these, in 46% it was reported that labour was normal - there was no interference of any kind apart from vaginal examination. Of course in these cases, it is possible that some were infected by the examining hand; so that, as no information is given as to the number who were not examined per vaginam, the figures in these two reports are not directly comparable. Yet the London Committee's report shows that in many instances, puerperal septicaemia is not the result of infection from extraneous sources of contamination. Colebrook (1926) suggests as a possibility that the non-haemolytic streptococci, often found in the vagina, may, when entrance is effected into a circulating blood stream of subnormal bactericidal power, develop haemolytic properties, and become pathogenic.

The mortality curve of puerperal sepsis shows that the death rate is highest at the extremes of reproductive life.

* Quoted from B.M.J. April 25. 1925.

Starting from a high value in the first quinquennium, the rate drops rapidly to a minimum in the 20-25 age group, after which there is a steady rise till the final quinquennium And it was shown that young mothers of 15-20 are, on the average, less healthy than the general female population at that age; but how far this will reflect on their resistance to infection is not a simple problem. There are two antagonistic factors at work here. It is no doubt highly probable that immunity in general varies with general health, and it might be justifiable to attribute a lessened resistance to infection to a lowered vitality. But a compensatory process may be active in some degree. A selective process by death of the less immune members of the community in early life, or repeated sub-lethal, but efficient as immunising, doses of pyogenic organisms leading to an actively acquired immunity, may have been taking place; and both of these processes might reasonably be expected to occur in a more intense degree in women of the lower social classes, from which class, as has already been shown, the majority of these young mothers are drawn.

The comparisons made between the death rates from sepsis in the different sections of the country show that the rate from sepsis follows closely, both in its general trend and also proportionately, the general female death rates at reproductive ages. The distribution in the different parts of the country does not seem to be dependent on the proximity to skilled medical care to any appreciable extent.

The size of the correlations deduced for individual towns between puerperal septic mortality and the general female death rate from all causes less parturition, are much smaller than might have been expected from the comparison already

made, but the two factors which have contributed to this result namely (a) the sampling errors in the death rates based on small numbers and (b) the greater degree of acquired immunity among the survivors to reproductive ages in the least healthy communities, have already been pointed out.

8. The classification of Causes of Death in childbearing with Regard to their Relationship with Age.

In part I, it was suggested that the causes of maternal death in childbearing might be grouped roughly into two broad categories with respect to their relationship with age, and the further evidence produced to attempt to explain the differences in the death rates at ages suggested that in the diseases included in group (a) - those which increased steadily with age without the rise in the quinquennial age group 15-20 - it was probable that conditions other than the general health of the mother were chiefly responsible for these, and consequently our attention should be directed to other causes, such as local infirmities in the uterus and adnexa. Prior to 1911, maternal deaths in childbearing are published in certain cause groups for individual counties. These were therefore, grouped into four categories to ensure as far as possible comparability in the causes of death as described in later reports. The four cause groups are; -

(a) puerperal fever.

(b) placenta praevia and flooding.

(c) puerperal convulsions.

(d) all other causes.

Of these, all except (b) placenta praevia and flooding follow the trend with age which suggested a relationship between these causes and the health of women.

The correlations were recalculated between each of these four groups and the general death rate in females 15-45 from all causes less parturition in 1901-03. The results are as follows; -

Correlation between Death Rate Females 15-45, and	
(a) puerperal fever	.6987±.053
(b) placenta praevia and flooding	.0388±.103
(c) puerperal convulsions	.3052±.093
(d) all other causes	.4440±.083

It will be seen that the only insignificant coefficient is the one in which such a result would have been predicted from a knowledge of the age distribution of the death rate. All the remaining groups show significant positive relationships with the general mortality rates in women of reproductive ages. In view of what has been said as to the non-distribution prior to 1911 of the births and deaths from the place where they occur to the place where they belong. too great significance cannot be attached to this finding, although the result is very suggestive: and it is curious that the correlations agree so closely with what was already said to be probably true. So that a knowledge of the age distribution of separate diseases seems to open up some possibilities as to the classification of the accidents and diseases of pregnancy and parturition into those which are dependant mainly on general, and these which are dependent on local conditions.

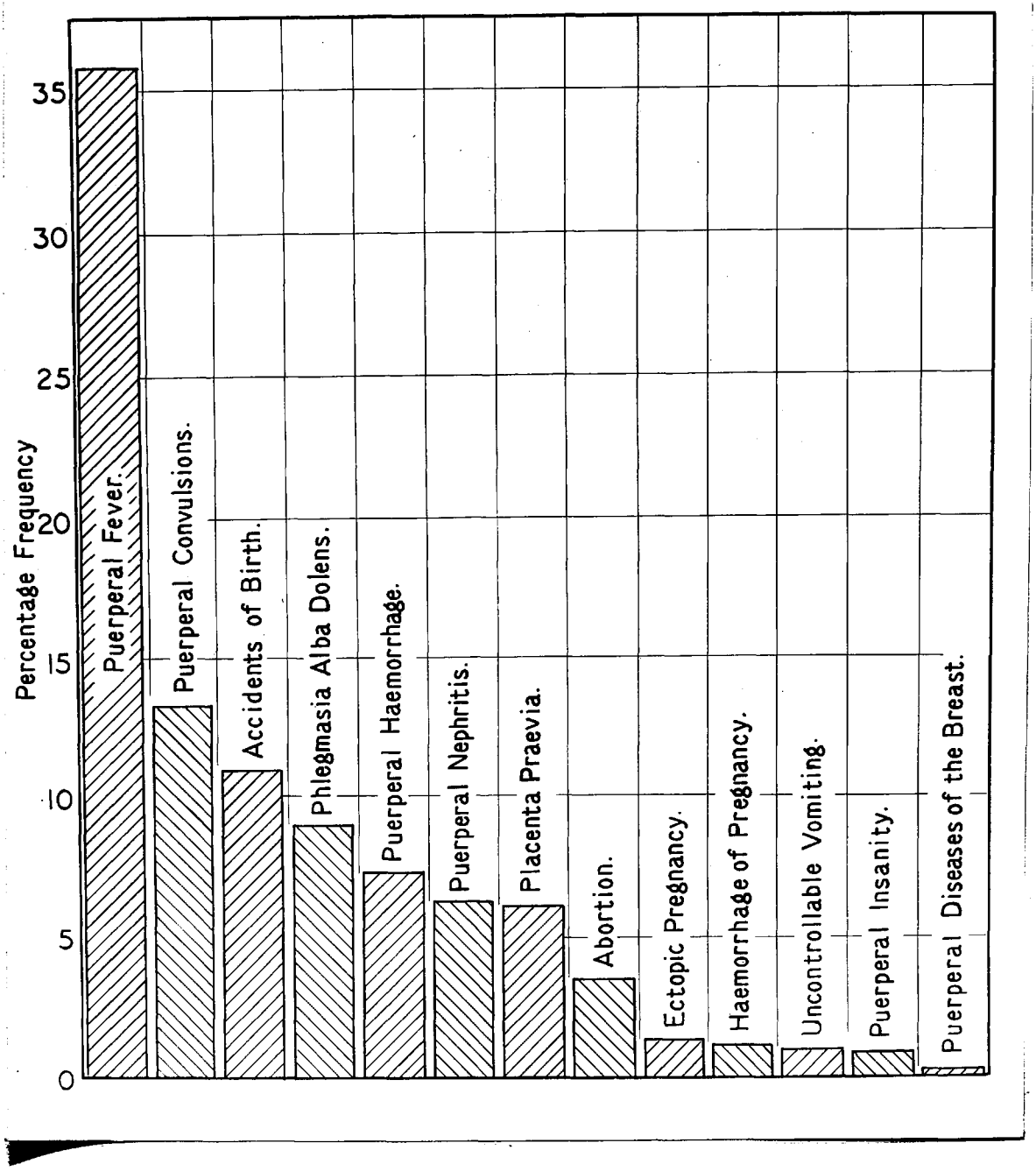
Summary and Conclusions.

In this section it has been shown that the age of the mother is not a factor of importance in the production of geographical variations in maternal mortality. This has been demonstrated by the calculation of factors for correction. These show that the age distribution and civil constitution of the female populations at reproductive ages in the counties of England and Wales are not sufficiently divergent from one another to affect the distribution of the crude rates of mortality in childbirth.

The death rate from all causes other than those connected with maternity in women of ages 15-45 shows a significant positive relationship with the mortality in childbearing. The regression line in the period 1921-23 for counties is typically skew, and it was suggested that this resulted from variations in the proximity to skilled medical assistance and the amount of hospital provision available. The methods of further procedure suggested by this finding showed that the explanation is probably true. The relationship between the general death rate of women in any district and the mortality rate in childbearing is lowered in proportion to the medical efforts of control. The truth of the explanation depended on the assumption that the amount of hospital accommodation was in part determined by the pre-existing rates of maternal mortality in that community, and evidence was produced to show this was a correct assumption, at least for London.

The importance of various cause groups of maternal death varies greatly in different aggregates of the country. In England and Wales the cause groups of death arranged in order of importance are for 1915-23 as follows; -

DIAGRAM 5.



Showing the percentage frequency of various causes of maternal death.

(See also Diagram 5)

Cause Group	% Frequency
Puerperal Sepsis	35.8
Puerperal Convulsions	13.4
Accidents of Childbirth	11.0
Phlegmasia Alba Dolens	9.0
Puerperal Haemorrhage other than Placenta Praevia	7.3
Puerperal Nephritis	6.2
Placenta Praevia	6.1
Abortion	3.5
Ectopic Pregnancy	2.4
Haemorrhage of Pregnancy	2.2
Uncontrollable Vomiting	1.0
Puerperal Insanity	0.9
Puerperal Diseases of the Breast	0.3
All Causes	100.0

The proportion of deaths from puerperal sepsis and accidents of pregnancy is least in rural communities and greatest in highly urbanised areas, whereas all other causes become relatively more important in rural than in urban districts.

The death rates from the several cause groups are affected to different degrees by medical efforts of control. On the assumption that the greater the proportional difference in the death rates in parts of the country with the smallest and greatest facilities for maternity supervision, the more is that cause of death affected by the provision of various methods of medical control, the causes of death in childbearing can be arranged as follows with regard to the prospect of diminishing or eliminating these by further provision of medical assistance to pregnant and parturient women; -

(1) Phlegmasia Alba Dolens
(2) Albuminuria and Convulsions
(3) Puerperal Haemorrhage
(4) Accidents at Birth
(5) Accidents of Pregnancy
(6) Puerperal Sepsis.

The two main groups of causes of death in childbearing, puerperal sepsis and the remainder, both show significant positive relationship with the general death rates in women of reproductive ages from all causes less those pertaining to childbearing.

The type of regression exhibited in counties provided further evidence that puerperal sepsis was not to any significant extent affected by the proximity to skilled medical assistance. The regression in counties was linear, whereas with other causes, an excessive mortality was demonstrated in sparsely-populated rural districts.

The magnitudes of the coefficients of correlation involving puerperal sepsis were, in general, lower than those found for other causes of childbed deaths. This was apparently contrary to what all the previous analysis tended to show, but the effects of errors of sampling in the death rates were shown to be probably greater with puerperal sepsis than with the remaining causes. Further, the question of the effect of variations in immunity to pyogenic organisms among women was discussed; and it seems possible that there are other influences, namely a selective death rate in pre-reproductive life of the less immune members of the community, and an actively acquired immunity from repeated sub-lethal doses of infection among the survivors, which, acting to a more intense degree in districts in which the general death rate in women from causes other than those connected with childbearing is highest, would tend to lower the correlation between puerperal sepsis and the general mortality in women at reproductive ages. The further analysis to attempt an explanation of the meaning of the correlation between the maternal mortality rates in childbearing and the death rates

in women at those ages from all causes apart from those connected with reproduction leads to the conclusion that it is most probably the expression of a relationship between the general health of women and the chance of dying in childbed.

The attempt to find if the relationship simply meant an association with deaths which could be prevented by medical and surgical care has failed. A more exact index of medical attention than is available in official statistical reports will be required before this factor can be quantitatively evaluated..

In the concluding section of this part of the study, a fairly strong argument has been presented in favour of the view expressed in Part I, that maternal deaths may be classified into two groups, by an examination of the death rates at ages, into those which are dependent to some extent on general conditions of the mother, and those not so dependent. The group, "placenta praevia and flooding," in which the death rate increases steadily with age from the beginning of reproductive life, is the only one of the four groups of causes of death available which shows no significant relationship with the general death rates in women 15-45 from all causes other than childbed causes. Consequently the classification into the two groups suggested previously may be of some value in assessing the relative importance of general and local conditions of the mother in the etiology of the several groups of causes of maternal death in childbearing.

Part III.

The Relation of Social Conditions to the Mortality in Childbearing.

Although the suggestion is sometimes made that the incidence of puerperal sepsis may be to some extent determined by the general social conditions of the patient, I have been unable to find any attempt to consider this relationship quantitatively. In the North of England committee's report on Puerperal Sepsis, it is noted that "in considering the question of etiology, account must be taken of the patient's general health and surroundings;" but no attempt to take either of these two factors into account was made. Geddes (1912) refers to the association which exists between puerperal fever and the number of persons per acre, the incidence of puerperal fever being greater in the closely populated areas of any district. But, as the number of persons to the acre is not a satisfactory index of the social or economic status of the population, this result has little value for the present purpose.

The question as to how for the social and economic level of a community determines, or is related to, the incidence of deaths in childbed is obviously of importance. In the first place, in the lower social classes, where overcrowding is greatest, cleanliness in the home least, and the prevalence of infectious diseases highest, it is not at all unlikely that in these places the chances of infection in the puerperium are greatly intensified. Not only so, the possibility of practising an aseptic technique in these houses is greatly minimised, the facilities for carrying out successful operative proceedures are very poor, and the difficulty of obstetrical manipulations is increased by defective lighting or lack of space.

There is further the problem that the death rate in childbearing is related to the general death rate in women of reproductive ages, and that the general death rate is highly correlated with social conditions, so that, even if social conditions alone were not factors of any importance in the maternal mortality, an indirect association might well be introduced because of the high correlation with the general death rate.

As to the indices to be used, the social and economic level of a district can be measured roughly in several ways. For example, housing conditions, with regard to the degree of overcrowding, may be measured by the proportion of the population living more than two in a room, or the number of rooms per person; economic conditions by the number of indoor female domestic servants per 1000 of the total population or per 100 private families, and social status by the occupations of the male inhabitants - the proportion of professional men, the proportion of general labourers or the proportion of pawnbrokers per 1000 occupied males. No one of these indices is an exact measure of the social standing of a district, but each is at least a useful crude index of the factors which we wish to measure, namely the greater liability to infection in poorer homes, and the lessened chance of success of obstetrical proceedures, should these become necessary.

Here I have only used two indices; - (1) the number of indoor domestic servants per 1000 of the total population, and (2) the number of rooms per person.

Table 24 shows the correlations between the death rates in women aged 15-45 from all causes less those pertaining to childbearing for the period 1921-23. It will be seen that both indices give fairly consistent results, and that in all the groups of districts examined there is a high degree

of association between the social conditions of any district and the death rate to which women of childbearing ages are subjected. There is apparently no difference in the intensity of the association when large towns or small rural communities are considered.

Table 24. Showing the Correlations between the Death Rate in Women 15-45 from All Causes less Childbearing and Indices of Social Status.

	Indoor Domestic Servants	Rooms per Person.
London	-.7698±.052	-.8230±.041
County Boroughs.	-.6268±.045	-.9764±.035
Urban Districts.	-.6882±.054	-.6547±.059
Rural Districts.	-.6210±.063	-.5993±.066

In table 25, a and b are collected, the results showing the relation between the childbearing mortality rates and social conditions in 1921-23.

Table 25. Showing the Correlations between (1) Total Maternal Mortality Rate, (2) Puerperal Fever Death Rate and (3) Death Rate from Other Causes in Parturition and Indices of Social Status.

(a) Domestic Servants.

	Maternal Mortality Rate	Puerperal Fever	Others of Parturition
London	.5114±.094	.2042±.122	.4896±.097
County Boroughs	-.0986±.074	-.0257±.074	-.0786±.074
Urban Districts	-.2253±.097	-.2257±.097	-.1586±.100
Rural Districts	-.2467±.097	-.1717±.100	-.2261±.097

(b) Rooms per Person.

	Maternal Mortality Rate	Puerperal Fever	Others of Parturition
London	.5897±.083	.3786±.109	.4137±.106
County Boroughs	-.1066±.074	.0159±.074	-.1093±.074
Urban Districts	-.2340±.097	-.2789±.095	-.1683±.100
Rural Districts	-.2924±.094	-.3618±.089	-.1548±.100

Here again both indices give very consistent results, but in this instance, the size of the coefficient and its sign differ very greatly in different kinds of districts. In the highly urbanised districts of London, the incidence of deaths in childbed from all causes is greater in the upper classes. Each of the two coefficients is significant with

regard to the probable error involved. With the two separate groups of causes of maternal death, the same relationship holds good, but the degree of association differs. In London Puerperal fever shows a lower correlation with both indices of social class than does the remaining death rate in childbearing. In County Boroughs none of the coefficients has any significance. Here it may be confidently concluded that no relationship whatever exists between social indices and the total death rate in Childbearing, or in the two separate groups of causes of death.

In Urban and Rural Districts the coefficients are all consistent with regard to sign, but in only one of the twelve coefficients does the value exceed three times the probable error. The uniformity in the series, however, seems to justify the conclusion that in these parts of the country, there is some slight correlation between the variables, indicating that, on the average, there is a tendency for the death rates in childbearing to increase with descent in the social scale.

Comparing these coefficients with the results previously obtained between the childbearing death rate, and the remaining death rate in women of reproductive ages, it will be noted that the trend of the coefficients as we change from Urban to Rural districts is exactly similar, but that in every instance the association between the health of women and the mortality rates in reproduction is higher than between social and general economic conditions and the rates of mortality in childbed.

If we proceed a stage further, and attempt to measure the relationship between the maternal mortality rate and one of these two factors, social conditions or general health, for

constant values of the remaining variable, it is found that apart from changes in the general death rates of women of reproductive ages, social conditions have no relation whatever to the death rates in childbearing, whereas the correlation with the general health of women at these ages shows that but little change in the degree of association with mortality in childbed occurs after having made allowance, as far as can be by a statistical process, for differences in social status. The coefficients of partial correlation are given in Table 26. It will be seen that in every case the correlations with the number of domestic servants per 1000 of the population are now all positive in sign, indicating increasing maternal death rates with ascent in the social scale; but none of these correlations is of any statistical significance. The coefficients for general health of women are but little changed, and present the same differences between urban and rural populations as did the crude values.

Table 26. Showing the Partial Correlations between (1) Maternal Mortality Rate, (2) General Death Rate in Women aged 15-45 from All Causes less Parturition, and (3) Social Status as measured by Domestic Servants per 1000 Total Population.

	$r_{12.3}$	$r_{13.2}$
London	-.3895±.108	.0866±.127
County Boroughs	.1322±.073	.0057±.074
Urban Districts	.3358±.091	.0671±.102
Rural Districts	.3210±.092	.0002±.103

Relation between Persons per Acre and Maternal Mortality.

In large towns the number of persons enumerated per acre is simply indicative of the density of the population within the houses themselves, and is intimately related to other indices such as the percentage of the population living more than two per room; the number of rooms per person, and other indices of social status. But in the aggregate of Urban, and

and more so in the aggregate of Rural Districts, persons per acre is not to the same degree correlated with social status. In these parts it is probably more indicative of the extent of land over which numerous isolated villages are scattered than of the amount of overcrowding in the home; so that it would appear to be a rough measure of the proximity to, or distance from, medical assistance. Consequently the correlations have been calculated between the number of persons per acre and the mortality rates in childbearing in both Urban and Rural Districts. These are given on Table 27.

Table 27. Showing the Correlations between the Death Rates in Childbearing and the Number of Persons per Acre.

	Maternal Mortality Rate	Puerperal Fever	Others of Parturition
Urban Districts	-.0148±.103	.1323±.101	-.1607±.100
Rural Districts	-.0842±.102	.2450±.097	-.2428±.097

The coefficients are all of greater magnitude in Rural than in Urban Districts. This may be due to the fact that the index in Rural Districts is a more reliable measure of the proximity of medical assistance than it is in Urban Districts. With the total maternal mortality rate there is a negative correlation in both sets of districts with the number of persons per acre, but none of these are significant, the probable error in both instances being larger than the coefficient. With the two groups of mortality in childbearing, differences are evident. Both coefficients for puerperal fever are positive, whereas those for other causes are negative in sign. The magnitudes of the coefficients are, however, of the same order. Thus, where the number of persons per acre is greatest, the mortality from causes other than puerperal fever is lowest, and that from puerperal fever highest. In so far, then, as crowding upon area is of value as indicating the degree of scattering of small villages over a large extent of land, and consequently, of the difficulty of readily obtaining skilled

medical attention in urgent cases, these correlations bear out to some extent what was already concluded from a study of the death rate in urban and rural area, namely, that puerperal fever had apparently no connection with the availability of skilled medical attention, and that the remaining causes of death in pregnant women were to some extent dependent on this factor.

Summary and Conclusions.

The results of this part of the study show that there is some relationship between the mortality rates in childbearing and various indices of the social and economic level of the community. The coefficients deduced show the same differences with respect to magnitude and sign in the separate aggregates of the country as have already been noted and discussed with the general death rates in women of reproductive ages. Thus in London the incidence of deaths in childbed is greatest in the districts containing a larger proportion of inhabitants of the upper social classes, whereas in the rest of the country, ascent in the social scale is accompanied by a diminution in the rates of mortality in childbearing. In County Boroughs, however, no significance attaches to the coefficients found. In Urban and Rural Districts, the coefficients are barely significant, but the uniformity of the series would appear to indicate an excess in the childbearing mortality in the lower social classes. The magnitude of all the coefficients between social status and childbearing mortality is lower than that between the general death rate in women of 15-45 and maternal mortality.

The general death rate in females of reproductive ages is intimately related to social class in all the subgroups of the country.

When allowance is made, by the method of partial correlation, for variations in the general death rate of women, all the correlations with social status become insignificant; whereas the original crude correlations between the general death rate of women and maternal mortality remain practically unchanged when variations in social level are eliminated.

These results, therefore, show that apart from variations in the health of women of reproductive ages, there is no uniform relationship between social conditions and the death rate in childbearing.

The correlations between the number of persons per acre and the mortality rates from childbed causes would appear to confirm the suggestion already made, that puerperal fever does not depend to any appreciable extent on the provision of skilled obstetrical assistance, but that the remaining causes of death are to some degree affected by this factor.

Part IV. Puerperal Sepsis and the Prevalence of Streptococal Diseases.

Of other factors concerned in determining the incidence of puerperal sepsis, the prevalence of certain infectious diseases is a correlative which has long been suspected. In the early days of bacteriology, such interrelationships were suspected on purely statistical grounds, Thus, Longstaff (1891) pointed out the remarkably close correlation between the seasonal variations and the secular trends in the mortality of erysipelas and childbed fever - a relationship so close that "he found it difficult to avoid the conclusion that they were both due to the one poison." A somewhat similar, but less striking association was shown with other diseases, such as pyaemia, scarlet fever, "rheumatism of the heart or pericardium" and diphtheria.

Even more emphatic were the views of Minor (quoted by Longstaff) who, writing in 1874 on "Erysipelas and Childbed Fever" said, in reference to the deaths from these two diseases in the United States in 1870;

"1. Erysipelas and childbed fever seem to prevail together throughout all the states. 2. Any marked change in any one locality, of one disease, was apparently accompanied by a corresponding increase of the other. 3. Where histories of past epidemics of either disease were obtainable from any of the states, the apparent connection of the two diseases was noticed by the physicians and remarked on. 4. This relationship indicates that there is an intimate connection existing between childbed fever and erysipelas, and justifies the inference that in any place where erysipelas is found, there will be found puerperal fever."

Again, on referring to an epidemic of childbed fever in Cincinnati he says,

"1. The two diseases, childbed fever and erysipelas, prevailed at the same time in the same localities. 2. Where an isolated death from childbed fever was noted outside of infected districts, a corresponding death from erysipelas was noted in the same locality. This was almost universally the case. 3. Infants die of erysipelas shortly after or before their mothers die of childbed fever. 4. A few physicians attending childbed fever cases and erysipelas cases at the same time, as exhibited by the death register, were the most unfortunate in their practices. 5. Physicians having large obstetric practices, but who were known to be believers in the close connection of childbed fever and erysipelas, returned few deaths from either causes."

Further, on examining the alleged connection of typhus fever and scarlatina with childbed fever, Dr. Minor found that, "1. Epidemic typhus is <u>not always</u> associated with an outbreak of epidemic childbed fever. 2. Epidemic scarlet fever is <u>very seldom</u> associated with an outbreak of epidemic childbed fever, or vice versa. 3. Epidemic erysipelas in <u>invariably</u> associated with an outbreak of childbed fever and vice versa."

Geddes (1912 and 1926), in two contributions to the study of puerperal sepsis, has also examined the suspected relationship between three epidemic infectious diseases and the varying prevalence of puerperal fever. His results would appear to show that the correlation is closest with erysipelas, somewhat less with Scarlet fever, whereas, diphtheria shows no close affinity with the incidence of puerperal fever. This author, however, appears to place little importance on the result, regarding it as a subsidiary consideration compared with his main (statistically unproven) thesis as to the

factor of greatest importance in determining the prevalence of septic infection in puerperal women.

With advancing knowledge of bacteriology and with increasing indications of the relationships in clinically different diseases between their causal agents, not only in their morphology, but also in cultural characteristics and in the specific morbid effects on their injection into animals, some at least of these relationships would appear to have an even greater significance than, for example, the explanation suggested by Longstaff, namely the prevalence of rainfall or the number of rainy days acting by purifying the air, and removing from it particles of contagious matter, and making them less diffusible.

In puerperal fever, as in other inflammatory conditions, bacteriological findings indicate that there is in all probability no specific organism, but "if general infection ensues, usually one organism only invades the blood stream, and this is almost always the streptococcus." (Lea 1910); and it is apparently agreed that the streptococcus pyogenes is the most common infecting agent in, at least the severe types of childbed fever.

The bacteriological reports of different investigators vary somewhat in the proportion of cases in which the streptococcus has been isolated. The reports of the London and North of England committees, already referred to, deal only with blood examinations. In the former investigation it was found that 53 of the 136 cases examined had streptococci in the blood, 4 had Bacillus coli, and in the remaining 79 instances the blood examination proved negative. In the North of England committee's report, 65% of the 75 cases examined gave positive streptococcal cultures.

Colebrook (1925) believes that a haemolytic streptococcus is responsible for about 90% of all cases of puerperal septicaemia. Similar results are reported by other investigators. MacKay (quoted by Furneaux Jordan, 1912) found a streptococcus in 17 out of 21 cases. This organism, he considers, is quite distinct from other streptococci, is the same identically in all the 17 cases, and that in any secondary pus, pleuritic fluid or Sputum, it is identical with that found in the uterine discharge. Further he has never seen a streptococcus with similar characteristics in any other type of sepsis. Bigger and Fitzgibbon (1925) in 158 swabs found streptococci present in 101 instances, and Abrahams (1924) isolated streptococci in 63 out of 120 uterine swabs.

The controversy concerning the characters of the organism with regard to its cultural characters, fermentation reactions, etc., and the original source of the organism does not effect this study in any way. Sufficient it is that one of the chief causal agents in puerperal septicaemia is a streptococcus, and we are concerned here solely with the effect of the incidence of other diseases due to, or intimately associated with streptococci on the prevalence of septic infection in puerperal women. In erysipelas, the causative organism, streptococcus erysipelatis, was isolated by Fehleisen in 1884, and this organism on inoculation in the human subject as a therapeutic measure in malignant disease reproduced erysipelas. But "one after another of the supposed points of difference between the streptococcus of erysipelas and that of suppuration has broken down, and it is now generally held that erysipelas is produced by the streptococcus pyogenes of a certain degree of virulence. But erysipelas passes from patient to patient as erysipelas, and

purulent conditions due to streptococci do not appear liable to be followed by erysipelas. On the other hand, the connection between erysipelas and puerperal septicaemia is well established clinically." (Muir and Ritchie,1913).

In the case of scarlet fever, recent bacteriological researches seem to have established an etiological relationship between a streptococcus and scarlet fever. Whether it (streptococcus, scarlatinae or anginosus) is the causa vera of the condition or a mere associate has no concern for us here. Certain it is that a streptococcus is almost constantly present at least in the superficial lesions, although examination of the scarlatinal joint effusions and renal complications in many instances have proved sterile.

That the association of puerperal women with patients suffering from certain infectious diseases is still regarded as a potential source of infection in the puerperium, may be inferred from the report on two cases (investigated by the North of England committee) in which the infection is supposed to have been conveyed from another patient. In one of these, a patient in the next bed was found to be suffering from scarlatina; in the other, the woman's husband developed erysipelas of the face and was transferred to a fever hospital. This misfortune so upset his wife that labour started prematurely, and the child was born before the arrival of either doctor or nurse. This patient developed septicaemia, in spite of the fact that everything was normal at the confinement, and there was no vaginal examination.

The investigation of the possibility of a direct relationship between these differently situated inflammatory conditions (as opposed to an indirect correlation by the intermediary of some general prevailing cause, such as

rainfall) seems therefore to be of some importance. The question to be answered, then, is not whether, when there is close contact between a puerperal woman and a patient suffering from infectious disease, the woman is or is not more than likely to develop septicaemia. The two cases related previously suffice to show that the chance of infection is probably much greater under these circumstances. The problem is to determine, when in any given locality, the incidence of streptococcal infectious diseases is above the average, whether or not the incidence of puerperal septicaemia is also increased.

The analysis made by Longstaff was in relation to deaths; but the notifications of cases of the diseases should afford much more reliable information with regard to the relationship, if any, than would deaths. The records of cases of the epidemic diseases considered here, namely erysipelas, scarlet fever and diphtheria, may be fairly accurate, but those of puerperal fever are notoriously defective, so that in addition to the notification rate, the mortality rate per 1000 births has also been used, the latter probably being a better indicator of the prevalence of at least the more severe type of puerperal infection.

The rates (notification and death rates) are for the two triennial periods 1911-13 and 1921-23, and are based on the estimated populations of 1912 and 1922.(Appendix).

Three separate groups of districts have been analysed, the 28 Metropolitan Boroughs of London, 43 Administrative Counties and 82 County Boroughs (75 in the period 1911-13)

In the following tables are collected the correlations between puerperal fever, both death and notification rates, and the incidence rates of scarlet fever and erysipelas.

Table 28. Showing the Correlations between Puerperal Fever Notification Rates and the Notification Rates of Scarlet Fever and Erysipelas.

(a) 1911-13	London	County Boroughs	Administrative Counties
Scarlet Fever	-.0870±.126	-.0623±.078	-.0154±.103
Erysipelas	-.0343±.127	.0891±.077	-.0210±.103
(b) 1921-23			
Scarlet Fever	.0929±.126	.0341±.074	.3976±.087
Erysipelas	.2402±.120	.2537±.070	.2476±.096

Table 29. Showing the Correlations between Puerperal Fever Death Rate and the Notification Rates of Scarlet Fever and Erysipelas.

(a) 1911-13	London	County Boroughs	Administrative Counties
Scarlet Fever	-.0723±.126	.0117±.077	.1358±.101
Erysipelas	.0059±.127	.1686±.076	.0778±.102
(b) 1921-23			
Scarlet Fever	-.2709±.118	-,0529±.074	.4744±.080
Erysipelas	-.3105±.115	.1128±.074	.3590±.090

The results for the first triennium (1911-13) show a remarkably uniform series of insignificant coefficients. In the second period, scarlet fever shows significant positive association with puerperal fever incidence, whether judged by the notification or death rate, in the administrative counties. In the two groups of boroughs the notification rate seems to be independent of the incidence rate of scarlet fever, whereas with the puerperal mortality rate, both coefficients are negative in sign. Erysipelas shows a uniformly small positive relationship with puerperal fever notification rate, but with the mortality rate this sequence is completely upset; the London Boroughs showing negative association, County Boroughs none whatever, and Administrative Counties a significantly positive relationship.

Considering the results for the two triennia and for the separate groups of districts as a whole, the values registered

do not suggest any special correlation between the local incidence of either of these two infectious diseases and that of puerperal fever. The correlations involving erysipelas and puerperal fever would suggest some association at the later period. Having regard to the magnitude of the probable errors involved, these results are significant in Administrative Counties and County Boroughs, but in London, insignificant, although of the same sign and actual magnitude. The uniform insignificance of the coefficients in 1911-13 would suggest a complete disassociation between them. But the significant relationships for 1921-23 cannot thus be satisfactorily dismissed.

With the mortality rate from puerperal fever and these diseases the correlations are the same as for notifications in 1911-13. From these it might well be concluded that the incidence of puerperal fever is unaffected by variations in the prevalence of these streptococcal infectious diseases. But in the period 1921-23 the relationships have changed. In the large towns, Metropolitan and County Boroughs, all the coefficients for the mortality rate from puerperal fever are lower than those for notification rates, those for London being actually negative; for County Boroughs the correlation with erysipelas is positive, with scarlet fever is negative, but each of no significance. In Administrative Counties both correlations are slightly higher, although not significantly so; and it is possible that this is in part accounted for by the less reliable notifications rates in these districts, as indicative of the prevalence of puerperal infection. The coefficient between erysipelas and puerperal fever is slightly lower than between scarlet and puerperal fevers.

From these results it can be confidently concluded that, whatever the association between puerperal fever and these diseases, it is not a constant one, and that the variations in the prevalence of puerperal fever are not to be explained, to any significant extent in any group of districts by the varying prevalence of streptococcal infectious diseases.

The results of the first triennium would lead to the suspicion that the similarity between the seasonal and secular trends in these diseases has nothing whatever to do with a prevalence of a similar type of organism. But the magnitude of the correlations for 1921-23 excludes a dismissal of these results without some attempted explanation by further analysis.

Since it is impossible to go into an examination of all the other complex factors associated with, or causing, the varying prevalence of these diseases, the most simple method is by comparing the results with some control series. The remainder of the deaths in parturient women assignable to the effects of pregnancy and childbirth (i.e. total maternal deaths less those recorded as due to sepsis) would on general grounds appear to be unaffected by the prevalence of streptococcal infections. Although it is possible that some of these deaths are due directly or indirectly to septic conditions (as is suggested by Dr.Stevenson in the Annual Report of the Registrar-General for 1923), the proportion due to this cause is probably small. If in such a case the coefficients of correlation between the mortality rate from causes other than septic infection in the puerperium were the same as those with puerperal fever, it would at least suggest that the association between streptococcal infectious diseases was an indirect relation due to some other factor or factors favouring the incidence both of infectious diseases

and the maternal death rate in childbearing. Such an association might arise, for example, from social or environmental conditions. If these were influential in varying the death rate from childbed causes, as well as the incidence of infectious diseases, we should quite reasonably expect an association between the maternal death rate and the prevalence of infectious diseases. The control, however, is not a complete control in so far as the death rate from causes in parturition etc., other than puerperal fever may still show no association with these infections, and yet our final correlations with puerperal fever and specific infections remain unexplained - whether it is the result of the prevalence of streptococcal diseases or an indirect association with some condition other than this which favours the incidence of both conditions.

In the following table are shown the coefficients between the remaining death rate in parturition and the two infectious diseases.

Table 30. Showing the Correlations between the Death Rate in Parturition apart from Puerperal Fever and the Notification Rates of Scarlet Fever and Erysipelas.

(a) 1911-13	London	County Boroughs	Administrative Counties
Scarlet Fever	-.6030±.081	-.0518±.078	.1767±.100
Erysipelas	-.3570±.111	.0745±.077	-.0181±.103
(b) 1921-23			
Scarlet Fever	-.4866±.097	-,1368±.073	.0042±.103
Erysipelas	-,1586±.124	-.1920±.072	.1155±.101

The most noteworthy point is that in most of the cases, the coefficients are smaller than those with puerperal fever, although they are still in the main insignificant. In the period 1911-13 the correlations for Administrative Counties and County Boroughs cannot be said to differ significantly from the results for puerperal fever death or incidence rates;

but in the Metropolitan Boroughs both coefficients are significantly lower than the values deduced for puerperal fever. In the period 1921-23 there is no significant difference in the correlations in London or in County Boroughs between the puerperal fever results and those for the remaining deaths in parturition; but the significant positive relationship found for puerperal fever in Administrative Counties still remain to be explained, because there is apparently no such correlation found with the remaining death rate in parturition. Still the results tend to confirm the suspicion that the relationship between streptococcal epidemic diseases and the incidence of puerperal fever is not a direct one. After all, to point out that such an association exists means nothing, if there attaches to it no adequate or satisfactory explanation. To point out a relation between other epidemic diseases means no more than that there are some factor or factors which favour the incidence of these, and gives no clue to the type of the relationship. Here the point to be examined is whether the incidence of puerperal infection is at all determined by the prevalence of other diseases with similar causative organisms, or whether it is an indirect correlation, and giving no idea of the underlying cause of the relation. So far we see that the results are discrepant, mainly so in London where the opposite kind of relationship to what might be expected holds good. The final test is to make a short analysis of the prevalence of some other disease with a similar type of seasonal prevalence, but one in which the causative organism is but seldom, if ever, the sole cause of infection in the puerperium. I have chosen diphtheria; the causal organism of which is seldom associated with puerperal

fever. In this case we should expect a lower correlation between puerperal fever and diphtheria than was found with either erysipelas or scarlet fever. The value of the control depends on the extent to which it is associated with these other infectious diseases. The incidence of diphtheria may be so intimately correlated with the incidence of erysipelas and scarlet fever that it is not a true control. Consequently the coefficients of correlation between each of these diseases were calculated first, and are given in Table 31.

Table 31. Showing the Correlations between each of the Infectious Diseases, Scarlet Fever, Erysipelas and Diphtheria.

(a) 1911-13	London	County Boroughs	Administrative Counties
Scarlet Fever - Diphtheria	.5371±.091	.0677±.078	.1442±.101
Scarlet Fever - Erysipelas	.2164±.122	.1739±.075	.6563±.059
Diphtheria - Erysipelas	.1030±.126	.0881±.078	.0879±.102
(b) 1921-23			
Scarlet Fever - Diphtheria	.7460±.057	.2824±.069	.4237±.084
Scarlet Fever - Erysipelas	.2495±.120	.3317±.066	.4537±.082
Diphtheria - Erysipelas	.3883±.108	.1014±.074	.1139±.102

The above results are scarcely such as to warrant the belief that our control is not a true control. With erysipelas and diphtheria there is no substantial correlation in either of the two periods except for the one significant case of Metropolitan Boroughs in 1921-23. With scarlet fever and diphtheria there seems to be a closer association, more marked in the later period than in the earlier period. In the former all the coefficients are statistically significant, but in the latter (1911-13) only the one for Metropolitan Boroughs is significant. It will be noted that with the

correlations scarlet fever and diphtheria, and scarlet fever and erysipelas, as a general rule the values registered for 1921-23 exceed those for 1911-13, the one exception being for Administrative Counties for scarlet fever and erysipelas. The figures used for calculating the rates in 1911-13 were not corrected for errors in diagnosis. The practice since the annual returns of notifications of infectious diseases were published in the Annual Reports of the Registrar-General instead of in the Local Government Board Reports is that the returns of each week are in the following week, corrected for mistaken diagnosis, and the figures given in the Registrar-General's Reports are those corrected for changes in diagnosis. Such is not the case with the notification returns for 1911-13, which were collected from the Local Government Board Reports. The effect of not making allowance for such mistaken diagnoses at the outset of the infection on the correlation between diseases in which differential diagnosis may be doubtful in some instances, will usually be to reduce the absolute magnitude of a correlation. This explanation of the differences at the two periods with differing degrees of accuracy of the notification returns, seems all the more probable when we recollect that the correlations should be reduced in proportion to the difficulty with which a differential diagnosis can be made between two diseases - the easier to mistake one disease for another, the more should the true value of the correlation be lowered. The conclusions which one would draw from these results as to the relative difficulty with which a differential diagnosis can be made at the outset of an infection in the case of the three diseases under consideration here, namely that scarlet fever and diphtheria are more easily confused, or that with respect to clinical signs and symptoms

they more closely resemble one another in the early stages, agrees well with what is common clinical knowledge. Scarlet fever and erysipelas show some evidence of their being confused, and diphtheria and erysipelas apparently not at all. Apart from the question of differential diagnosis, however, the values of the correlations are of such an order of magnitud that there is little doubt but that the disease may be regarded in the light of a fairly reliable control.

The following are the results deduced for the correlations between diphtheria notification rates and the mortality and incidence rates of puerperal fever.

Table 32. Showing the Correlations between Diphtheria Notification Rates, and

(a) Puerperal Fever Notification Rates.

	London	County Boroughs	Administrative Counties
1911-13	-.0916±.126	-.1525±.076	-.1046±.102
1921-23	-.1275±.125	.2140±.071	.4054±.086
(b) Puerperal Fever Death Rates.			
1911-13	-.0925±.126	-.1564±.076	.2008±.099
1921-23	-.4767±.099	.0071±.074	.3464±.091

Comparing these results with those already found for scarlet fever and erysipelas, it will be seen that there is a striking similarity between the two series. The significantly positive correlations found between puerperal infection and streptococcal diseases in administrative counties are balanced by equally high coefficients with diphtheritic infections. Consequently it may be safely taken that the incidence of puerperal septicaemia is not to be explained even in part on the assumption of a greater or less prevalence of streptococcal epidemic diseases, and that in those districts in which there is apparently some evidence of association, the foregoing analysis shows that it is an indirect relationship due to the prevalence of some other

factor which is favourable to the incidence of both types of infection.

Summary and Conclusions.

Although the proximity of patients suffering from certain streptococcal infections to lying-in women in all probability increases the liability of these mothers to develop puerperal sepsis, there is no evidence that variations in the prevalence of these diseases are of any importance in leading to variations in the incidence of puerperal septicaemia. In those groups of districts in which there is some evidence of the incidence of these diseases being correlated, it has been shown that the association is most probably due, not to the varying local prevalence of similar types of organisms, but to some other condition favouring the incidence of infections of both streptococcal and non-streptococcal origin.

Part V. INFANT MORTALITY.

Schemes for maternal and infant welfare are so intimately connected that some short consideration of the mortality among infants remains to be made. There is no need to emphasise the importance of this part of the study, in view of the fact that mortality rate of infants is considerably higher than at any other period of life prior to that at which we can hope for little more reduction.

Since the beginning of the present century the risk to infants has diminished considerably. Previous to that, the death rates at later ages had already been falling, but the fate of infants and young children had failed to follow the same course. In 1901, a fairly abrupt change occurred, and since then infant mortality has steadily declined, the rate of decline having shown no tendency to decrease, apart from minor annual fluctuations, until the last few years.

If the death rate under one year be further sub-divided, it is found that the mortality experienced in the first days of extra-uterine existance is far greater than at any other period, and from that point rapidly declines, the death rate in the last three months of the first year of life being only about 3% of that experienced in the first week, when reckoned per unit of time.

A closer inspection of the trend of mortality at various ages under one year shows that all ages have not shared in this amelioration to the same extent. Each age period has been affected in varying degrees. The following figures show that, as a general rule, the nearer to birth the less has the mortality rate been affected.

Table 33. Showing the Distribution in Age Periods of the Infant Mortality Rates per 1000 Births.

	Under 1 month	1-3 months	0-3 months	3-6 months	6-12 months	Under 1 year
1901-05	-	-	70	28	40	138
1906-10	40	23	63	22	32	117
1911-15	39	20	59	20	31	110
1916-20	37	17	54	14	22	90
1921925	33	13	46	12	18	76

Under one month the rate of mortality between the quinquennia 1906-10 and 1921-23 declined 17½ per cent, at one to three months 43½ per cent, all under three months 36 per cent, three to six months 57 per cent, and six to twelve months 55 per cent.

The time of the appearance of this general change, however, was approximately the same in each of the separate age groups under one year, the death rates having risen to a maximum in the quinquennium 1896-1900.

As a consequence of this differential decline, the proportion of deaths which occur at those ages has changed significantly, the deaths at, and shortly after birth now forming a more important contribution to the total death roll.

These differences in the behaviour of the death rates at various ages under one year suggest that at each of these ages, the several factors in the production of infant mortality differ in their importance at each of these age groups. This we already know from general medical knowledge to be probably true. In early infancy, the effects of pre-natal influences will scarcely have worn off, but the more distant from birth, the less important are such factors likely to become. The effects of variations in obstetrical assistance (using the term in its widest sense) are also likely to be most clearly reflected on the mortality at and immediately succeeding birth. Maternal and environmental influences would appear to become of more and more importance as infancy advances.

It seems fairly obvious, therefore that the death rate of infants under one year cannot be taken as a compact group and satisfactorily investigated as such. In infant life, at least four broad stages can be recognised, which are perfectly definite in character although overlapping one another in time to a greater or less degree. First of all is the foetal or parasitic stage, extending from the period of conception until immediately the infant is born. Secondly, and included in the first, are the several stages of labour itself. Thirdly, a period of adjustment to a new mode of life which consists of the first few days or weeks of independent extra-uterine existence, and lastly, there is the remainder of infant life. There can be no doubt that each of these periods represent entirely different phenomena, and the mortality at each of these stages seems to require special investigation.

From the statistical returns of the Registrar-General and the Annual Reports of the Chief Medical Officer of the Ministry of Health, it is fairly easy to obtain a subdivision of the mortality of infants into parts which at least approach the classification suggested. No account can be taken of the loss of possible lives in early foetal life (abortions, etc) but the notifications of still births published in appendices to the Annual Reports of the chief Medical Officer of the Ministry of Health represent, as accurately as can be done at the present time, the deaths of foetuses at any period between the 28th week of intra-uterine life and full time. Although in some parts of the country notifications are somewhat defective, since these are not yet compulsory, the figures given probably represent fairly accurately the distribution of still births throughout the country. The death rate of infants born alive may be subdivided simply into two

categories, (a) the death rate from "congenital debility, malformation and premature birth" (Number 28 of the short list of causes of death given for each separate district in the Reports of the Registrar-General), and (b) the remainder of infant deaths under one year. Group (a) consists of deaths from accidents of birth, prematurity, atalectasis, hydrocephalus and other developmental defects. This, for convenience, will be referred to as the neo-natal death rate. The remainder of infant deaths are mainly the result of gastro-enteric, respiratory and infectious diseases. These will be referred to as the post-natal death rate. Although no separate account can be taken of the deaths during the processes of labour itself, it will be seen that this subdivision into three groups corresponds fairly well to the stages of life suggested. Besides representing to some extent a biological classification, it also represents fairly well a temporal subdivision, since the greater part of the area of the death curve from neo-natal causes is contained in the first month of life, whereas epidemic, respiratory and enteric diseases are not very prevalent at this time.

The Relationship between Infant Mortality and Environment, Maternal Health and the Medical Assistance at Childbirth.

Of the numerous possible factors which may affect infant life at each of these stages, in the present section an attempt has been made to measure three of the presumably chief ones; -

1. The quality of the obstetrical assistance in childbed,
2. The health of the mother, and
3. Social and environmental conditions.

As a rough measure of 1. the total maternal mortality rate in childbearing has been taken; but, since a great part of this death rate is formed by the group of conditions under

the term puerperal sepsis, and since this, as has been shown previously, is not determined to any significant extent by the proximity to medical aid in childbearing, the two sub-groups of the mortality in childbearing, puerperal sepsis and the remainder, have, in addition, been considered separately. As an index of the general level of the health of mothers in any district, the death rate in women aged 15-45 from all causes less those connected with childbearing has been used as the most exact measure which is available from any statistical returns. For social and environmental indices, the proportion of female indoor domestic servants per 1000 of the total population, the proportion of the population living more than two in a room, and the number of rooms per person have been used as general measures of the factors. Still birth returns are not available for Urban and Rural Districts, so that these have only been investigated in the Counties of England and Wales, and separately for County Boroughs. The remaining two groups of infant deaths have been analysed in Counties, County Boroughs, Urban and Rural Districts.

The rates relate to the births and deaths in the triennium 1921-23. The results for counties will be considered first. The mean death rates, their standard deviations and coefficients of variations are given on Table 35.

Table 35. Showing the Means, Standard Deviations and Coefficients of Variation of the three Infant Death Rates.

	Mean	Standard deviation	Coefficient of variation.
Ante-natal Mortality	31.08	6.65	21.41
Neo-natal Mortality	30.54	3.50	11.45
Post-natal Mortality	38.08	10.92	28.67

Calculated per 1000 births, the post-natal death rate of infants is highest, and, both absolutely and relative to

its mean value, the most variable. The average ante-natal death rate is much lower than this, and is also less variable. The neo-natal death rate is lowest of all, not only in its mean value, but also in itw dispersion throughout the country. Bur this comparison of the mean values is obviously unfair. The still birhh rate is calculated on all deaths which occur in the three months before full time, as well as those occurring during labour but before the child is born; the neo-natal death rate is (roughly) confined to the first month after birth, and the remainder of the infant death rate is spread over eleven months of the year; so that if these separate mortality rates be reckoned approximately as death rates per 1000 births per annum, the mortality experienced in the short period succeeding birth is 360 per 1000 births, the ante-natal mortality 124 per 1000, and 40 per 1000 per annum in the remainder of infant life. (These figures are but crude approximations to the truth, as they are based on the false assumptions that the frequency distributions of these deaths at the three periods of life are rectangular and do not overlap one another; but they are sufficient to demonstrate that the force of mortality, the death rate per unit of time, in the period immediately subsequent to birth is about three times as great as that in the three months preceding birth and about nine times as high as that which occurs later in the first year of life.)

The crude correlation coefficients between these three death rates and the factors being considered in relation to them are given on Table 35.

Table 35. Showing the Correlation between each of the Infant Death Rates and Certain Influentail Factors.

	Ante-natal mortality	Neo-natal mortality	Post-natal mortality
Death Rate in Females 15-45	.391±.087	.624±.063	.817±.034
Maternal Mortality Rate	.508±.076	.429±.084	.492±.078
Puerperal Sepsis Death Rate	-.055±.103	.133±.101	.488±.078
Maternal Death Rate less Sepsis	.603±.065	.418±.085	.310±.093
% Living more than 2 per room	-.004±.103	.440±.083	.653±.059
Domestic Servants per 1000 Population	-.224±.098	-.654±.059	-.724±.049

From these it will be noted that the health of mothers is most closely related to the post-natal death rate, less so with the neo-natal death rate and least of all with the still birth rate. With each of the death rates, the correlations are certainly significant with regard to the probable errors involved.

The total mortality rate of women in childbearing, curiously enough, shows but little difference in its relationship with the three groups of infantile deaths, a result which, if the maternal mortality rates were an exact index of the state of obstetrical supervision, would immediately lead to the suspicion that an indirect association due to some other factor had produced the result. But if the mortality due to puerperal sepsis be excluded, the remainder of the death rates of women in childbearing becomes less associated with the death rates of infants as age advances. In all instances, the coefficients are significant, but the relationship with still births is highest and that with the post-natal death rate lowest. Comparing the coefficients with those for health of the mother, the coefficients involving

maternal health are, with still births, lower than for those with the index used for the availability of obstetrical assistance; but in the neo-natal and post-natal death rates, maternal health shows higher correlations than the death rate does of women in childbearing.

With external environmental and social conditions there is no significant relationship with the ante-natal death rate, but fairly high and certainly significant relations with both the neo-natal and post-natal mortalities, the post-natal rate showing a slightly closer association with both indices of environment than ~~was~~ *does* the neo-natal death rate.

Each of the variables we are studying in relation to the mortalities of infancy are, as has been shown previously, interrelated to some exteht, environment and the general health of women fairly closely, maternal mortality significantly with maternal health and only slightly with environment, whereas the real criterion of obstetrical facilities (i.e. deaths in childbearing less puerperal sepsis) is less correlated with maternal health than is the total maternal mortality rate, and not at all with environment.

Accordingly it seems of interest and importance to ascertain the extent to which each of these factors is related to the infant death rates when due allowance has been made for any indirect association which may be introduced by the correlation among the variables themselves; i.e. to calculate the coefficients of partial correlation between each of the infant death rates and any one of these factors for constant values of the remaining two. In deducing the partial correlations, the number of domestic servants per 1000 population has been taken as the measure of environment. The results are given on Table 36.

Table 36. Showing the Coefficients of Partial Correlation.*

$r_{14.59} = .195 \pm .099$	$r_{24.59} = .159 \pm .100$	$r_{34.59} = .524 \pm .075$
$r_{15.49} = .404 \pm .086$	$r_{25.49} = .309 \pm .093$	$r_{35.49} = .348 \pm .090$
$r_{19.45} = .050 \pm .103$	$r_{29.45} = -.417 \pm .085$	$r_{39.45} = -.378 \pm .088$

These coefficients suffice to show that the important factor in determining still birth mortality is the quality of obstetrical aid in childbirth. Maternal health shows a slight but insignificant positive relationship, and environment none at all.

The neo-natal death rate shows about equal relationship with environment and the maternal mortality rates in childbearing; but the health of the mother is not significantly related to the mortality rate at this period of infant life.

The post-natal death rate is most closely connected with variations in the health of women and somewhat less so with both environment and the total maternal mortality rate in childbed. It will also be noted that the partial correlation between the post-natal death rate and maternal mortality rate for constant values of environment and maternal health is of the same order of magnitude as that found for both the neo-natal and the still birth rate. That there should be such a high residual correlation with the mortality of women in childbearing and the infant death rate at this stage of life is certainly contrary to what would have been predicted. We should expect that the effects on the mortality of infants of the quality of midwifery should decrease as the age of the infant increases; but from the results it would appear that this is not so. There are two possibilities, however, which must be borne in mind in this connection,

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* The subscripts are ;-
1. = Ante-natal mortality
2. = Neo-natal mortality
3. = Post-natal mortality
4. = Death Rate Females 15-45
5. = Maternal Mortality Rate
8. = Domestic Servants per 1000 Population

(1) In places where many women lose their lives in childbed, many more are rendered invalids for a time from the effects of causes which they managed to survive, but which killed others, and because of this many infants must be left without proper maternal care. (2) The total death rate of women in pregnancy and parturition is being used here as a measure of the quality of the assistance provided for the mother during pregnancy and in labour; but, as has already been pointed out, it is only a rough measure of this factor, and we must not overlook the fact that it may equally well serve as a measure of some other factor which is associated not only with deaths of women in childbed, but also with some causes of infant deaths. For instance in the present case, it might be suggested that some infant deaths late in the first year of life may be dependent on the proximity to competent medical assistance. Cases such as these can easily be adduced. So that here it is quite possible that the correlation may simply demonstrate a relationship between deaths which are preventable by timely medical intervention. But, before considering either of these possibilities, it seemed advisable to enquire if similar results would be produced by taking the mortality rates in childbed from causes other than puerperal sepsis as indicative of variations in the obstetrical facilities. Consequently the partial correlations have been recalculated using this variable instead of the total maternal mortality rate, and these are given on Table 37.

Table 37. Showing coefficients of partial correlation.*

$r_{14.79} = .172 \pm .099$	$r_{24.79} = .135 \pm .101$	$r_{34.79} = .552 \pm .071$
$r_{17.49} = .546 \pm .072$	$r_{27.49} = .424 \pm .084$	$r_{37.49} = .194 \pm .099$
$r_{19.47} = -.021 \pm .103$	$r_{29.47} = -.468 \pm .080$	$r_{39.47} = -.356 \pm .090$

*The subscripts are ;-

1 = Ante-natal mortality
2 = Neo-natal mortality
3 = Post-natal mortality
4 = Death Rate Females 15-45
7 = Death Rate from Causes in Childbearing less Puerperal Sepsis
9 = Domestic Servants per 1000 Population

From these it will be seen that the coefficients involving this portion of the maternal deathsrate are now higher in both the ante-natal and neo-natal mortalities, but with the post-natal mortality the correlation has now no statistical significance. It may be concluded, then, that the provision of assistance to pregnant and parturient women is in counties reflected on the still birth rate and slightly less so on the neo-natal mortality rate, and that after approximately the first month of life, the effects of this factor cease to show any significant relationship with the death rates of infants.

Among infants born alive, it is to be noted that environment plays a greater part early in life than does the health of the mother, which at this period of infancy is apparently of no great importance, whereas after the neo-natal stage of life has been passed, the health of the mother would appear to take slight precedence over environmental influences.

Finally it remains to be determined what is the sum total effect of these three variables on the death rates at each of these three periods of infant life. Adopting Yule's (1922) notation, the multiple correlation coefficients between each of the infant death rates and these three factors have been calculated and are given on Table 38.

Table 38. Showing the Coefficients of Multiple Correlation.

$R_{1.459} = .403 \pm .086$
$R_{2.459} = .556 \pm .071$
$R_{3.459} = .698 \pm .053$

The coefficient is smallest for the still birth rate, slightly greater for the neo-natal death rate and greatest for the post-natal death rate. A similar result is obtained if, instead of using the total maternal mortality rate, we use the death rates from all childbed causes less puerperal

sepsis. These are given on Table 38.

Showing the Coefficients of Multiple Correlation.

$R_{1.479} = .483 \pm .079$
$R_{2.479} = .585 \pm .068$
$R_{3.479} = .681 \pm .055$

An insignificant increase results in the total coefficients for the still birth and neo-natal mortality, and an equally insignificant decrease with the post-natal death rate.

Assuming that variations in each of these three variables are capable of being to a great extent eliminated, in the case of environment by suitable administrative measures and in the remaining two, the health of the mother and the quality of assistance provided for the mother at the birth of the child, by organised medical efforts of control, these results show that least of all can be hoped for from these factors in the case of still births, somewhat more with neo-natal deaths and most of all with the post-natal death rate. Although this is by no means a complete catalogue of all the conditions influencing infant life, and although the variables used here are, at their best, but imperfect measures of the factors we wish to investigate, these results fully demonstrate that there is still a problem to be solved. By eliminating fluctuations in all of these three factors, the variations in the mortalities of infancy can only be reduced in the case of still births by 12%, neo-natal deaths 19% and post natal deaths 27%. So that even if this could be effected there still would remain appreciable differences in the rates of mortality in different parts of the country and which are presumably determined by measurable causes.

Since data similar in all respects to those already examined for counties are available for the separate County Boroughs of England and Wales, the whole series of constants have been recalculated for these districts in 1921-23 for

purposes of comparison.

The mean death rates at each of the three periods of infant life and the variability in the distributions throughout the country are given on Table 39.

Showing the Mean, Standard Deviations and Coefficients of Variation of the Three Infant Death Rates in County Boroughs.

	Mean	Standard Deviation	Coefficient of Variation
Ante-natal mortality	35.18	9.75	27.70
Neo-natal mortality	33.27	5.53	16.62
Post-natal mortality	49.52	13.19	26.63

Comparing these figures with those for counties, it will be noted that all the death rates are higher in large towns than in the country generally, but that the difference is greatest in the case of the post-natal death rate. In County Boroughs the death rate at this period is 30% higher than in counties, whereas the still birth rate is only 13% and the neo-natal mortality only 9% higher than in counties. Evidently, then, the conditions in urban communities prejudicial to infant life are reflected most clearly on the post-natal death rate, less so on the ante-natal, and least of all on the neo-natal death rate.

With regard to variability in the rates of mortality, in County Boroughs the coefficients of variation of the ante-natal and post-natal death rates are equal in magnitude, whereas in counties the post-natal death rate showed a slightly greater dispersion than the still birth rate. The neo-natal rate is only slightly more variable, both absolutely and relative to its mean value, in County Boroughs than in Counties.

The crude correlation coefficients between the three divisions of the infant death rate and the variables already referred to are given on Table 39.

Table 39. Showing the Correlations between Each of the Infant Death Rates and Certain Influential Factors in County Boroughs.

	Ante-natal mortality	Neo-natal mortality	Post-natal mortality
Death Rate in Females 15-45	.241±.070	.418±.061	.707±.037
Maternal Mortality Rate	.383±.064	.339±.066	.183±.072
Puerperal Sepsis Death Rate	.280±.069	.189±.072	.153±.073
Maternal Death Rate less Sepsis	.319±.067	.244±.070	.109±.074
Rooms per person	-.319±.074	-.612±.047	-.971±.003
Domestic Servants per 1000 Population	-.171±.072	-.437±.060	-.658±.042

These results compare very well with those already found for counties, and, although in most cases the coefficients seem smaller, none of the observed differences are of any statistical significance.

Using the same notation as before, the partial correlations are given on Table 40.

Showing the Coefficients of Partial Correlations in County Boroughs.*

$r_{14.59}$ = .136±.073	$r_{24.59}$ = .173±.072	$r_{34.59}$ = .491±.057
$r_{15.49}$ = .359±.065	$r_{25.49}$ = .312±.067	$r_{35.49}$ = .106±.074
$r_{19.45}$ =-.030±.074	$r_{29.45}$ =-.261±.069	$r_{39.45}$ =-.393±.063

Here again in all essential respects the series of coefficients agree with the previous series.

The total correlations are also of the same order of magnitude as those found for counties. These are given on Table 41.

Showing the Coefficients of Multiple Correlation.

$R_{1.459}$ = .308±.067
$R_{2.459}$ = .405±.062
$R_{3.459}$ = .594±.048

* The subscripts have the same meaning as in Counties.

Consequently it may be said that these findings give some support to the conclusions already reached.

In Urban and Rural Districts, returns of still births are not available, but the constants have been calculated for the neo-natal and post-natal death rates.

Table 42. Showing the Means, Standard Deviations and Coefficients of Variation of the Infant Death Rates in

(a) Urban Districts.	Mean	Standard deviation	Coefficient of variation
Neo-natal mortality	30.81	4.27	13.84
Post-natal mortality	38.08	10.18	26.75
(b) Rural Districts.			
Neo-natal mortality	29.33	4.02	13.71
Post-natal mortality	31.67	9.42	29.74

As will be seen from Table 42, the rates of mortality in both period of infant life are higher in Urban that in Rural Districts, but that each of the death rates of these two aggregates of districts is lower than in County Boroughs. Here again, however, it will be seen that the post-natal death rate is much more different in town and country than is the neo-natal death rate. Comparing County Boroughs and Rural Districts, the neo-natal rate is 13% higher, but the post-natal death rate 56% higher in County Boroughs than in Rural Districts. Similarly the aggregate of Urban Districts shows a neo-natal death rate 5%, and a post-natal rate 20% higher than in Rural Districts.

The coefficients of variation of the neo-natal mortality rates tend to be slightly greater in towns than in rural districts, whereas the variability in the post-natal death rate tends to diminish in passing from rural districts to large towns.

The coefficientw of correlation are given on Table 43.

	Urban Districts		Rural Districts	
	Neo-natal mortality	Post-natal mortality	Neo-natal mortality	Post-natal mortality
Death Rate in Females 15-45	.566±.070	.772±.042	.423±.084	.587±.067
Maternal Mortality Rate	.308±.093	.341±.091	.383±.088	.528±.074
Puerperal Sepsis Death Rate	.043±.103	.151±.100	.180±.100	.372±.089
Maternal death Rate less Sepsis	.440±.083	.377±.088	.381±.088	.436±.083
Rooms per person	-.529±.074	-.775±.042	-.516±.075	-.629±.062
Domestic Servants per 1000 population	-.576±.069	-.648±.060	-.497±.077	-.629±.062

From these it appears that there are no great differences from the results already found.

But the coefficients of partial correlation (Table 44) show some distinct differences.

Showing the Coefficients of Partial Correlation.

(a) Urban Districts.	
$r_{24.59}$ = .229±.097	$r_{34.59}$ = .552±.071
$r_{25.49}$ = .142±.101	$r_{35.49}$ = .084±.102
$r_{29.45}$ =-.323±.092	$r_{39.45}$ =-.260±.096
(b) Rural Districts.	
$r_{24.59}$ = .077±.102	$r_{34.59}$ = .198±.099
$r_{25.49}$ = .273±.095	$r_{35.49}$ = .437±.083
$r_{29.45}$ =-.341±.091	$r_{39.45}$ =-.454±.082

Considering first the neo-natal death rates. In both Urban and Rural Districts there is a positive and significant correlation with the index of environment, and these are of the same order of magnitude as already found both for counties and County Boroughs. Also in both aggregates of districts health of the mother shows no significant relationship with the death rate at this period of life. With the total maternal mortality rate, however, the coefficient for Rural

Districts is barely significant, but that for Urban Districts, although positive, is, with regard to its probable error, quite insignificant. These results, therefore, contrast with the previous findings.

With the post-natal death rates, differences are also noticeable. In Urban Districts all the coefficients agree with what has already been found. The index of maternal health shows the highest correlation, environment a smaller but apparently significant correlation, and the mortality rate of women in childbed, no relationship. In Rural District on the other hand, environment would seem to play a larger part than the health of the mother, which shows a positive but statistically insignificant correlation, whereas a definitely significant positive correlation is found with the maternal mortality rate in childbearing. A result similar to this was found for counties, but when, instead of the total maternal mortality, the death rate from causes in childbed other than puerperal sepsis was taken as the index of medical care of women in pregnancy and at childbirth, the final correlation became insignificant. Consequently all the partial correlations have been recalculated in County Boroughs, Urban and Rural Districts. These are given on Table 45.

Showing the Coefficients of Partial Correlation.

	County Boroughs	Urban Districts	Rural Districts.
$r_{24.79}$	.191±.072	.180±.100	.083±.102
$r_{27.49}$	.221±.071	.378±.088	.285±.095
$r_{29.47}$	-.252±.070	-.366±.089	-.342±.091
$r_{34.79}$	.498±.056	.540±.073	.236±.089
$r_{37.49}$	.036±.074	.241±.097	.324±.092
$r_{39.47}$	-.391±.063	-.282±.095	-.436±.083

In County Boroughs, it will be seen that no difference is made in any of the coefficients by substituting this second index of medical care. In Urban Districts, the neo-natal death rate now shows a significant positive correlation with this index, and the remaining two factors, environment and health of the mother, show no significant changes in their relationships. With the post-natal death rate, the correlation with this second index of the quality of obstetrical supervision is greater than that found by using the total maternal mortality rate, although it still does not attain to the required standard of significance.

In Rural Districts the neo-natal death rate shows no substantial differences from the results already found; but the post-natal death rate shows some slight change. The correlation with maternal health has been raised, but not to any significant degree; that with environment remains unchanged; but the association with the death rate of females from childbed causes other than sepsis, although somewhat lower than that which was found with the total maternal mortality rate, is still quite significant with regard to its probable error. Comparing the correlations with this factor in the three aggregates of districts, there seems to be a definite tendency for its value to increase as we pass from highly urbanised communities to scattered rural districts. A series of results such as this would, therefore, lead to the suspicion that this index of the medical supervision of pregnant and parturient women was also indicative of some other factor influential in infant life. It has been suggested previously that, as this death rate is dependent on the proximity to medical care, a relationship

such as this might arise where, in any group of districts, a part of the death rates depended on the rapidity with which competent medical skill could be summoned. The trend of this series of coefficients seems to be sufficiently definite to justify the assumption that some such explanation may suffice. If it be true, then it leads to the conclusion that in rural communities there is some portion of the post-natal death rate of infancy, due presumably to acute conditions, which could be prevented by the timely arrival of medical assistance, and that deaths such as these form an insignificant part of the death rates in urban communities.

The coefficients of multiple correlation for the two death rates, neo-natal and post-natal, in Urban and Rural Districts are given on Table 46.

Showing the Coefficients of Multiple Correlation.

	Urban	Rural
$R_{2.459}$	.632±.062	.568±.070
$R_{3.459}$	.790±.039	.749±.045

These agree very well both with one another and with those already found in counties and County Boroughs, the coefficients being in both instances higher for the post-natal than for the neo-natal mortality rates.

These results for widely different parts of the country are so generally consistent one with another, both with regard to sign and magnitude, that the inferences to be drawn from them may be stated with a reasonable degree of assurance.

The ante-natal death rate is definitely associated with the rates of mortality of mothers from causes of death peculiar to childbearing. A reservation must, however, be made in that the main cause of maternal death, puerperal sepsis, has no significant relationship with the death rate at this period of infant life. The size of the correlation

between the two rates of mortality is, however, not of the order of magnitude which would lead to the belief that this was the only factor of importance in determining the height of the still birth rate. Although the results seem to justify the hope that increased attention to mothers during pregnancy and both at and after labour will be the means of reducing some causes of death of infants in ante-natal life, the actual saving of infant life at this stage will, in proportion to the total, not be very great.

Further, so far as our data can be trusted, the health of the mother and differences in environment or social status do not, when allowance has been made for variations in the childbearing mortality rates, appear to have any influence on the still birth rate. Although there is a significant correlation with maternal health, the partial correlation coefficients show that this is a secondary association due to the fact that both the ante-natal death rate and the general mortality of women of reproductive ages are related to the mortality rates of mothers in childbearing. These results are in accord with the findings of Bruce Murray (1924). The comparison of the weights and lengths of the offspring of primiparous women in the pre-war, war and post-war periods made by this author shows that the health and nutrition of the mother during pregnancy has no effect on the state of the nutrition of the infant at birth, and that "the foetus lives, like a true parasite, regardless of the expense to the mother." It seems not unreasonable to conclude, then that external factors acting on the mother do not affect the infant's chance of survival prior to birth.

The coefficients of multiple correlation show that the sum total effect of these three factors on the ante-natal

death rate is not very large, and leads to the conclusion that a large part of this death rate would still remain, even if it were possible to remove the conditions which these indices measure, and which are prejudicial to the survival of the foetus.

The neo-natal death rate is also significantly associated with the death rates of mothers in childbearing, so that it seems justifiable to infer that some part of this early mortality is within the scope of an energetic medical service. Further, our results show that at this stage of life, changes in environment seem to be factors of importance in determining the height of the mortality rate. This finding would appear to be contrary to accepted opinion. Brend (1913), comparing the average death rates from neo-natal causes in various groups of social class, concludes that "the great bulk of these deaths are due to some obscure internal derangement of normal processes in the mother or infant which are either independent of external environment or are due to some factor or factors in the external environment equally common among all classes under all circumstances." The figures quoted by Brend do, however, show a rise in the neo-natal mortality rates with descent in the social scale although the differences are not very great. But, as the present analysis shows, the variations exhibited in the mortality at this period of life are not nearly so wide as those shown by the post-natal death rate. Consequently, provided the correlations with social status were equal, a simple comparison of the mean value in different groups of social classes will not show such striking differences with the neo-natal as with the post-natal mortality rates. Our results show that, in spite of the low variability in the neo-natal mortality, these small variations

are almost as intimately connected with changes in the external environment as are the wider variations in the post-natal death rates. The only difference between the two is that for equal changes in environment the neo-natal death rate will not show a reaction as extensive as will the post-natal death rate. That is, although the correlations are almost equal, the coefficient of regression on environment of the neo-natal rate is lower than that of the post-natal rate. That a relation such as this should exist so early in infancy is by no means absurd. Even if it be true that at birth infants of all social classes are equally likely to survive if they could be placed under similar circumstances after birth, it must be remembered that the infant has suffered a sudden and complete change in its mode of existence. In utero, all the functions characteristic of extra-uterine life had been performed for it by the mother. Its food is pre-digested and conveyed to the foetus in a form immediately available for assimilation, and aeration of its blood and the excretory processes are also carried out by the placental circulation and not by the foetal organs themselves. But examination of the ammiotic fluid has revealed traces of foetal urinary constituents, and in obstructed delivery meconium may be passed from the foetal bowel, so that in all probability at term, foetal development has reached a stage when its organs are capable of performing the functions required in after-life. A comparison of the extra and intra-uterine environments, however, shows that immediately after birth a sudden difference occurs. In utero, the foetus lies bathed in a fluid of almost uniform (body) temperature, whereas at birth

it is expelled into a much colder athosphere. And it is obvious that the heat-regulating mechanism can have had no previous trial of its efficiency, as seems to be possible with the heart, kidneys and bowel. Thus it does not seem unreasonable to suppose that one of the important factors at this stage of life is the adequate conservation of the body heat of the new-born child. In this connection, some results recorded by Louise McIlroy (1925) are of extreme interest and importance. A series of babies at birth were cleaned with olive oil instead of by bathing, and it was found that these lost less weight after birth than did the infants who were bathed in the ordinary manner. Even better results were found when, in addition to being oiled, the infant was transferred to a cot with warm blankets and hot water bottles. These results show that the loss of heat is an important consideration to the infant at birth. Thus it does not seem improbable that as our results show, differences in the environment into which an infant is born may be of no small importance.

The health and nutrition of the mother do not seem to be factors of any serious consideration in determining the fate of the infant in this early stage of life.

The coefficients of multiple correlation show that, together, these three factors can only account for 19% of the variability in the neo-natal rates of mortality. Here again we must recognise the existence of other factors than these determining the chance of survival.

The causes of death in post-natal life seem to be those which are most amenable to control by administrative measures or organised medical effort.

At this stage, the health of the mother takes precedence over environment, whereas the effects of the obstetrical aid afforded to the mothers in childbearing have by this time

worn off. It has also been suggested from a comparison of the results found for large cities and scattered rural communities, that in the latter there is a portion of the post-natal death rate, and this most probably due to urgent conditions, which could be removed if medical assistance were more readily available.

2. The Relation of Breast Feeding to the Mortality of Infancy.

As has been remarked previously, it is impossible to take into account the effect of more specific factors on the life of the infant. The required data are not available for such a study. Since there is no statistical material with regard to the prevalence of breast feeding of infants, an indirect process of reasoning may be adopted to attempt an estimate of the effects of this factor on the mortality in infancy. For this reason, too much reliance cannot be placed on the results, and these must always remain subsidiary in value to the conclusions reached by means of a direct and properly controlled investigation.

The greatest value of breast, as opposed to artificial feeding on the mortalities of infancy is supposed to be manifested in the death rate from infantile diarhoea and other enteric disturbances. If we contrast the distribution of the deaths from this cause with that of the length of time for which breast feeding is carried on, we find that deaths from diarrhoea reach a maximum value at the fourth month of life, whereas the length of breast feeding, judging from the results of investigation in three great towns in Scotland, (Noel Paton, 1926) has a bi-modal distribution with peaks at the end of the first and between the sixth and ninth months Thus there is an entire lack of correspondence between the two

curves, the number of deaths from diarrhoea reaching a maximum at the time when the least proportion of babies is being weaned.

Further, the diarrhoea death rate is not confined to the period during which infants are breast-fed, quite an appreciable number of deaths from enteritis occurring in the second year of life.

Again, it is commonly stated, and is probably true, that breast feeding is much less common in the upper than in the lower social classes. Consequently there should be a lower correlation between indices of environment and the death rate from diarrhoea than with other cause groups of death in infancy. The death rates from diarrhoea, infectious diseases and diseases of the respiratory system have, therefore, been calculated separately for the triennium 1921-23 in the Metropolitan Boroughs of London, and each of these has been correlated with several indices of environment and social status. The results of this are given on Table 47.

Table 47. Showing the Correlations between Indices of Social Status and the Mortality Rates from Diarrhoea, Infectious Diseases and Respiratory Diseases.

	Diarrhoea	Infectious Diseases	Respiratory Diseases
Rooms per Person	-.57±.09	-.69±.07	-.64±.08
% Living more than 2 per Room	.72±.06	.75±.06	.73±.06
Domestic Servants per 100 Families	-.19±.12	-.30±.12	-.33±.11
Crude Death Rate from Tuberculosis	.51±.09	.63±.08	.55±.09

From these coefficients it will be seen that none of these three causesgroups of death can claim precedence over the others in the degree of association with social or economic status. This result, therefore, while in no way depreciating the enormous superiority of breast over artifical methods of feeding, would seem to indicate that the superiority is not the result of the specificity of the

constituents of breast milk as opposed to those in cow's milk or in artificial foods, but simply due to the greater amount of infection - the great drawback to artificial methods of feeding.

3. The Causes of Still Birth.

In this country there is no record of the causes of death among still born infants in official reports. The following table, however, has been prepared from the admirable statistical returns of the Netherlands to show the causes of ante-natal deaths in that country. The figures are given separately for males and females, and the rates of mortality and the percentage frequency of each of the causes of death are given together. The births and deaths on which these rates and frequencies are based relate to the twelve years 1911-22.

Table 48. Showing the Proportional Frequency of, and the Mortality Rate per 10,000 Live Births from Several Causes of Still Birth in the Netherlands 1911-22.

	Mortality		Frequency	
	Male	Female	Male	Female
Syphilis	0.58	0.64	1.44	1.81
Other General Diseases of the Mother.	0.83	0.79	2.05	2.21
Habit Abortion	0.36	0.36	0.89	1.01
Albuminaria	1.42	1.46	3.52	4.08
Traumatism and Prolonged Labour	0.28	0.25	0.70	0.68
Placenta Praevia	2.84	2.50	7.02	7.01
Foetal Deformities	2.48	2.95	6.14	8.27
Premature Birth	7.11	6.04	17.59	16.93
Difficult Labour	4.76	3.32	11.77	9.31
Torsion and Compression of the Umbilical Cord	2.80	2.04	6.92	5.71
Foetal Asphyscia	2.30	1.93	5.69	5.41
Unclassified Causes	1.74	1.52	4.31	4.26
Unknown Causes	12.91	11.90	31.95	33.33
All Causes	40.42	35.70	100.00	100.00

The grave objection which is most obvious in these figures is the large proportion of foetal deaths in which the death is registered from unknown causes. The defect is one which prevents accurate comparison with any figures collected from a more accurate source, such as a hospital, in which the investigator in all probability will combine clinical

examination of the pregnant woman with post-mortem examination of the dead-born foetus. The proportion of deaths from unknown causes in this series is probably the result of the two factors; (1) that many of the women have not been seen by either a doctor or midwife before the infant was born, and (2) that post-mortem examinations are seldom, if ever, carried out in general practice.

If the defect in these figures were solely due to the fact that in all these cases the mother had not been attended until after the child was born, by distributing these deaths from unknown causes to each of the known cause groups according to the proportional frequency of each of these, a fair degree of comparability between these figures and more accurate statistics might be obtained. But since this is not the sole cause of such a proportion of unknown deaths, this procedure must obviously be wholly inaccurate, since this would amount to the assumption that all causes of foetal death were equally easy to diagnose - an extremely improbable assumption. On the other hand, these figures are of some value as a general guide to the most important causes of foetal death in a random sample of the total population. More accurate investigations normally afford a biassed view of the relative importance of certain causes of death, due to selection of material. The type of selection will depend on the source of the data. Hospital statistics would be weighted in favour of foetal deaths from causes which endanger the life of the mother. Consequently these causes which endanger the lives of both mother and foetus in utero will be over-represented as causes of foetal death as compared with the frequency pertaining to the general population; whereas foetal deaths due to conditions proper to the foetus, which cause neither disease in the mother, nor difficulties in delivery from disproportion between the presenting part and the maternal pelvis, will be under-

represented. That this is the case can be shown by a comparison of the proportion of foetal deaths from a complication such as torsion of, or pressure on the umbilical cord. This condition will cause no difficulty to the mother, and consequently should be under-represented in a hospital population of still births. In a recent report by Holland and Lane-Claypon (1926), in 41 out of 1673 dead-born infants, the death was due primarily to this complication. In the figures quoted here for the Netherlands, 5219 of the total 81773 still births were due to the same cause. In the former case the proportion, therefore, is 2.45%, in the latter 6.38%. that is more than double the proportion from this cause are found in the general population as compared with a selected hospital population. The group comprising foetal deformities does not offer the same grounds for comparison, because, although many of these are due to hydrocephalus and the obstruction resulting from the excessive size of the head in many instances causes interference with labour, other deformities, such as congenital cardiac malformations, will cause no obstruction to delivery; so that congenital malformations will only be included under causes of foetal death which also endanger the life of the mother provided that an excessive proportion of deformities are those causing obstruction to delivery. Actually in the Netherlands statistics, the proportion due to foetal deformities is 7.08% whereas in the report by Holland and Lane-Claypon 8.25% of the total still births were from this cause.

The total still births rate in the Netherlands for these 12 years (irrespective of sex) is 3.90 per 1000 live births, as compared with the rate for England and Wales (in the ante-natal loss of life in these two countries. (of 3·11 per 1000 births. Thus there is no great difference

The death rate of males from all causes is 13% greater than that of females.

For individual cause groups, the greatest proportional excess in the male death rate is in the group "difficult labour", and this followed closely by the death rate from pressure on or torsion of the umbilical cord. The former group shows a death rate 43% higher in males than in females, the latter 37% excess in males. These figures would appear to give support to the view that the greater size of the male head is probably a cause of some greater difficulty in labour than there is with a female birth. The other group of causes of death in which such a factor might be revealed is the relatively unimportant cause, "traumatism and prolonged labour" in which, however, the male death rate is only 12% in excess of the female. The sole cause of death in which females have a fairly large excess death rate is from foetal deformities, in which the male death rate is 16% lower than the female. The doubtful figures for deaths from syphilis give a rate 9% lower in males than in females; but, as in this country, probably little reliance can be placed on these figures.

With regard to the relative importance of the causes of death, leaving out of consideration the deaths from unknown causes, premature birth claims the greatest number of the deaths both in males and females. Difficult labour is the second chief cause of death, and is followed closely by placenta praevia, and foetal deformities. Torsion and compression of the cord accounts for 6.4% of deaths, and albuminuria for only 2.1%.

It will then be seen that many of the causes of foetal deaths are also important causes of maternal deaths, and gives reason for the belief that the further extension of care to pregnant women will result in benefit for both the mother

and child. But if, as seems probable, the majority of the group of unknown causes are not associated with maternal distress (if so they would be included under difficult labour or some similar category), and noting the large proportion of deaths from premature birth and foetal deformities, the latter being outwith human control, it would appear that even with the best obstetrical services in the world, a high ante-natal loss of life will always remain. Hospital statistics in this connection are apt to produce a too optimistic outlook, since, as has been shown, these contain an undue proportion of foetal deaths from causes in which obstetrical supervision would benefit both mother and child. This results from the selected population studied. But the figures given here afford reason for some scepticism as to the advantages to the foetus of increasing attention to the mother.

4. Visceral Variability in Foetal and Infant Life.

In most statistical investigations of the mortalities in infancy, probably more consideration is given to the effects of external factors acting on the infant than to the changes which take place in the infant itself as growth proceeds. Brownlee (1917), from a study of the mortality rates at ages from various causes of deaths in infancy and childhood, has shown that these obey certain definite laws, and his results serve to emphasise the importance of further exploration of the changes in the physiological processes of the developing child.

The biometric constants relating to man have in the past been practically always confined to the adult period of life. Visceral and skeletal measurements and interrelationships at this period are fairly well known; but until recent years little

interest seems to have been taken in the foetal and early infant stages of life. Signs are not wanting, however, that the defect is being appreciated. Holland (1922), in a part of his investigation into the causes of foetal death, published data with regard to the organ weights of five viscera, in addition to body weight and length and placental weight in a series of dead-born infants collected from several lying-in hospitals. The total series of 300 foetuses are divided into three sets (1) foetuses examined in the fresh state, (2) those born macerated, and (3) a small group of syphilitic foetuses. Since the autolytic processes associated with maceration affect the organ weights to varying degrees, depending for the most part on the enzyme content of the organ, and since such data can throw no light on the anatomical differences in health and disease, the short series of foetuses born and examined in the fresh state are only considered here.

1. Visceral Variability in Foetal Life.

A difficulty which confronts any investigation of this kind is that analysis can only be carried out on the statistics of dead infants, so that it is essential that the statistical constants be compared with some control series. Since we obviously cannot know what is the degree of variation in the viscera of living healthy foetuses and infants, an attempt must be made to obtain the closest approximation to this. From the already short series of 149 fresh foetuses, 71 of these, in which the cause of death was prolonged labour, instrumental delivery or torsion of or pressure on the cord, have been extracted as a presumably normal series. This selection is, of course, open to the objection that most of these causes of death are probably associated with some pelvic deformity of the mother causing dystocia, so that the selection may be one of a series of foetuses from mothers

whose general health is below the average. But it is the nearest approach to normality which can be extracted from the data, and, if our previous results can be trusted, the health of the mother does not appear to be of any significant importance in the life of the infant at this state.

The analysis of these data will be confined to a discussion of (a) the relative variabilities in the foetal organs of the "normal" and total series, (b) a comparison of foetal with adult visceral variability and (c) the differences in the variation of the sexes.

(a) Table 49 contains the coefficients of variation in the two series.

Showing the Coefficients of Variation for certain Bodily characteristics of the Foetus (a) "normal" series, (b) Total Series.

	(a) "Normal"	(b) Total
Body Weight	25.56	31.51
Body Length	9.05	10.67
Thymus	43.79	47.32
Liver	33.59	37.62
Spleen	35.43	56.48
Suprarenals	33.65	41.47
Kidneys	30.24	34.79

In the normal series the thymus is the most variable organ and the kidney the least variable. Body weight and body length show less variation than does any of the viscera.

In the total series, the spleen takes precedence over the Thymus in variability, but the other organ weights show no change in their position relative one to another. Comparing the two series, it will be seen that in every instance, the variation is greater in the total than in the normal series. The excess is more marked with body weight than with body length. Among the viscera, the spleen would appear to be the organ which suffers the greatest change in disease. The suprarenal glands are also greatly affected, and the liver, kidneys and thymus show the smallest changes. There is, however,

an obvious objection to the above comparison. Our normal series consists of foetuses which have survived until full time and consequently are all of approximately the same age, whereas the total series consists of foetuses who have reached a stage of viability but whose ages differ more widely (although not to a very great degree). So that we have been comparing two groups of foetuses in one of which differences in age are so relatively small as to be negligible, whereas in the other, differences in age may be of great importance, since in the few months preceeding full time, the foetus is growing very rapidly. I have therefore proceeded a stage further and calculated the coefficients of variation for constant body weight and length. This will remove as far as possible the limitation in the previous comparison. The new coefficients are collected in Table 50.

Table showing the Visceral Coefficients of Variations for Constant Body Weight and Length.

	(a) "Normal"	(b) Total
Thymus	35.46	40.39
Liver	19.61	20.16
Spleen	28.72	58.88
Suprarenals	29.41	33.62
Kidneys	26.80	26.78

Except in kidney weights, the normal series still show a less degree of variability than does the total series. It will also be seen that the liver is not affected to any significant extent in passing from a normal to a diseased population of foetuses. Further, the spleen still shows the greatest reaction in disease. The two ductless glands, thymus and suprarenals, are affected approximately to the same degree.

(b) The variability in the viscera of foetusus may now be compared with the following table from Pearl (1905), showing the coefficients of variation in the adult "healthy" and "hospital" populations. In all the comparable data, it will be noted that the foetal organs show a much wider range

relatively than do all the organs of healthy adults except the spleen. From this table also we see that, in comparing a healthy and a diseased population, the differences in variability produced by disease in adult life are much greater than are those found in the two foetal series given here.

Table 51. Showing the Coefficients of Variation in "Healthy" and "Hospital" Populations (Adults)

	(a) Healthy	(b) Hospital
Liver	14.80	21.12
Spleen	38.21	50.58
Kidneys	16.80	24.63
Body Weight	10.37	-
Body Length	3.99	-
Heart	17.71	32.39

Since chronic diseases affect the organs to a greater extent than acutely fatal illnesses, we must conclude either that diseases affecting the foetus in utero are rapidly fatal conditions which allow but little time for the production of gross changes in the organs, or that the foetus is already in such an unstable condition physically that any untoward circumstance of however slight a character rapidly upsets the normal processes.

The results of the above comparison, therefore, lead to the conclusions that the foetal viscera are extremely variable both on health and disease; that disease affects the foetal organs to a less extent than does disease in adult life, and that foetal death from disease occurs very rapidly.

(c) The coefficients of variation for the sexes are given on Table 52.

Showing the Coefficients of Variation for the Sexes in the Total Series of Foetuses.

	Male	Female.
Body Weight	34.73	24.38
Body Length	11.50	8.99
Thymus	53.07	41.06
Liver	38.43	31.93
Spleen	63.42	34.89
Suprarenals	40.54	40.35
Kidneys	35.38	33.75

These show that the male foetus in every instance exceeds

the female in variability and, although here again the differences are small, the uniformity in the series is sufficiently striking to warrant the conclusion that the male at this stage of life is really the more variable. Pearson (1897) has shown that in adult life the female is slightly more variable than the male, and this he attributes to a relatively less intense struggle for existence. This explanation is obviously insufficient to account for differences in variability in intra-uterine life. The extremely high variability of both sexes in foetal life, however, can probably be explained on this assumption. Before birth, the foetus is a parasite, not depending on its own organs for carrying out the functions required of them in post-natal life, so that the organism has little need of them at this early stage, and it would appear "that each organ has a life and growth of its own, irrespective of the needs of the organism as a whole." The lack of any struggle for existence, therefore, would appear to be reflected on the physical characters of the foetal viscera.

2. Visceral Variability in Infancy. From data collected by Professor Turnbull in the Pathological Department of the London Hospital, and to which I have been allowed access, a series of coefficients of variation have been calculated for certain organ weights and for body weight and length in the first year of life to show the changes that occur during this period. The data available are insufficient to extract from them a "healthy" series at each of the ages under one year, so that the vast majority of these infants have died from some disease processes. Still the short comparison which it has been possible to make reveals certain points of interest.

The coefficients of variation are given on Table 53.

Table 53. Showing the Coefficients of Variation at Several Age Periods in Infant Life.

(a) Males.	Under 1 week	1 week-1 month	1-3 months	3-6 months	6-9 months	9-12 months
Body Weight	31.34	34.45	30.44	28.79	29.59	27.89
Body Length	9.35	8.10	9.19	8.56	8.62	9.27
Heart	40.35	47.31	40.35	35.58	32.67	32.67
Spleen	70.31	91.21	82.83	63.37	76.89	52.02
Kidneys	40.48	50.86	42.44	36.86	31.91	29.03
Thymus	61.88	74.77	102.51	85.42	98.98	78.79
(b) Females.						
Body Weight	32.93	28.96	26.84	31.90	33.64	25.43
Body Length	9.48	9.36	9.16	9.18	9.56	8.47
Heart	51.90	43.66	46.91	42.21	33.90	31.90
Spleen	52.68	73.79	105.45	76.54	59.99	57.02
Kidneys	52.84	45.49	49.71	42.66	33.97	26.25
Thymus	59.05	74.43	87.43	93.91	85.22	88.01

In nearly every instance the coefficients are lower both in males and females in the first age period (foetuses and deaths under 1 week) than in the immediately subsequent group. The values given for this early age compare reasonably well with the values given already for male and female foetuses. After the first week, the variability shows a general tendency to decline as the infant grows up. Irregularities in some of the age groups are apparent, especially with the thymus and less so with the spleen, but the variability at the end of the first year of life has become less than it was in the first month with the other organs. And further, when it is remembered that the older the infant the greater becomes the chance of death from some chronic condition, and therefore that, other things being equal, the variability should increase with age, it would be even more likely that the decrease represented in these figures is smaller than what actually does occur. With regard to the lower variability in the first week of life as compared with later ages, it is in all probability not a real phenomenon because

all of these deaths are from accidents of birth, and consequently these cases really represent a more or less "healthy" population, so that the series of foetal deaths and deaths under one week are not really comparable with those occurring later in infancy, which are due chiefly to bronchopneumonia or gastro-enteritis.

In this series no constant differences in the sexes can be demonstrated. From the foregoing analysis, then, it may be concluded that the variations in infant viscera tend to become smaller as age advances. Under a given environment, according to Greenwood (1904), high variability is indicative of instability, and he has shown that this is typical of the diseased state in adult life. To this it seems justifiable to add that high variability is also characteristic of certain phases of life, diseased conditions entirely apart. Instability in this sense is apparently present at puberty. It is also a feature in ante-natal life, in which the male is probably more unstable than the female. In infancy, too, instability is evident, and, as the infant continues to grow, part of this wears offgradually.

Summary and Conclusions.

In this section an attempt has been made to determine the relative importance of several factors on the mortality rates of infancy. In view of the differences in the rates at the several ages under one year and of the differential decline in these rates within recent years, it has been suggested that for any complete consideration of the death rates in infancy, some subdivision of the rate, either of a biological or temporal character, must be effected, and each of these subdivisions examined separately. The infant mortality rate has been treated in three broad categories, namely the ante-natal, neo-natal and post-natal death rates; and it has been shown that each of these depends on different factors.

Considered as death rates per unit of time the neo-natal rate is much higher than at any other period of life. The ante-natal death rate is much lower than this, and the post-natal rate lowest of all.

In relation to these rates, the influence of three, presumably important, factors have been measured. These are;-

1. The provision of skilled attendance to mothers in childbed.
2. The health of the mother, and
3. Environmental and social conditions.

The indices used as measures of three variables and their limitations have been pointed out.

Our results show that, of these factors, only the provision of skilled medical assistance to mothers in childbed is of importance in connection with ante-natal mortality. The general health of the mother and external environmental conditions have no direct influence on the death rate at this period of life. The magnitude of the correlation, still leads to the further conclusion that a

great part of the still birth rate is not to be controlled by improvements in even all of these factors.

The neo-natal death rate is related both to variations in external environment and in the obstetrical assistance to mothers in childbed. At this stage of life, again, the health of the mother has no substantial influence on the death rate. External surroundings and the quality of the obstetrical assistance afforded to the mother are of approximately equal importance in determining these rates; but here again the conclusion is advanced that the greater part of the death rate at this stage of life is outwith human efforts of control.

The post-natal death rate seems to offer the greatest scope for administrative proceedures. In this case the health of the mother would appear to come first in order of importance, environment also is of some importance, whereas the effects of variations in obstetrical services have now ceased to be reflected on the mortality of infancy.

In isolated rural communities there is a part of the post-natal death rate which could be eliminated by the speedy arrival of skilled medical assistance.

No data are available to attempt an evaluation of the influence of any specific factors on the rates of mortality; but an indirect process of reasoning has led to the suggestion that the superiority of natural, as opposed to artificial feeding in its effect on the mortalities of infancy is rather due to the increased risks of infection in artificial feeding than to any specificity of the constituents of human milk.

Foreign statistics have been collected and analysed to enquire into the causation of still births. An obvious defect in these was pointed out, namely the large proportion of deaths due to unknown causes. A comparison of these

figures with those collected from several maternity hospitals has shown that hospital figures give a biassed view of the problem. The proportion of deaths due to causes in which the life of the mother as well as that of the foetus is endangered is greatly magnified, and consequently will produce a too optimistic estimate of the amount of amelioration which will result from increased attention to pregnant and parturient women. The statistics which have been given in this section show that in a really random sample of the population only a small proportion of still births are the result of causes which can be controlled by this method, and that the chief cause of ante-natal death are developmental defects of the foetus and prematurity.

A short study has been made of certain statistics - anatomical features of the foetus and infant. From this it has been inferred that the foetus is physically in a state of extreme instability, that the conditions which kill in utero are rapidly fatal to the foetus, and that this instability is a somewhat more prominent feature in the male than in the female. As infancy advances, visceral variability decreases steadily, so that it would seem probable that some time is necessary for the foetus to adapt itself to its new mode of existence after birth. This state of unstable equilibrium in early life may provide some reason for the higher mortalities at these ages.

Part VI. General Conclusions.

Attention has been drawn in the foregoing analysis to the effects on the risks of dying from any cause in childbearin which are produced by changes in the mother herself.

A simple arithmetical process, described in Part I, has sufficed to overcome one of the defects of our national system of birth registration. In this country births are not given according to the age of the mother; but a sufficiently accurate distribution may be effected by the use of foreign fertility rates. A comparison between the results of the two methods of distributing the births has shown that, although illegitimate births found only a small proportion of the total, their proper assignment according to ex-nuptial fertility at ages is a matter of no small importance in assessing the relative risk of death to mother of different ages.

Each of the cause groups of maternal deaths have been shown to bear certain definite relationships with age. The more important causes of death tend to show an excess in the rate in young mothers at the beginning of reproductive life, after which the mortality rate falls to a minimum at ages 20-25, and thereafter gradually increases till the end of the procreative period. In general, the death rate at the end of life is higher than that at the beginning of life. Puerperal convulsions is the only exception to this rule; but it has been shown that, when the death rates at ages from this cause are based on primiparous instead of total births, the distribution according to age is the same as that of the other important causes of death. The remaining and somewhat less important causes of death follow a slightly different course. These tend to increase steadily as age advances, without showing any excess in the first quinquennium.

Several conditions which may have a relation to the

observed age distribution have been discussed; and it has been shown that the excessive ~~changes~~ dangers of primiparious births cannot of itself account for the skewness of the regression on age. The general death rates in women of childbearing ages from causes other than those connected with reproduction were then examined; and it was found that a close parallelism existed between the two rates of mortality. The possibility of an optimum period for reproduction was considered; but the general conclusion reached was that, apart from the excessive dangers of primiparity and the adverse selection which has been shown to exist in the youngest group of married women, the death rates would probably increase steadily with age.

The superiority of age-specific over crude rates of mortality has been amply demonstrated by the fact that a decline of nearly 50% in the puerperal death rate in the age group 15-20 has occurred, and a less important change in the second quinquennium of reproductive life. Both of these changes have been obscured by the use of crude rates of mortality.

Similarly a rate uncorrected for parity has been shown to lead in some instances to pessimistic estimates of the true changes in the death rates. Here it has been shown that the decline in the death rate from eclampsia has been in part obscured because of the decline in the birth rate causing an increased proportion of primiparous births. From foreign statistics, a simple linear relationship has been shown to hold between the height of the birth rate and the proportion of first-born children, and from this regression equation, it has been possible to demonstrate that the true decline in deaths from eclampsia is really about 50% greater than is shown by the use of uncorrected rates of mortality.

These changes in the rates of mortality have been brought into relation with the changes which have occurred in the health of married as compared with that of other women. The younger married women are now a much healthier sample of the general female population of the same ages than they were previously; and the correlation between the two death curves has led to the assumption that part at least of the puerperal mortality is determined by the general health of the parturient. In Part II, an attempt has been made to give a quantitative estimate of the effects of differences in the age and of differences in the health of reproductive females on the death rates in childbearing.

The age of the mother has been shown to have no significant influence on the variations in the maternal mortality rate in the counties of England and Wales. The age distributions of the female populations at childbearing ages are not sufficiently divergent from one another to make any substantial difference in the crude rates of mortality.

The health of the mother, as measured by the death rates in females aged 15-45 from all causes other than those connected with childbearing, does, however, exert a significant influence on the childbearing mortaltiy rates. Certain peculiarities in the regression line have led to the further conclusion that these rates are also substantially affected by the obstetrical services available in any district. By comparing the results found for different parts of the country and in the same districts at different epochs, it has been shown that the relationship between the health of the mother and her chance of dying in childbed can be obscured by the introduction of varying degrees of medical supervision. The further conclusion has, however, been demonstrated, namely that no great advance has been made in the attempts at control of the death rates in maternity within recent years.

The effects of the proximity to skilled obstetrical assistance in childbed have been shown to affect different causes of death to different degrees. By further provision of lying-in hospitals and of other measure of control, deaths from eclampsia and phlegmasia alba dolens should react most favourably, and puerperal sepsis and accidents of pregnancy least of all.

The assumption that the correlation between the maternal mortality rate and the death rate from all other causes was in reality a relation between health of women and the death rates in childbearing has been tested by using another index of health; and the conclusion reached is that the health of the mother is the factor which has been measured.

The division of the causes of death, suggested by an examination of the correlation of each of these with the age of the mother, into (1) causes which depend to some extent on the health of the mother and (2) those which do not so depend, received some support from certain results deduced for the period 1901-03. The value of age-specific death rates has thus been amply demonstrated.

In Part III, the influence of social and environmental factors has been examined, and the results clearly show that, apart from an indirect association between maternal health and social status, there is no association whatever between adverse environmental conditions and a high rate of mortality in childbearing.

In Part IV, the effect on the prevalence of Puerperal sepsis of variations in the prevalence of streptococcal i infections diseases has been examined. The results are sufficiently consistent that the conclusion reached seems strictly justified, namely that, although close contact between a puerperal woman and a patient suffering from certain

infectious diseases probably does increase the chance of the woman developing sepsis in the puerperium, the variations in the prevalence of those infectious diseases is not a factor which determines to any significant degree the variations in the prevalence of puerperal sepsis.

In Part V, is represented an analysis of the mortality of infancy. As has been pointed out, this must be considered in separate stages of life. The conditions influencing the death rates in each of these stages of life which it has been possible to consider are (1) the quality of the obstetrical assistance afforded to the mother, (2) the health of the mother and (3) Social conditions. Of these, only the first seems to have any important influence on the ante-natal mortality rate. Social conditions and the health of the mother are not related to the death rate in intra-uterine life. The further conclusion which can be stated is that the greater part of the death rate at this period is independent of each of these factors.

The neo-natal death rate shows approximately equal relationship with the quality of obstetrical assistance in childbirth and changes in environment. The health of the mother seems to have no significant influence on the mortality at this stage of life. Here again a large part of the death rate is not amenable to control.

In post-natal life, health of the mother takes precedence over environment in its relation to the death rate, and the effects of the medical care at childbirth by this time have now worn off.

The main causes of still births are those in which medical assistance will procure little or no amelioration. The causes which are apparently within the field of administrative control

form but an insignificant portion of the total number of still births. This conclusion is contrary to the conclusions to be drawn from hospital statistics; but it has been shown that these give rise to biassed estimates of the amount of reduction to be hoped for by further provision of obstetrical assistance, because the selection of cases shows a greater proportion of those causes of death in which the life of both mother and infant is endangered than there is in the general population.

Evidence has also been produced to show that both in ante-natal and post-natal life, the infant is physically in a state of unstable equilibrium, and that being in such a state, it will respond more quickly to adverse external influences that will the more stable adult. This instability would appear to wear off gradually as age advances.

The bearing of the results of this study on the further efforts at the conservation of maternal and infant life seems fairly obvious. In any schemes for administrative reform, in which it is impossible to include the whole universe under consideration, it is essential that our efforts should be concentrated on that part of the population in which the risk of death is greatest. It is improbable that, unless some radical change in the present system occur, all women can be afforded propoer medical attention throughout their pregnancy, during labour and in the puerperium. So that the following points must be taken into consideration in medical efforts at prevention;-

1. The relative importance of each cause of death.
2. The degree of success with which medical efforts, either of a prophylactic or curative nature, are attended.
3. The age of the parturient woman.
4. The parity, and if multiparous, her previous obstetrical history.
5. The general health of the woman.
6. The immunity to pyogenic organisms.

For obvious reasons, immunity can only be determined wit h some difficulty, but our results show that this is a factor of some importance in the chief cause of maternal death,

The bearing of each of these factors in determining the rate of mortality have been fully discussed. Of the methods of prevention which are suggested in dealing with childbearing mortality, ante-natal supervision seems to be the most hopeful proceedure. But since at present it is not possible to supervise all pregnant women, our efforts must be concentrated. This study suggests that ante-natal supervision would reap the greatest success with the minimum expenditure of time and money if it were confined mainly to primiparae. The diseases which occur early in pregnancy (abortion, ectopic pregnancy etc.) are apparently very little amenable to control by ante-natal examination, and in any case these form but an insignificant contribution to the total death roll. The greatest benefit from this proceedure is like to be produced in the death rate from eclampsia - the second chief cause of death in child-bearing. The majority of these cases occur in first pregnancies, so that by supervision of primiperae the majority of these deaths could be eliminated. Further, deaths due to accidents at birth, in which osseous defects in the pelvis are the primary causes in many instances, could be reduced, and these women, should another pregnancy supervene, could be instructed to come in future for early medical examination. The majority of the remaining causes of death cannot be foreseen by ante-natal examination, but in all these cases, as the present study shows, special precautions should be taken with older parturients.

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APPENDICES.

Appendix I. Showing the Factors for Correcting for Age in the Maternal Mortality Rates in the Counties of England and Wales 1921-23

London	1.006	Hereford	0.992
Surrey	0.975	Shropshire	0.992
Kent	0.995	Stafford	1.013
Sussex	0.980	Worcester	1.002
Hampshire	0.998	Warwich	1.006
Berkshire	0.986	Lincoln	1.002
Middlesex	0.985	Nottingham	1.007
Hertford	0.981	Derby	1.011
Buckingham	0.985	Cheshire	0.993
Oxford	0.987	Lancashire	0.999
Northampton	0.997	York (W.R.)	1.002
Bedford	0.993	York (E.R.)	1.005
Essex	0.997	York (N.R.)	1.004
Suffolk	0.993	Durham	1.019
Norfolk	0.992	Northumberland	1.002
Wilts	0.991	Cumberland	1.003
Dorset	0.988	Westmorland	0.979
Devon	0.994	Monmouth	1.021
Cornwall	0.995	South Wales	1.002
Somerset	0.988	North Wales	0.983
Gloucester	0.997	Cambridge	0.992
	Leicester 1.001		

Appendix II. Showing (1) the Proportion of In-patients to Total Births, (2) the Mortality from Puerperal Sepsis per 10,000 Births, and (3) the Mortality from Other Accidents and Diseases of Pregnancy and Parturition per 10,000 Births in the Metropolitan Boroughs 1914-16.

	(1)	(2)	(3)
Battersea	6.6	15.1	21.0
Bermondsey	3.7	4.6	19.3
Bethnal Green	5.7	10.2	13.0
Camberwell	3.7	13.8	18.0
Chelsea	15.9	17.0	22.6
Deptford	1.8	15.5	10.0
Finsbury	12.1	16.3	22.2
Fulham	4.9	16.1	18.7
Greenwich	2.8	14.0	12.6
Hackney	4.7	16.3	11.7
Hammersmith	5.3	16.9	16.9
Hampstead	6.4	23.9	29.2
Holborn	25.0	23.9	14.3
Islington	5.9	15.6	13.9
Kensington	11.0	20.3	14.9
Lambeth	11.8	15.4	18.4
Lewisham	2.5	16.0	16.9
Paddington	12.2	22.5	16.6
Poplar	3.9	18.0	13.2
St.Marylebone	30.2	19.0	19.0
St.Pancras	14.6	15.8	15.8
Shoreditch	10.3	13.5	17.7
Southwark	9.3	19.3	15.9
Stepney	10.4	13.1	13.6
Stoke Newington	3.8	10.1	16.8
Wandsworth	3.6	14.1	17.7
Westminster	10.0	21.9	25.2
Woolwich	9.8	16.9	22.9

Appendix III Showing the Rates of Mortality per 100,000 Births in the Counties of England and Wales in 1901-03, from (1) Puerperal Convulsions, (2) Placenta Praevia and Flooding, (3) Other Causes of Death in Childbed and (4) the Death Rate in Females 15-45 from All Causes less those due to Childbearing.

	(1)	(2)	(3)	(4)
London	22.9	39.1	98.3	47.6
Surrey	26.2	56.1	89.8	39.6
Kent	28.9	52.2	118.2	48.4
Sussex	29.4	92.9	115.1	38.9
Hampshire	39.1	45.9	102.1	45.1
Berkshire	48.2	48.2	125.4	44.7
Middlesex	32.7	59.9	80.4	38.9
Hertford	28.4	51.1	102.2	32.6
Buckingham	22.1	80.8	110.2	36.1
Oxford	30.7	76.7	107.4	36.5
Northampton	61.2	72.1	111.7	43.8
Bedford	40.1	32.1	112.2	39.1
Essex	33.1	66.2	82.5	42.8
Suffolk	24.8	74.4	138.1	43.4
Norfolk	35.9	74.6	99.3	41.6
Wiltshire	61.1	122.2	137.6	41.0
Dorset	84.8	49.4	120.1	40.1
Devon	57.8	100.6	119.8	46.1
Cornwall	93.8	98.3	120.6	39.1
Somerset	42.8	70.3	100.8	42.5
Gloucester	37.7	75.4	99.1	42.0
Hereford	25.1	25.1	226.3	42.1
Shropshire	24.3	63.2	136.1	44.6
Stafford	34.9	78.4	110.2	48.9
Worcester	27.9	58.3	121.2	43.2
Warwick	27.4	73.8	101.2	47.9
Lincoln	60.6	95.9	141.4	44.1
Nottingham	25.9	93.4	102.1	55.0
Derby	42.1	77.4	110.6	35.6
Cheshire	39.6	92.9	128.1	45.2
Lancashire	42.6	70.4	135.6	57.8
York (W.R.)	65.8	86.9	143.7	49.0
York (E.R.)	39.2	88.2	129.9	50.0
York (N.R.)	47.7	65.6	154.9	46.9
Durham	54.2	80.9	151.2	57.2
Northumberland	41.7	71.8	166.9	60.9
Cumberland	66.6	71.1	177.7	53.6
Westmorland	0.0	232.7	186.1	38.0
Monmouth	50.1	105.9	153.1	57.1
South Wales	74.6	97.3	188.2	58.8
North Wales	74.6	109.1	202.2	57.4
Cambridge	38.2	60.1	114.6	43.1
Leicester	37.9	65.8	123.9	41.2

Appendix IV. Showing the Rates of Mortality in the Counties of England and Wales in 1901-03 from (1) All Causes less those connected with Childbearing per 10,000 Females 15-45,
(2) All Causes of Death in Childbearing per 10,000 Births,
(3) Puerperal Sepsis per 10,000 Births.
(4) Childbearing Causes other than Sepsis per 10,000 Births.

	(1)	(2)	(3)	(4)
London	47.6	32.3	16.3	16.0
Surrey	39.6	33.8	16.6	17.2
Kent	48.4	36.3	16.4	19.9
Sussex	38.9	39.8	16.1	23.7
Hampshire	45.1	31.4	12.7	18.7
Berkshire	44.7	38.6	16.4	22.2
Middlesex	38.9	31.7	14.4	17.3
Hertford	32.6	34.1	15.9	18.2
Buckingham	36.1	33.1	11.8	21.3
Oxford	36.5	39.8	18.4	21.4
Northampton	43.8	41.3	16.9	24.4
Bedford	39.1	32.8	14.4	18.4
Essex	42.8	33.1	14.9	18.2
Suffolk	43.4	34.3	10.6	23.7
Norfolk	41.6	37.1	15.8	21.3
Wilts	41.0	47.9	15.8	32.1
Dorset	40.1	40.2	14.8	25.4
Devon	46.1	48.4	20.6	27.8
Cornwall	39.1	48.7	17.4	31.3
Somerset	42.5	36.1	14.7	21.4
Gloucester	42.0	39.8	18.6	21.2
Hereford	42.1	41.4	13.7	27.7
Shropshire	44.6	37.4	15.1	22.4
Stafford	48.9	44.3	21.9	22.4
Worcester	43.2	29.1	18.4	20.7
Warwich	47.9	41.9	21.7	20.2
Lincoln	44.1	49.7	19.9	29.8
Nottingham	55.0	46.9	24.7	22.2
Derby	35.6	47.1	24.1	23.0
Cheshire	45.2	50.9	24.8	26.1
Lancashire	57.8	50.8	25.9	24.9
York (W.R.)	49.0	52.7	23.1	29.6
York (E.R.)	50.0	48.7	23.0	25.7
York (N.R.)	46.9	44.9	18.1	26.8
Durham	57.2	50.1	21.5	28.6
Northumberland	60.9	46.3	18.2	28.1
Cumberland	53.6	56.4	24.8	31.6
Westmorland	38.0	60.6	18.7	41.9
Monmouth	57.1	59.2	28.3	30.9
South Wales	58.8	67.3	31.2	36.1
North Wales	57.4	63.9	25.3	38.6
Cambridge	43.1	34.4	13.1	21.3
Leicester	41.2	37.2	14.4	22.8

Appendix V. Showing the Rates of Mortality in 1911-13 from

(1) All Causes less those connected with childbearing per 10,000 Females 15-45.
(2) Tuberculosis (all forms) per 10,000 Females 15-45.
(3) Violence apart from Suicide per 1,000,000 Females 15-45.
(4) All Causes of Death in Childbearing per 10,000 Births.
(5) Puerperal Sepsis per 10,000 Births.
(6) Childbearing Causes other than Sepsis per 10,000 births.
(7) Appendicitis per 100,000 Total Population in (a) Counties (b) Metropolitan Boroughs (d) Urban Districts and (c) County Boroughs, and (e) Rural Districts.

(a) Counties.	(1)	(2)	(3)	(4)	(5)	(6)	(7
London	38.9	12.8	9.5	29.1	13.8	15.3	7.8
Surrey	27.7	9.1	6.2	33.1	13.2	19.9	8.8
Kent	34.0	12.8	7.4	31.6	11.1	20.5	6.3
Sussex	30.9	11.7	6.3	33.3	12.9	20.4	7.4
Hampshire	34.4	13.3	5.8	35.2	11.8	23.4	7.8
Berkshire	32.6	12.1	6.5	37.3	15.4	21.9	8.4
Middlesex	30.8	10.3	7.1	30.8	13.6	17.2	8.9
Hertford	28.9	10.0	7.7	32.4	13.6	18.8	6.2
Buckingham	30.9	11.2	7.9	29.1	11.2	17.9	6.6
Oxford	32.1	12.5	6.7	20.4	6.8	13.6	7.9
Northampton	36.5	15.6	4.0	34.9	14.9	20.1	4.9
Bedford	35.8	13.5	4.9	32.3	12.1	20.2	5.6
Essex	36.4	12.4	7.7	31.3	11.9	19.4	6.1
Suffolk	36.8	14.9	5.3	38.1	10.8	27.3	6.9
Norfolk	36.2	15.4	7.1	30.3	10.7	19.6	6.1
Wiltshire	31.7	10.4	7.3	40.1	8.8	31.3	7.1
Dorset	31.6	11.0	6.5	42.8	10.7	32.1	8.5
Devon	39.9	16.4	6.9	42.8	13.6	29.2	6.8
Cornwall	36.1	15.5	4.2	44.8	11.2	33.6	6.9
Somerset	33.0	12.3	8.6	31.9	13.3	18.6	7.0
Gloucester	38.2	15.2	8.1	35.7	10.7	25.0	6.6
Hereford	36.3	15.4	9.0	49.2	16.9	32.3	8.1
Shropshire	37.0	13.2	6.7	35.3	9.9	25.4	7.0
Stafford	43.6	15.2	9.4	41.1	15.2	25.9	7.0
Worcester	39.1	12.9	8.2	29.3	7.9	21.4	9.2
Warwich	36.6	11.8	7.3	37.2	15.6	21.6	6.4
Lincoln	38.4	14.8	8.3	37.2	12.1	25.1	6.2
Nottingham	38.3	13.4	9.3	31.9	12.8	19.1	5.2
Derby	36.2	12.3	7.1	39.1	12.4	26.7	5.9
Cheshire	36.9	12.9	8.3	46.7	14.8	31.9	8.1
Lancashire	45.7	14.7	10.0	45.3	15.4	29.9	7.1
York (W.R.)	41.3	13.2	8.1	46.3	14.4	31.9	6.9
York (E.R.)	41.4	15.0	10.4	34.1	12.0	22.1	5.5
York (N.R.)	45.3	15.6	9.1	40.1	10.9	29.2	7.6
Durham	47.0	17.1	8.4	43.9	12.6	31.3	5.5
Northumberland	44.6	16.9	7.1	40.7	9.5	31.2	5.6
Cumberland	42.0	16.9	7.4	48.8	15.6	33.2	8.3
Westmorland	29.6	10.0	8.3	48.9	5.4	43.5	7.4
Monmouth	43.5	13.1	9.9	47.1	11.5	35.6	6.9
South Wales	46.9	18.7	8.0	55.8	16.4	39.4	6.0
North Wales	46.7	19.9	9.0	59.3	19.9	39.4	7.4
Cambridge	33.1	13.0	7.1	27.9	15.5	12.4	3.8
Leicester	39.3	17.2	6.1	41.3	13.4	27.9	6.0

(b) Metropolitan Boroughs.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Battersea	67.0	23.3	12.0	24.1	14.0	10.1	6.2
Bermondsay	70.0	25.3	14.3	20.6	10.3	10.3	5.6
Bethnal Green	55.7	19.3	7.0	29.5	13.5	16.0	4.7
Camberwell	105.7	37.7	21.0	29.9	17.0	12.9	7.5
Chelsea	21.7	5.3	13.7	37.4	10.7	26.7	10.2
Deptford	47.7	16.0	13.3	32.2	21.1	11.1	7.6
Finsbury	44.0	16.0	15.0	30.8	14.1	16.7	6.6
Fulham	61.7	21.0	15.3	25.4	11.9	13.4	7.1
Greenwich	37.0	12.3	2.7	28.9	15.1	13.8	9.7
Hackney	84.0	32.7	11.0	31.9	16.9	15.0	8.2
Hammersmith	50.3	18.3	14.0	32.8	21.5	11.3	7.3
Hampstead	18.3	4.0	9.0	38.7	10.3	28.4	9.3
Holborn	20.0	6.7	11.3	19.0	7.6	11.4	4.9
Islington	133.3	45.7	29.3	23.2	13.4	9.8	6.7
Kensington	48.0	14.3	21.7	34.3	16.1	18.2	11.3
Lambeth	122.3	40.7	19.3	31.3	12.6	18.7	6.5
Lewisham	50.3	13.7	12.0	27.3	16.6	10.7	8.7
Paddington	44.7	14.0	16.7	30.8	19.8	11.0	10.5
Poplar	77.7	27.0	4.3	27.5	13.1	14.4	6.6
St.Marylebone	36.3	10.3	5.0	24.9	11.7	13.2	11.5
St.Pancras	95.0	28.7	23.3	32.3	16.5	15.8	7.4
Shoreditch	60.3	19.7	12.7	22.6	13.2	9.4	6.3
Southwark	102.7	36.7	26.7	17.4	11.6	5.8	7.0
Stepney	134.7	43.3	30.0	27.2	13.8	13.4	6.6
Stoke Newington	15.7	5.0	3.3	46.7	24.9	21.8	6.6
Wandsworth	132.7	29.0	29.7	39.0	21.7	17.3	8.7
Westminster	44.0	11.3	23.0	39.1	14.5	24.6	9.3
Woolwich	49.0	18.7	8.7	21.4	11.9	9.5	10.1

V (c)

County Boroughs	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Barrow	41.1	13.0	9.1	47.2	15.1	32.1	7.7
Bath	27.8	9.3	7.0	19.3	16.1	3.2	7.7
Birkenhead	45.0	14.3	11.1	31.5	13.1,	18.4	5.7
Birmingham	36.4	11.7	6.8	37.5	17.3	20.2	5.6
Blackburn	44.1	11.5	8.1	61.1,	18.8	42.3	8.5
Blackpool	40.2	10.5	10.1	47.0	16.8	30.2	14.5
Bolton	44.3	13.0	6.8	34.0	9.7	24.3	7.3
Bootle	58.9	22.1	19.4	28.0	7.8	20.2	6.6
Bournemouth	26.7	13.1	5.1	26.8	8.1	18.7	7.8
Bradford	44.5	14.9	7.8	58.7	18.4	40.3	8.7
Brighton	36.9	13.3	7.5	34.2	15.8	18.4	7.6
Bristol	40.7	16.1	9.0	39.9	14.1	25.8	6.6
Burnley	45.0	13.3	21.6	73.9	24.2	49.7	8.3
Buxton	51.1	18.0	9.0	50.8	12.7	38.1	4.2
Bury	42.3	15.1	10.3	63.6	27.7	35.9	11.3
Canterbury	32.5	13.5	0.0	20.0	6.7	13.3	5.4
Chester	40.0	16.1	13.1	50.5	14.4	36.1	6.8
Coventry	40.6	13.4	7.6	32.7	12.4	20.3	9.3
Croydon	31.0	11.2	5.1	35.7	13.1	22.6	7.3
Derby	39.5	14.4	4.3	36.5	11.4	25.1	6.1
Dudley	43.1	11.0	19.2	18.4	4.6	13.8	5.8
Eastbourne	26.9	10.0	8.0	15.2	3.8	11.4	7.4
Exeter	37.2	15.7	2.6	23.8	13.6	10.2	5 5
Gateshead	52.1	19.9	8.4	45.0	13.7	31.3	5.4
Gloucester	37.2	15.6	18.9	25.2	8.4	16.8	4.0
Great Yarmouth	44.5	20.0	9.4	34.8	12.4	22.4	7.1
Grimsby	38.7	13.3	12.8	39.7	15.9	23.8	7.4
Halifax	39.3	11.9	4.7	53.6	10.7	42.9	10.6
Hastings	34.3	13.6	7.7	32.9	7.3	25.6	12.6
Huddesfield	44.7	12.1	11.2	50.3	15.7	34.6	7.0
Ipswich	40.0	16.9	9.1	41.1	11.2	29.9	4.8
Kingston	46.0	16.0	11.7	35.7	12.6	23.1	4.5
Leeds	44.2	16.1	9.6	45.7	18.1	27.6	4.1
Leicester	41.4	17.7	7.0	41.5	14.1	27.4	4.5
Lincoln	39.6	12.1	11.6	30.8	14.2	16.6	7.4
Liverpool	54.5	20.0	12.1	35.9	12.3	23.6	4.8
Manchester	48.8	16.5	10.7	37.5	12.9	24.6	6.9
Middlesborough	55.0	15.9	20.3	40.7	14.9	25.8	7.8
Newcastle	46.6	18.1	5.0	38.6	5.9	32.7	5.3
Northampton	40.9	17.1	4.2	36.8	10.6	26.2	4.4
Norwich	35.8	16.8	1.1	22.3	13.6	8.7	6.5
Nottingham	41.0	14.3	6.2	33.3	15.6	17.7	5.1
Oldham	50.0	15.1	5.1	65.5	30.8	34.7	7.4
Oxford	28.9	9.9	6.8	16.6	6.7	9.9	6.9
Plymouth	49.2	19.5	10.3	35.8	14.1	21.7	9.5
Portsmouth	39.6	16.3	8.1	34.7	15.6	19.1	5.4
Preston	44.4	12.7	11.6	51.2	14.3	36.9	6.8
Reading	33.2	13.5	6.1	37.4	20.6	16.8	8.6
Rochdale	46.3	15.2	14.9	66.2	24.4	41.8	9.7
Rotherham	46.6	15.5	9.5	42.8	16.1	26.7	7.9
St.Helens	50.0	16.8	6.2	27.0	12.4	14.6	3.7
Salford	48.5	16.4	12.3	40.0	13.7	26.3	7.3
Sheffield	39.8	11.2	8.2	39.1	14.7	24.4	5.9
Smethwich	39.9	13.1	11.4	40.7	11.9	28.8	5.0
Southampton	41.5	14.0	3.4	36.1	12.8	23.3	9.4
Southport	27.4	8.2	4.6	31.8	10.6	21.2	7.6
South Shields	58.5	23.1	5.1	39.5	14.8	24.7	4.0
Stockport	45.4	17.5	11.4	54.6	16.8	37.7	5.4
Stoke	52.7	18.3	7.5	44.7	17.9	26.8	5.4
Sunderland	45.3	17.0	8.1	49.3	15.7	33.6	6.8
Tynemouth	55.9	18.9	9.2	40.9	9.7	31.2	11.7
Walsall	43.5	15.8	11.9	45.3	17.1	28.2	11.1
Warrington	43.1	14.5	15.7	41.3	15.9	25.4	10.5
W.Bromwich	42.6	14.4	6.5	34.5	14.8	19.7	4.4
W.Ham	42.8	14.6	11.9	20.0	7.9	12.1	6.1
W.Hartlepool	40.4	17.2	4.3	39.4	12.5	26.8	5.2

Wigan	51.2	17.5	8.9	39.5	10.6	28.9	8.9
Wolverhampton	38.4	13.0	4.3	37.6	17.4	20.2	8.7
Worcester	38.3	14.4	8.1	26.3	6.6	19.7	11.8
York	35.7	12.6	11.3	32.6	15.4	17.2	6.4
Cardiff	47.2	19.6	13.8	37.3	11.9	25.4	6.5
Merthyr Tydfil	49.2	19.5	7.5	65.8	26.1	39.7	4.4
Newport	45.6	15.6	9.8	41.5	10.1	31.4	7.4
Swansea	48.9	19.1	8.3	49.4	9.1	40.3	7.4
Devonport	47.2	19.1	3.7	41.0	11.9	29.1	7.6

V (d) Urban Districts

Bedford	33.2	12.1	4.3	33.8	15.6	18.2	6.4
Berkshire	35.3	14.4	4.6	40.6	17.4	23.2	9.8
Buckingham	30.4	11.6	6.8	31.2	7.8	23.4	6.6
Cheshire	35.1	11.8	6.6	48.4	15.2	33.2	8.6
Cornwall	35.6	14.6	4.5	42.9	11.6	31.3	7.6
Cumberland	47.0	20.1	8.4	49.7	16.6	33.1	7.4
Derby	36.6	13.0	9.2	35.9	11.7	24.2	5.5
Devon	35.7	15.6	6.5	47.9	15.4	32.6	6.3
Dorset	30.5	10.2	4.6	36.1	11.6	24.5	8.3
Durham	47.0	16.6	10.7	40.7	11.6	29.1	5.4
Essex	34.6	11.8	6.6	35.4	13.8	21.6	6.8
Gloucester	30.9	12.9	4.9	30.2	12.4	17.8	6.0
Hereford	32.6	13.6	3.3.	39.7	11.9	27.8	7.5
Hertford	32.1	11.0	7.3	29.0	11.6	17.4	6.0
Kent	33.9	12.1	8.0	32.4	11.3	21.1	6.7
Lancashire	41.5	12.5	8.8	52.9	17.6	35.3	7.5
Middlesex	30.6	10.3	6.6	31.2	14.1	17.1	8.9
Norfolk	28.0	11.2	11.2	23.7	5.3	18.4	7.1
Northumberland	45.5	16.9	7.5	41.6	12.9	28.7	4.1
Nottingham	35.7	12.7	11.5	30.1	13.2	16.9	5.4
Oxford	38.9	17.2	3.7	28.3	8.1	20.2	10.0
Shropshire	40.2	14.6	6.6	34.4	9.6	24.8	6.4
Somerset	31.6	12.1	4.8	34.9	14.2	20.7	8.4
Stafford	44.6	15.5	13.2	34.8	11.1	23.7	7.0
Surrey	26.8	8.4	6.1	33.3	12.7	20.6	8.9
Warwich	38.4	12.3	7.6	42.4	13.6	28.8	8.5
Westmorland	34.1	12.9	13.8	38.6	6.4	32.2	3.7
Wiltshire	31.4	11.0	5.4	33.1	5.2	27.9	7.9
Worcester	37.8	12.5	5.2.	34.9	11.6	23.3	9.6
York (E.R.)	36.0	13.0	4.3	31.1	5.2	25.9	4.9
York (N.R.)	45.5	17.3	3.9	36.2	8.3	27.9	6.1
York (W.R.)	40.2	12.8	6.9	50.9	14.6	36.3	7.6
Glamorgan	45.8	16.5	7.6	58.3	17.4	40.9	6.1
Monmouth	43.8	11.9	11.2	50.9	12.8	38.1	7.0
Cambridge	31.5	11.9	7.2	23.3	15.1	8.2	3.7
Lincoln	37.0	14.7	3.9	37.5	9.9	27.6	5.7
Northampton	35.7	15.7	5.2	30.3	17.7	12.6	4.6
Southampton	30.9	10.1	4.4	32.1	9.7	22.4	9.5
Suffolk	32.9	12.2	6.5	39.3	16.7	22.6	8.2
Sussex	29.9	11.2	6.6	37.9	12.3	25.6	7.7
Leicester	38.7	17.2	1.3	46.8	14.7	32.1	8.7
North Wales	42.8	18.5	9.8	50.0	16.9	33.1	7.1
South Wales	46.8	18.7	2.9	53.3	14.6	38.7	4.8

Rural Districts.	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bedford	40.8	16.3	6.2	29.6	6.3	23.3	4.3
Berkshire	31.0	10.0	7.6	36.1	11.2	24.9	7.5
Buckingham	31.3	11.0	8.6	27.7	13.3	14.4	6.6
Chester	30.6	11.3	8.0	52.7	14.9	37.8	10.2
Cornwall	36.5	16.4	3.9	46.1	10.8	35.3	6.4
Cumberland	33.4	11.6	5.7	46.9	13.6	33.3	9.6
Derby	34.1	10.3	6.1	43.4	13.7	29.7	6.1
Devon	37.6	14.9	7.8	47.3	12.4	34.9	6.3
Dorset	33.1	12.0	8.8	50.1	9.7	40.4	8.9
Durham	44.1	15.4	7.1	47.7	11.8	35.9	5.6
Essex	35.2	12.2	6.6	35.4	11.8	23.6	4.3
Gloucester	37.6	14.7	5.3	45.1	8.4	36.7	7.4
Hereford	38.6	16.5	12.7	54.4	19.6	34.8	8.5
Hertford	23.4	8.1	8.4	38.4	17.1	21.3	6.4
Kent	34.5	14.5	6.4	30.6	10.9	19.7	5.3
Lancashire	35.8	10.3	5.6	52.9	15.4	37.6	7.1
Middlesex	33.4	9.9	16.5	24.2	3.1	21.1	8.7
Norfolk	36.6	14.5	8.8	34.6	10.2	24.4	5.5
Northumberland	33.4	13.1	9.9	44.2	9.4	34.8	6.8
Nottingham	36.4	12.3	12.6	32.3	6.4	25.9	5.1
Oxford	31.5	12.2	7.9	19.3	6.4	12.9	7.6
Salop	34.2	12.0	6.9	35.9	10.1	25.8	7.5
Somerset	36.1	13.5	12.2	32.7	12.1	20.6	5.9
Stafford	32.9	11.8	5.0	54.2	23.1	31.1	8.4
Surrey	27.1	9.2	7.5	30.7	14.6	16.1	9.1
Warwich	33.9	10.5	9.9	33.9	11.3	22.6	6.9
Westmorland	25.8	7.6	3.8	56.4	4.7	51.7	10.0
Wiltshire	32.0	9.8	9.1	45.3	11.6	33.7	6.6
Worcester	39.5	13.6	7.8	27.6	4.8	22.7	9.1
York (E.R.)	35.8	15.4	9.7	31.2	10.9	20.3	8.1
York (N.R.)	37.1	13.0	7.5	45.8	10.6	35.2	9.5
York (W.R.)	38.9	12.6	9.8	37.7	8.9	28.8	6.2
Glamorgan	41.7	16.4	7.1	47.1	12.2	34.9	5.0
Monmouth	38.5	15.1	3.1	26.5	3.3	23.2	5.0
Cambridge	34.5	14.0	6.9	31.6	15.8	15.8	3.8
Lincoln	38.9	16.0	9.3	37.3	11.7	25.6	6.0
Northampton	33.5	14.2	2.5	38.4	15.3	23.1	5.6
Southampton	33.0	13.4	6.4	40.8	10.2	30.6	7.7
Suffolk	38.4	16.2	2.6	35.9	6.6	29.3	6.8
Sussex	27.7	11.2	4.0	32.6	14.7	17.9	5.7
Leicester	36.3	16.3	7.9	37.4	11.6	25.8	6.3
North Wales	49.6	21.0	8.4	64.8	21.6	43.2	7.6
South Wales	51.7	24.0	8.1	73.5	23.2	50.3	6.6

Appendix VI. Showing the Rates of Mortality in 1921-23 from
(1) All Causes less those connected with childbearing per 10,000 Females 15-45.
(2) Tuberculosos (All forms) per 10,000 Females 15-45,
(3) Violence apart from Suicide per 1,000,000 Females 15-45,
(4) All Causes of Death in Childbearing per 10,000 Births,
(5) Puerperal Sepsis per 10,000 Births,
(6) Childbearing Causes Other than Sepsis per 10,000 Births
(7) Appendicitis per 100,000 Total Population in
(a) Counties (b) Metropolitan Boroughs, (c) County Boroughs,
(d) Urban Districts, and (e) Rural Districts.

(a) Counties.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
London	34.6	12.4	7.1	29.1	13.9	15.2	7.5
Surrey	26.2	9.0	6.3	35.1	12.3	22.8	10.8
Kent	30.3	11.8	4.9	36.6	13.0	23.6	6.6
Sussex	26.2	9.6	4.8	38.9	11.8	27.1	7.8
Hampshire	29.7	11.7	6.5	36.3	13.7	22.6	6.9
Berkshire	30.1	11.3	7.1	28.2	11.9	16.3	7.6
Middlesex	30.3	10.4	5.6	33.0	14.6	18.4	6.8
Hertford	27.9	9.4	7.9	34.5	10.6	23.9	8.6
Buckingham	26.9	10.9	6.6	32.9	11.7	21.2	6.9
Oxford	28.0	11.9	7.5	35.3	9.1	26.2	7.1
Northampton	33.3	13.3	6.2	45.3	13.2	32.1	6.6
Bedford	30.4	12.6	6.0	29.9	7.9	22.0	8.6
Essex	31.8	11.4	6.4	28.3	9.9	18.4	7.2
Suffolk	33.2	15.0	3.7	27.6	9.2	18.4	7.4
Norfolk	33.2	15.5	5.4	30.4	11.2	19.2	6.8
Wiltshire	31.0	11.8	4.7	37.6	8.9	28.7	7.5
Dorset	29.0	10.9	6.8	33.6	12.3	21.3	6.6
Devon	35.9	16.3	5.4	37.7	9.3	28.4	6.6
Cornwall	33.9	14.9	5.2	38.3	7.6	30.7	10.3
Somerset	30.4	12.4	5.3	27.0	4.9	22.1	7.7
Gloucester	36.1	14.6	7.6	34.8	11.1	23.7	7.4
Hereford	31.4	15.4	7.8	32.7	11.4	21.3	6.8
Shropshire	34.8	12.3	5.6	34.4	5.3	29.1	9.0
Stafford	35.5	12.4	6.8	40.6	14.9	25.7	7.6
Worcester	33.5	13.7	9.1	27.8	7.6	20.2	8.8
Warwich	31.0	10.7	6.7	33.4	14.2	19.2	8.1
Lincoln	35.1	14.5	4.1	33.6	10.0	23.6	6.4
Nottingham	36.4	13.7	8.5	36.0	12.6	23.4	6.2
Derby	33.1	11.1	6.6	38.2	11.6	26.6	6.2
Cheshire	33.2	10.3	5.9	44.4	14.8	29.6	7.6
Lancashire	39.8	13.4	6.9	42.8	16.1	26.4	7.2
York (W.R.)	36.0	11.8	7.1	46.9	17.8	29.1	6.8
York (E.R.)	37.4	14.5	8.7	44.2	14.4	29.8	8.4
York (N.R.)	34.5	12.5	6.5	32.3	6.9	25.4	5.5
Durham	43.8	16.6	6.6	41.6	12.3	29.3	5.3
Northumberland	39.7	15.4	6.2	40.2	13.3	26.9	6.2
Cumberland	37.5	14.0	14.3	50.8	9.2	41.6	8.7
Westmorland	25.6	9.5	2.0	49.8	42.9	46.9	16.7
Monmouth	42.4	15.9	7.1	45.6	12.4	33.2	6.8
South Wales	43.2	17.8	6.9	56.2	18.4	37.8	7.2
North Wales	37.1	15.3	4.9	54.8	14.9	39.9	8.0
Cambridge	28.7	11.6	6.2	39.3	13.1	26.2	5.3
Leicester	36.4	16.1	6.1	32.3	11.6	20.7	6.6

(b) VI. Metropolitan Boroughs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Battersea	34.7	12.7	5.3	30.5	6.4	24.1	5.5
Bermandsey	47.3	17.3	11.7	17.8	6.3	11.5	8.0
Bethnal Green	40.0	15.0	4.7	30.5	12.4	18.1	6.8
Camberwell	34.7	13.3	4.0	30.4	18.0	12.4	4.8
Chelsea	26.0	8.3	10.0	50.3	12.6	37.7	8.3
Deptford	37.0	12.7	13.0	31.1	11.7	19.4	10.5
Finsbury	44.0	15.0	14.3	20.8	8.7	12.1	11.7
Fulham	34.7	12.3	5.7	40.5	25.3	15.2	7.1
Greenwich	41.0	14.3	2.7	25.9	13.7	12.2	8.8
Hackney	34.7	13.0	6.7	27.5	14.1	13.4	7.7
Hammersmith	37.7	14.7	6.0	36.4	18.2	18.2	7.4
Hampstead	26.0	6.3	8.0	36.2	20.7	15.5	6.9
Holborn	31.0	7.3	23.7	26.2	15.7	10.5	9.3
Islington	31.0	12.3	6.7	24.5	12.5	12.0	7.8
Kensington	28.7	8.0	10.0	45.4	25.8	19.6	9.1
Lambeth	34.0	13.3	8.4	30.5	19.1	11.4	7.7
Lewisham	31.0	10.3	5.0	33.1	11.0	22.1	9.1
Paddington	27.3	8.3	8.3	25.5	12.1	13.4	5.5
Poplar	37.0	13.0	3.3	30.4	12.9	17.5	8.2
St.Marylebone	27.7	9.0	7.7	27.5	7.8	19.6	11.4
St.Pancras	33.7	12.0	5.3	27.0	14.6	12.4	6.6
Shoreditch	45.0	20.0	5.3	19.2	7.9	11.3	7.9
Southwark	42.0	16.0	3.7	26.1	11.3	14.8	6.4
Stepney	41.3	14.3	9.7	24.8	11.0	13.8	8.6
Stoke Newington	30.3	9.3	7.0	43.8	30.3	13.5	10.1
Wandsworth	31.3	13.0	5.7	27.3	11.6	15.7	7.2
Westminster	24.7	7.0	11.3	34.2	12.6	21.6	5.9
Woolwich	37.3	16.7	5.7	23.3	12.2	11.1	4.9

(c) County Boroughs.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Barnsley	54.1	21.0	2.6	63.3	21.1	42.2	7.7
Barrow	38.4	12.9	5.8	35.9	4.2	31.7	8.4
Bath	23.0	6.7	1.9	15.7	3.1	12.6	8.8
Birkenhead	37.8	14.7	2.8	44.4	15.4	28.9	9.5
Birmingham	31.9	10.7	5.7	30.3	14.2	16.1	7.0
Blackburn	36.3	10.1	2.9	60.3	20.6	39.7	6.2
Blackpool	25.4	8.4	3.4	60.1	15.0	45.0	8.6
Bolton	39.5	12.2	3.5	46.8	18.2	28.7	10.0
Bootle	47.2	21.6	7.1	27.8	8.2	19.6	4.2
Bournemouth	23.2	10.0	7.3	46.4	26.1	20.3	4.9
Bradford	35.3	10.9	6.8	55.6	34.0	21.6	7.9
Brighton	30.8	12.2	5.4	27.2	11.4	15.7	4.7
Bristol	37.4	15.1	8.0	29.8	7.8	22.1	7.2
Burnley	35.2	11.9	5.9	44.1	14.7	29.4	7.9
Buxton	34.2	13.4	11.4	45.3	6.0	39.3	6.0
Bury	40.2	10.0	4.4	48.4	31.1	17.3	4.1
Canterbury	32.9	11.2	0.0	50.2	28.7	21.5	4.2
Carlisle	35.3	11.6	7.1	51.1	10.8	40.3	11.9
Chester	41.7	13.9	9.5	42.9	23.4	19.5	12.9
Coventry	32.4	12.3	3.1	42.6	14.6	27.9	12.7
Croydon	31.2	13.0	4.0	39.1	15.2	23.8	8.3
Darlington	38.1	12.6	6.0	41.9	15.4	26.4	7.0
Derby	32.7	11.5	6.1	28.9	11.3	17.6	4.3
Dewsbury	39.4	7.8	11.8	66.1	18.9	47.2	10.3
Dudley	39.4	15.1	9.8	35.6	8.9	26.7	7.5
Eastbourne	22.5	7.8	5.3	31.1	22.2	8.9	6.2
East Ham	34.9	13.3	6.5	20.8	12.1	8.8	7.5
Exeter	32.1	15.5	4.4	44.3	9.5	34.8	2.8
Gateshead	46.4	19.0	9.9	35.9	11.3	24.5	5.5
Gloucester	39.8	16.9	7.8	43.6	14.5	29.1	7.6
Gt.Yarmouth	35.1	17.6	2.2	26.2	11.6	14.6	9.4
Grimsby	40.8	17.2	5.1	39.3	8.2	31.1	4.3
Halifax	36.0	12.2	5.0	65.3	18.4	47.0	8.3
Hastings	27.4	10.6	7.7	80.3	19.1	61.2	12.3
Huddersfield	37.7	11.2	12.4	74.6	17.8	56.9	6.3
Ipswich	31.8	12.3	3.4	20.6	8.2	12.3	5.8
Kingston	43.1	16.5	11.3	45.4	18.1	27.4	8.5
Leeds	38.2	14.9	7.4	45.6	18.3	27.4	5.6
Leicester	37.8	17.6	7.3	34.3	16.8	17.5	6.3
Lincoln	31.3	11.5	2.0	33.8	10.4	23.4	4.5
Liverpool	43.6	17.6	7.9	33.4	15.9	17.5	5.6
Manchester	43.2	16.0	9.3	37.2	17.5	19.7	6.9
Middlesborough	42.6	15.4	5.4	39.3	11.1	28.2	5.4
Newcastle	39.9	16.4	7.2	42.1	14.5	27.6	5.8
Northampton	30.6	11.6	2.8	34.7	13.5	21.2	5.4
Norwich	35.1	17.5	5.3	34.7	14.7	20.0	6.8
Nottingham	35.9	13.4	7.2	33.2	12.8	20.4	5.0
Oldham	44.8	12.5	9.6	60.9	41.0	19.9	8.3
Oxford	22.8	11.0	8.8	40.6	11.1	29.6	6.5
Plymouth	41.6	19.2	4.6	41.4	10.9	30.5	6.3
Portsmouth	33.9	13.5	5.0	34.3	12.9	21.4	6.9
Preston	34.5	11.5	5.3	50.6	16.8	33.8	5.5
Reading	32.2	13.3	8.6	24.4	5.6	18.8	5.7
Rochdale	40.0	12.5	9.7	57.9	10.0	47.9	7.6
Rotherham	38.4	11.2	4.2	32.4	13.3	19.1	6.7
St.Helens	41.7	13.0	4.2	34.2	13.0	21.2	5.3
Salford	46.1	17.7	7.1	36.2	13.3	22.9	7.7
Sheffield	36.2	10.9	7.1	36.4	15.8	20.7	5.4
Smethwick	29.9	11.1	8.6	47.8	30.6	17.2	5.1
Southampton	35.0	15.6	5.1	35.4	14.7	20.6	4.7
Southend	28.8	12.4	3.4	34.1	10.7	23.4	10.9

Southport	26.5	8.7	7.6	28.7	9.6	19.2	7.4
South Shields	51.4	23.0	8.3	41.4	10.1	31.3	8.2
Stockport	32.6	11.6	6.0	55.8	22.9	32.9	6.9
Stoke	42.0	14.8	4.5	44.6	17.3	27.3	9.9
Sunderland	45.4	16.2	4.2	42.2	11.9	30.4	5.1
Tynemouth	40.9	18.2	6.4	30.4	10.1	20.3	5.1
Wakefield	41.3	14.6	14.9	75.3	29.0	46.3	9.3
Wallasey	32.0	10.4	5.3	44.8	21.5	34.3	10.4
Walsall	34.9	14.7	8.4	26.2	9.2	17.0	6.0
Warrington	37.3	15.4	8.7	48.5	19.8	28.7	3.4
West Bromwich	35.5	9.9	11.4	40.3	18.5	21.8	6.9
West Ham	38.2	13.2	8.6	24.2	8.7	15.4	8.0
West Hartlepool	39.1	13.6	3.9	35.8	8.9	26.8	5.2
Wigan	50.3	14.4	8.7	46.6	21.1	25.6	6.9
Wolverhampton	31.3	9.6	2.6	58.4	19.5	39.0	6.3
Worcester	30.5	14.3	5.4	31.1	6.9	24.2	1.4
York	35.6	11.9	12.4	37.2	7.8	29.4	5.9
Cardiff	44.9	20.1	12.6	51.3	28.5	22.8	6.9
Merthyr Tydfil	49.4	19.5	5.5	44.8	19.0	25.8	6.0
Newport	46.0	18.3	5.9	45.6	10.6	35.0	8.4
Swansea	41.1	17.2	6.8	58.1	20.6	37.4	6.0

(d) Urban Districts.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bedford	27.6	10.5	3.0	29.3	4.4	24.9	9.1
Berkshire	28.6	9.9	7.9	27.2	13.6	13.6	6.0
Buckingham	26.0	10.8	2.7	24.3	5.6	18.7	8.6
Cheshire	34.1	9.3	6.2	39.1	12.2	26.9	6.5
Cornwall	35.6	15.4	4.6	38.4	8.2	30.2	10.6
Cumberland	43.6	16.0	11.8	54.8	8.0	46.8	9.3
Derby	34.4	11.5	5.4	37.1	11.5	25.4	6.1
Devon	33.1	14.5	5.2	28.1	5.0	23.1	7.9
Dorset	27.6	10.1	7.5	29.8	9.4	20.4	6.4
Durham	44.9	17.4	7.4	44.4	13.7	30.7	5.0
Essex	30.1	10.6	6.5	33.6	12.2	21.4	6.5
Gloucester	33.7	13.9	7.9	41.9	19.1	22.1	7.7
Hereford	31.9	16.1	10.1	34.7	11.6	23.1	5.0
Hertford	27.1	9.5	5.6	38.3	14.7	23.6	8.2
Kent	30.0	11.6	3.3	35.9	11.0	24.9	6.9
Lancashire	37.6	11.0	6.0	48.4	16.1	32.4	8.2
Middlesex	30.4	10.4	5.7	33.9	14.8	19.1	6.6
Norfolk	29.5	13.4	2.1	20.1	2.9	17.2	6.6
Northumberland	37.3	14.9	6.6	38.7	11.6	27.1	6.4
Nottingham	38.5	14.7	8.9	32.6	13.9	18.7	7.1
Oxford	28.9	12.3	7.9	46.7	5.8	40.9	8.8
Shropshire	34.7	13.2	3.9	14.6	2.9	11.6	9.1
Somerset	30.0	13.3	3.8	21.3	4.7	16.6	6.3
Stafford	35.4	12.5	6.9	35.8	11.9	23.9	7.4
Surrey	25.0	8.2	6.8	33.9	10.8	23.1	9.5
Warwich	26.6	9.4	5.2	49.7	22.1	27.6	10.5
Westmorland	27.7	7.1	0.0	43.1	0.0	43.1	22.6
Wiltshire	27.8	12.0	3.0	34.7	8.3	26.4	6.9
Worcester	33.1	13.6	7.8	29.2	7.8	21.4	9.7
York (E.R.)	26.8	11.2	1.7	46.9	13.8	33.1	11.4
York (N.R.)	31.1	11.7	5.8	30.1	4.2	25.9	6.6
York (W.R.)	34.2	11.1	6.2	44.7	14.1	30.6	7.7
Glamorgan	45.1	17.3	6.4	57.1	17.9	39.2	6.8
Monmouth	41.5	14.9	7.2	46.9	13.1	33.8	6.1
Cambridge	27.9	10.4	6.7	28.1	5.9	22.2	6.1
Lincoln	32.9	13.5	2.7	31.1	10.2	20.9	6.9
Northampton	34.8	14.6	7.9	56.1	16.4	39.7	8.0
Southampton	38.1	11.1	5.0	35.1	13.6	21.5	8.6
Suffolk	34.4	14.0	3.2	27.1	10.3	16.8	9.5
Sussex	23.8	8.1	5.5	41.6	10.4	31.2	9.2
Leicester	35.1	16.1	5.9	24.5	5.4	19.1	5.9
North Wales	31.6	13.2	5.6	44.7	9.8	34.9	8.3
South Wales	40.3	19.4	4.3	51.2	13.3	37.9	8.8

(e) Rural Districts.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bedford	35.7	16.6	11.6	30.9	13.3	17.6	7.7
Berkshire	29.4	10.6	5.4	31.6	15.8	15.8	9.7
Buckingham	27.6	10.9	9.6	39.1	16.2	22.9	5.6
Cheshire	26.7	7.2	7.0	44.6	9.7	34.9	6.5
Cornwall	32.5	14.5	5.6	38.1	7.0	31.1	10.1
Cumberland	31.5	12.9	21.8	44.4	9.9	34.5	6.2
Derby	31.7	10.4	8.3	43.3	11.9	34.4	7.3
Devon	34.5	15.8	6.6	40.4	11.2	29.2	6.8
Dorset	30.9	11.9	5.9	37.9	15.5	22.4	6.7
Durham	40.7	14.6	5.7	40.1	11.6	28.5	4.5
Essex	28.2	9.5	5.0	25.4	5.1	20.3	6.6
Gloucester	34.1	13.2	6.5	38.4	12.8	25.6	7.6
Hereford	31.1	14.9	6.4	31.6	11.3	20.3	7.9
Hertford	29.6	8.9	13.4	27.6	3.1	24.5	9.3
Kent	31.0	12.3	6.9	37.3	16.7	20.6	6.0
Lancashire	33.8	9.8	6.1	47.5	14.8	32.7	8.9
Middlesex	28.9	10.3	2.3	15.5	9.3	6.2	10.5
Norfolk	32.7	14.3	7.4	31.6	11.2	20.4	6.2
Northumberland	45.2	12.4	2.5	47.6	18.7	28.9	7.7
Nottingham	33.1	12.7	10.7	48.0	9.6	39.4	6.8
Oxford	31.5	12.5	6.4	29.1	9.1	19.9	8.6
Shropshire	34.9	11.4	7.1	50.9	7.3	43.6	8.9
Somerset	33.3	13.5	7.8	33.6	5.5	28.1	8.4
Stafford	32.9	10.7	7.5	42.7	15.2	27.5	8.3
Surrey	24.7	7.0	7.2	34.4	13.5	20.9	7.0
Warwich	29.3	11.0	16.5	30.9	8.5	22.4	8.8
Westmorland	23.8	11.5	3.7	54.7	4.9	49.7	12.2
Wiltshire	32.3	10.9	6.1	39.7	9.4	30.3	7.9
Worcester	32.6	12.9	12.0	19.6	6.5	13.1	7.6
York (E.R.)	30.7	13.6	3.1	44.5	7.9	36.6	8.0
York (N.R.)	31.6	11.0	8.3	25.8	5.2	20.6	4.1
York (W.R.)	33.7	10.4	7.4	46.9	18.7	28.2	5.2
Glamorgan	37.4	14.4	7.8	61.3	17.6	43.7	5.6
Monmouth	41.3	17.9	9.6	32.8	10.9	21.9	8.5
Cambridge	29.6	12.8	5.8	48.9	19.3	29.6	4.6
Lincoln	36.2	15.4	5.6	33.7	10.6	23.1	7.1
Northampton	33.7	13.0	7.2	42.0	9.8	32.2	6.0
Southampton	26.3	9.0	10.4	38.2	11.1	27.1	7.3
Suffolk	33.0	14.9	4.4	31.1	8.9	22.2	6.7
Sussex	26.7	10.0	2.5	35.9	9.6	26.3	7.4
Leicester	35.2	13.9	4.2	35.3	8.8	26.5	7.6
North Wales	41.9	17.1	4.4	60.9	18.1	42.9	7.9
South Wales	44.1	18.4	4.1	59.1	12.7	46.4	9.8

Appendix VII. Showing the Notification Rates in 1911-13 from
(1) Scarlet Fever per 1000 Population
(2) Diphtheria per 1000 Population
(3) Erysipelas per 10,000 Population
(4) Puerperal Sepsis per 10,000 Births
in
(a) Metropolitan Boroughs, (b) County Boroughs, (c) Administrative Counties, and (in Administrative Counties only)
(5) Death Rate from Puerperal Sepsis per 10,000 Births,
(6) Death Rate from Childbearing Causes other than Sepsis per 10,000 Births.

(a) Metropolitan Boroughs.

	(1)	(2)	(3)	(4)
Battersea	3.5	1.5	8.3	19.5
Bermondsey	3.9	1.9	12.0	41.2
Bethnal Green	2.5	1.7	18.3	37.0
Camberwell	3.1	1.4	9.3	20.1
Chelsea	2.4	1.2	6.0	53.4
Deptford	4.3	1.8	18.7	12.2
Finsbury	2.4	1.7	19.0	28.5
Fulham	3.5	1.8	7.7	56.3
Greenwich	3.8	2.9	12.0	27.5
Hachway	2.9	1.3	11.3	38.9
Hammersmith	3.0	1.4	8.3	20.4
Hampstead	1.7	1.7	5.0	28.4
Holborn	2.5	1.6	8.0	11.4
Islington	3.0	1.7	7.0	23.6
Kensington	2.1	1.1	6.7	28.3
Lambeth	3.1	1.3	8.0	33.1
Lewisham	3.0	2.4	6.0	20.5
Paddington	2.3	1.7	8.3	28.6
Poplar	3.0	1.8	12.0	38.0
St.Marylebone	2.9	1.2	8.0	17.6
St.Pancras	2.5	2.2	9.3	29.3
Shoreditch	2.3	1.5	14.3	21.7
Southwark	3.3	1.6	15.0	28.0
Stepney	2.7	1.6	14.3	41.1
Stoke Newington	2.0	1.4	7.3	15.6
Wandsworth	2.8	1.4	6.3	42.9
Westminster	1.8	1.1	5.3	46.3
Woolwich	4.5	2.9	6.7	30.9

VII (b) County Boroughs

	(1)	(2)	(3)	(4)
Barrow	4.5	2.7	9.6	28.3
Bath	2.4	0.5	7.0	32.2
Birkenhead	4.4	1.2	5.5	32.4
Birmingham	6.7	1.1	8.6	33.6
Blackburn	1.8	0.6	6.3	30.6
Blackpool	1.5	0.8	4.1	60.4
Bolton	2.1	0.7	5.5	13.8
Bootle	2.7	0.9	4.8	15.6
Bournemouth	1.9	0.8	3.1	42.1
Bradford	2.0	1.6	8.6	33.2
Brighton	4.3	1.1	7.0	34.3
Bristol	3.0	1.8	8.2	33.9
Burnley	1.8	1.3	11.9	30.9
Buxton	4.7	1.8	10.3	22.2
Bury	3.7	0.7	5.7	49.8
Canterbury	1.8	3.1	5.3	6.7
Chester	1.4	1.2	3.1	28.8
Coventry	6.8	1.7	6.1	22.6
Croydon	2.7	3.4	5.1	24.3
Derby	2.2	2.1	9.1	25.1
Dudley	1.1	2.5	7.6	13.9
Eastbourne	5.0	1.6	5.1	3.8
Exeter	4.3	0.8	5.1	16.9
Gateshead	2.5	0.9	5.7	6.8
Gloucester	4.9	2.0	5.2	25.2
Great Yarmouth	2.7	1.4	5.2	19.9
Grimsby	2.6	2.0	3.6	14.3
Halifax	1.9	1.0	5.5	17.9
Hastings	1.2	0.8	5.9	25.6
Huddersfield	4.7	0.9	5.1	31.4
Ipswich	2.2	1.9	6.3	22.4
Kingston	1.5	1.3	6.9	31.4
Leeds	3.0	2.0	7.5	30.7
Leicester	4.6	0.9	7.2	28.1
Lincoln	2.3	1.9	6.9	4.7
Liverpool	3.9	1.4	11.4	21.3
Manchester	3.8	0.9	6.2	13.4
Middlesborough	5.5	1.3	5.8	14.9
Newcastle	3.6	1.7	6.5	10.6
Northampton	12.4	0.9	7.5	19.3
Norwich	3.8	2.5	5.6	8.6
Nottingham	3.3	1.5	7.6	17.8
Oldham	3.9	0.5	7.7	39.6
Oxford	1.1	0.4	3.2	29.9
Plymouth	2.5	1.2	12.6	25.6
Portsmouth	4.8	3.6	5.9	25.6
Preston	4.9	2.1	7.4	17.9
Reading	1.2	1.6	5.2.	41.1
Rochdale	4.8	0.5	6.5	43.6
Rotherham	4.6	1.1	9.2	26.7
St.Helens	7.2	1.5	9.6	30.1
Salford	3.9	1.4	8.5	36.4
Sheffield	4.8	1.3	9.8	39.7
Smethwich	4.9	1.0	9.1	10.2
Southampton	1.8	2.5	5.2	14.1
Southport	1.2	0.7	3.6	28.1
South Shields	4.7	0.6	6.7	14.8
Stockport	1.7	0.7	5.2	33.8
Stoke	3.7	2.8	8.0	37.6
Sunderland	3.2	1.1	6.0	11.4

Tynemouth	2.9	1.0	6.5	15.6
Walsall	2.0	0.4	9.1	26.9
Warrington	2.2	1.4	8.5	44.6
W.Bromwich	1.8	0.4	7.0	18.1
W.Ham	2.9	1.3	9.7	14.3
W.Hartlepool	3.2	1.2	5.1	7.9
Wigan	1.4	0.5	7.0	22.4
Wolverhampton	3.6	0.6	8.5	22.9
Worcester	2.9	2.0	5.7	32.9
York	3.4	1.0	5.5	12.1
Cardiff	3.8	2.9	8.0	19.1
Mrthry Tydfil	3.4	0.6	2.5	28.7
Newport	7.1	0.8	3.9	15.7
Swansea	2.7	1.6	2.8	13.1
Devonport	3.7	1.8	5.2	18.9

VII. (c) Administrative Counties.

	(1)	(2)	(3)	(4)	(5)	(6)
Bedford	2.9	1.3	5.9	20.9	12.1	20.2
Berkshire	1.4	0.8	3.0	22.6	13.1	24.4
Buckingham	2.2	0.5	5.1	15.6	11.2	17.8
Cheshire	3.1	1.4	5.8	23.4	14.8	34.1
Cornwall	1.3	1.4	3.8	12.7	11.2	33.6
Cumberland	2.9	0.8	7.4	18.7	15.6	33.2
Derby	4.0	1.4	5.8	26.3	12.7	26.9
Devon	1.6	1.1	3.0	15.3	13.9	33.7
Dorset	1.8	1.2	2.9	12.9	10.7	32.1
Durham	5.1	1.4	6.9	8.4	11.7	32.1
Essex	2.5	1.2	6.5	25.4	13.3	22.1
Gloucester	3.0	1.2	4.6	12.2	7.8	25.3
Hereford	3.0	1.4	4.9	30.9	16.9	32.3
Hertford	1.9	0.9	4.5	14.7	13.6	18.8
Kent	2.6	1.7	4.8	16.3	11.2	20.6
Lancashire	3.0	0.9	6.5	29.8	17.2	35.6
Lincoln	1.6	1.1	4.0	13.2	10.2	26.4
Middlesex	2.6	1.3	5.8	23.4	13.6	17.2
Norfolk	1.7	0.8	3.2	9.7	9.2	23.4
Northampton	3.6	1.2	5.3	15.9	16.6	17.8
Northumberland	4.4	1.6	6.0	7.4	12.1	30.2
Nottingham	3.3	1.2	6.3	15.9	11.1	19.9
Oxford	1.9	0.4	4.4	14.9	6.9	14.9
Shropshire	2.5	0.9	3.0	29.7	9.9	25.4
Somerset	1.4	1.1	3.5	18.1	12.9	20.7
Southampton	1.6	1.2	3.4	12.4	9.9	26.3
Stafford	2.9	1.0	6.1	21.2	13.2	25.7
Suffolk	2.2	0.7	4.1	10.7	10.7	26.6
Surrey	1.9	1.2	4.9	25.9	13.3	19.1
Sussex	1.9	1.1	2.9	20.6	13.6	21.4
Warwick	4.8	0.9	6.4	11.9	12.4	25.6
Westmorland	2.3	1.6	5.6	8.2	5.4	43.6
Wiltshire	2.0	0.9	3.7	17.6	8.8	31.2
Worcester	3.8	1.2	6.9	11.3	8.7	23.1
York (E.R.)	1.8	1.6	5.5	11.7	8.8	22.4
York (N.R.)	3.2	1.7	4.6	6.9	9.2	30.6
York (W.R.)	3.6	1.2	6.8	17.1	12.8	33.9
Monmouth	6.1	1.0	6.4	19.7	11.9	36.6
Glamorgan	4.6	1.2	4.5	23.1	16.1	39.4
South Wales	2.2	1.2	3.3	22.9	20.1	46.1
North Wales	2.2	2.5	3.8	16.6	19.9	39.4
Cambridge	3.5	1.3	5.6	24.8	15.4	12.4
Leicester	3.6	1.2	6.0	12.3	12.8	28.3

Appendix VIII. Showing the Notification Rates in 1921-23 from
(1) Scarlet Fever per 1000 Population
(2) Diphtheria per 1000 Population
(3) Erysipelas per 10,000 Population
(4) Puerperal Sepsis per 10,000 Births,
in
(a) Metropolitan Boroughs, (b) County Boroughs, (c) Administrative Counties, and (in Administrative Counties only)
(5) Death Rate from Puerperal Sepsis per 10,000 Births
(6) Death Rate from Childbearing Causes other than Sepsis per 10,000 Births.

(a) Metropolitan Boroughs.

	(1)	(2)	(3)	(4)
Battersea	5.2	3.8	4.4	34
Bermondsey	5.9	6.7	3.3	19
Bethnal Green	4.7	4.5	6.5	44
Camberwell	4.4	3.1	3.7	23
Chelsea	2.8	1.8	3.4	41
Deptford	5.3	3.5	5.7	32
Finsbury	4.9	4.6	15.1	45
Fulham	4.3	2.7	5.5	91
Greenwich	5.8	5.0	5.2	41
Hackney	4.5	3.3	3.4	35
Hammersmith	5.2	2.7	3.1	41
Hampstead	3.2	3.0	2.6	26
Holborn	3.8	3.1	3.6	21
Islington	5.2	3.6	3.4	33
Kensington	3.0	1.9	3.5	35
Lambeth	4.3	1.9	3.8	55
Lewisham	4.0	2.4	3.2	25
Paddington	3.9	2.5	5.1	36
Poplar	4.3	3.3	4.9	36
St.Marylebone	3.1	2.2	4.9	18
St.Pancras	5.3	3.1	4.7	30
Shoreditch	5.3	4.4	5.9	32
Southwark	4.4	3.7	6.7	36
Stepney	4.2	3.7	4.5	33
Stoke Newington	4.3	2.0	2.6	47
Wandsworth	3.8	2.2	3.3	23
Westminster	2.5	1.6	2.9	29
Woolwich	5.1	2.8	3.1	37

VIII (b) County Boroughs

	(1)	(2)	(3)	(4)
Barnsley	1.5	1.1	6.3	59.4
Barrow	3.3	0.3	2.8	4.2
Bath	1.7	1.4	3.4	0.0
Birkenhead	2.4	0.9	3.6	25.1
Birmingham	3.3	1.7	5.0	69.1
Blackburn	1.7	0.3	3.9	50.1
Blackpool	2.5	0.5	2.6	42.1
Bolton	3.1	0.6	3.5	12.4
Bootle	3.8	1.6	2.6	27.8
Bournemouth	1.4	0.7	1.9	17.4
Bradford	3.3	1.1	6.5	65.4
Brighton	2.8	1.3	2.4	11.4
Bristol	4.2	2.6	4.2	34.2
Burnley	3.9	1.4	6.1	22.9
Buxton	2.4	0.9	2.5	3.1
Bury	2.7	0.9	4.1	58.8
Canterbury	1.0	1.4	2.7	14.3
Carlisle	2.0	1.2	3.6	21.6
Chester	2.6	2.0	1.8	23.4
Coventry	2.4	0.6	2.3	37.2
Croydon	3.6	1.8	2.4	19.1
Darlington	2.3	0.8	4.4	33.1
Derby	3.7	1.3	4.3	42.7
Dewsbury	3.3	0.7	1.9	15.7
Dudley	1.5	0.1	1.1	11.1
Eastbourne	1.0	1.1	2.7	22.2
East Ham	4.7	1.6	2.8	14.3
Exeter	1.3	0.9	1.6	25.3
Gateshead	3.0	0.7	3.2	13.8
Gloucester	1.8	1.8	4.3	17.4
Great Yarmouth	2.7	0.8	2.4	8.7
Grimsby	1.2	1.1	1.6	8.2
Halifax	2.5	0.7	2.0	6.1
Hastings	1.1	0.2	2.7	22.9
Huddersfield	1.2	1.3	3.7	35.6
Ipswich	1.3	2.8	2.2	41.1
Kingston	1.0	1.8	3.0	30.6
Leeds	4.6	1.1	4.4	44.4
Leicester	2.5	0.9	3.7	26.6
Lincoln	0.7	0.9	1.9	7.7
Liverpool	3.1	1.3	5.5	24.9
Manchester	4.9	1.1	4.8	97.7
Middlesborough	3.9	0.7	4.1	11.9
Newcastle	3.0	1.0	5.4	25.7
Northampton	2.9	1.7	3.9	52.8
Norwich	5.2	2.1	3.5	16.1
Nottingham	1.9	0.8	3.9	15.1
Oldham	3.5	0,6	4.9	42.2
Oxford	3.1	0.7	2.4	33.2
Plymouth	1.7	1.0	2.9	16.4
Portsmouth	5.4	2.5	3.0	11.1
Preston	2.2	1.3	3.0	32.4
Reading	3.6	1.1	5.4	22.6
Rochdale	4.7	0.9	3.1	13.9
Rotherham	2.8	0.7	7.2	9.6
St.Helens	2.1	0.8	5.5	37.7
Salford	5.4	1.4	5.4	37.9
Sheffield	2.4	1.2	4.7	60.4
Smethwick	3.9	1.7	3.6	76.4
Southampton	1.9	1.8	2.2	28.6
Southend	2.7	0.6	2.5	61.8

Southport	1.8	0.9	3.5	22.4
South Shields	3.2	0.5	2.5	8.1
Stockport	2.2	1.1	3.7	50.1
Stoke	3.6	1.0	6.1	46.1
Sunderland	2.2	0.4	5.6	22.2
Tynemouth	2.9	0.6	3.6	16.2
Wakefield	3.2	0.9	2.5	43.4
Wallasey	3.2	0.9	2.0	40.8
Walsall	1.4	0.7	3.2	35.4
Warrington	3.4	0.8	5.0	48.6
West Bromwich	5.2	2.6	7.9	25.2
West Ham	3.2	2.2	4.9	14.9
West Hartlepool	1.9	0.5	2.8	46.4
Wigan	1.9	0.6	7.5	10.6
Wolverhampton	2.9	0.3	1.7	33.4
Worcester	1.6	1.3	5.1	13.8
York	2.9	0.7	2.5	9.8
Cardiff	2.3	1.3	3.3	41.6
Merthyr Tydfil	2.2	1.4	3.3	15.6
Newport	4.4	1.6	3.4	25.8
Swansea	2.3	1.8	2.2	29.1

VIII (c) Administrative Counties.

	(1)	(2)	(3)	(4)	(5)	(6)
Bedford	1.5	1.2	1.6	15.8	7.9	22.1
Berkshire	2.8	1.1	1.6	17.9	15.1	15.1
Buckingham	2.3	0.8	2.3	9.4	11.7	21.2
Cheshire	3.0	1.2	3.0	25.6	11.4	29.2
Cornwall	0.9	0.9	2.0	10.4	7.6	30.7
Cumberland	1.7	1.0	2.7	12.8	8.8	41.8
Derby	1.9	1.1	3.0	21.6	11.7	28.4
Devon	1.2	0.9	2.2	15.2	8.3	26.4
Dorset	1.2	0.5	2.3	21.3	12.3	21.3
Durham	2.8	0.9	3.7	12.6	12.8	29.7
Essex	3.0	1.5	3.0	24.4	10.1	21.1
Gloucester	1.9	0.9	2.1	14.6	14.6	24.8
Hereford	1.4	1.1	1.8	19.9	11.4	21.3
Hertford	2.2	1.0	1.9	16.4	10.6	23.9
Kent	2.4	1.6	2.6	19.3	12.7	23.7
Lancashire	2.8	0.9	5.0	28.9	15.9	32.4
Lincoln	1.2	0.9	2.0	9.7	10.4	22.1
Middlesex	4.1	2.3	3.1	30.2	16.6	18.4
Norfolk	1.5	0.8	1.6	13.4	8.6	19.8
Northampton	2.4	0.6	2.8	13.1	13.1	35.9
Northumberland	3.1	0.7	4.4	14.4	13.1	27.4
Nottingham	1.6	0.7	3.0	22.7	12.6	25.4
Oxford	2.8	0.6	2.5	17.9	8.3	24.9
Shropshire	2.0	1.2	1.9	29.7	5.3	29.1
Somerset	1.9	0.7	2.9	17.9	5.2	23.6
Southampton	1.9	0.9	1.6	17.6	12.3	24.3
Stafford	2.6	0.8	3.0	24.3	12.9	24.9
Suffolk	1.5	0.9	1.9	23.6	9.4	19.9
Surrey	2.8	1.3	2.4	20.1	11.4	22.6
Sussex	1.8	0.6	1.6	16.6	9.9	28.6
Warwick	2.8	0.9	3.3	25.4	14.1	24.6
Westmorland	2.0	0.5	2.0	8.8	2.9	46.9
Wiltshire	2.1	0.7	2.1	11.9	8.9	28.6
Worcester	2.5	0.6	2.1	14.6	7.4	17.9
York (E.R.)	1.3	0.9	2.3	9.1	10.1	35.3
York (N.R.)	2.1	0.8	2.9	10.1	4.6	23.8
York (W.R.)	2.2	1.0	4.0	18.9	15.4	29.9
Monmouth	3.1	1.1	2.0	17.2	12.9	32.7
Glamorgan	4.1	1.5	2.4	19.7	17.8	40.3
South Wales	1.6	1.3	1.8	26.3	12.9	43.1
North Wales	1.7	1.5	2.0	11.7	14.9	39.9
Cambridge	1.6	0.7	2.5	17.2	13.1	26.2
Leicester	1.3	1.2	2.4	10.2	7.4	23.3

Appendix IX Showing (1) the Still Birth Rates, (2) Neo-natal Death Rates and (3) Post-natal Death Rates per 1000 Live Births and (4) the Number of Female Indoor Domestic Servants per 1000 Population and (5) the Percentage of the Population living more than two in a room in the Counties of England and Wales 1921-23.

	(1)	(2)	(3)	(4)	(5)
London	26.6	26.9	45.7	38	16.1
Surrey	21.1	23.2	29.8	60	4.3
Kent	24.7	25.6	30.7	43	4.6
Sussex	27.4	27.4	26.4	66	4.2
Hampshire	29.3	27.7	28.9	44	4.0
Berkshire	34.1	25.7	33.4	52	4.0
Middlesex	22.1	26.2	32.9	35	7.8
Hertford	19.8	25.3	23.9	46	3.8
Buckingham	21.8	26.4	23.2	47	3.5
Oxford	29.6	27.3	23.7	54	3.7
Northampton	30.4	31.7	30.3	27	3.3
Bedford	25.6	30.0	34.0	30	3.1
Essex	24.1	25.6	33.4	25	8.1
Suffolk	31.1	30.7	25.8	40	3.8
Norfolk	16.3	31.9	32.8	36	3.6
Wiltshire	32.4	29.3	24.7	37	4.6
Dorset	31.3	29.7	26.9	48	3.3
Devon	37.1	27.3	34.1	44	7.2
Cornwall	35.9	35.6	30.2	37	2.8
Somerset	37.2	25.9	25.4	46	3.3
Gloucester	30.9	27.9	34.6	34	5.8
Hereford	27.1	32.6	29.1	50	4.1
Shropshire	41.6	31.1	30.7	44	7.9
Stafford	34.8	36.4	54.2	18	11.1
Worcester	37.8	29.1	38.4	29	8.6
Warwick	30.8	32.4	42.9	22	8.9
Lincoln	28.8	30.1	43.4	32	3.8
Nottingham	26.9	34.8	48.4	21	4.5
Derby	36.6	31.7	42.4	21	5.8
Cheshire	34.0	30.9	43.3	32	6.9
Lancashire	39.4	34.4	56.4	17	8.7
York (W.R.)	38.8	35.9	55.1	19	11.5
York (E.R.)	29.3	31.4	53.4	29	7.4
York (N.R.)	26.2	34.9	53.7	34	9.7
Durham	32.9	38.6	59.3	19	29.5
Northumberland	23.2	34.6	55.9	27	30.8
Cumberland	36.2	35.4	41.6	29	10.6
Westmorland	42.8	32.9	31.1	54	2.2
Monmouth	45.4	33.3	47.6	20	8.8
South Wales	44.6	30.4	52.6	23	7.4
North Wales	35.2	31.4	46.5	39	6.9
Cambridge	27.7	30.9	30.7	40	3.5
Leicester	24.7	31.6	42.9	21	3.4

Appendix X. Showing (1) the Still Birth Rates, (2) Neo-natal Death Rates and (3) Post-natal Death Rates per 1000 Live Births and (4) the Number of Female Indoor Domestic Servants per 1000 Population and (5) the Number of Rooms per Person in the County Boroughs of England and Wales 1921-23.

	(1)	(2)	(3)	(4)	(5)
Barnsley	40.3	39.9	64.2	19	0.92
Barrow	13.7	36.9	48.5	18	0.98
Bath	40.2	29.9	28.2	62	1.39
Birkenhead	39.3	27.3	52.8	27	1.01
Birmingham	33.1	33.0	47.3	18	1.06
Blackburn	46.9	41.0	62.3	9	1.11
Blackpool	48.6	27.3	41.5	38	1.28
Bolton	40.7	35.7	56.5	12	1.01
Bootle	48.1	32.4	54.7	13	0.95
Bournemouth	48.1	36.6	27.7	87	1.42
Bradford	32.1	37.7	54.4	15	1.03
Brighton	28.6	33.4	34.9	50	1.16
Bristol	34.6	27.7	39.1	27	1.13
Burnley	56.8	39.5	72.8	8	1.06
Burton	24.2	36.6	36.6	25	1.23
Bury	52.7	39.1	51.1	11	1.11
Canterbury	37.9	25.1	28.0	43	1.35
Carlisle	43.4	37.1	56.5	18	0.94
Chester	39.4	30.8	53.5	38	1.08
Coventry	31.8	36.9	35.5	13	1.06
Croydon	26.3	23.0	40.3	40	1.25
Darlington	34.3	35.0	52.9	27	0.94
Derby	32.2	32.7	38.9	16	1.22
Dewsbury	51.6	49.1	56.0	13	0.88
Dudley	30.1	33.8	49.0	14	0.91
Eastbourne	17.9	27.1	26.7	84	1.26
East Ham	19.2	22.9	36.2	11	0.99
Exeter	40.4	35.1	40.2	43	1.31
Gateshead	22.2	34.8	65.8	15	0.72
Gloucester	37.2	39.6	36.6	27	1.23
Gt.Yarmouth	22.2	27.1	44.5	29	1.37
Grimsby	21.4	31.4	61.2	25	1.13
Halifax	32.1	43.4	56.4	15	1.02
Hastings	34.7	25.9	22.7	66	1.36
Huddersfield	40.6	35.1	44.0,	17	0.96
Ipswich	28.1	27.9	32.0	32	1.25
Kingston	30.8	31.6	63.0	19	1.04
Leeds	45.8	38.6	64.2	18	1.02
Leicester	24.9	32.8	52.8	15	1.26
Lincoln	32.2	32.7	46.0	29	1.23
Liverpool	30.2	32.9	68.3	20	0.98
Manchester	42.2	30.7	63.7	17	1.04
Middlesborough	34.2	36.8	69.9	19	0.89
Newcastle	20.3	34.3	61.5	25	0.78
Northampton	36.6	28.7	30.9	19	1.27
Norwich	13.3	32.7	38.4	26	1.27
Nottingham	23.4	36.7	54.2	19	1.18
Oldham	54.9	44.5	65.2	9	1.00
Oxford	37.3	24.7	22.2	65	1.40
Plymouth	30.7	28.5	39.8	25	0.93
Portsmouth	26.6	28.2	32.4	26	1.20
Preston	38.7	27.2	75.9	10	1.40
Reading	28.6	26.3	32.3	33	1.24
Rochdale	47.7	37.3	49.3	10	1.05
Rotherham	28.6	37.9	55.2	22	0.95

St.Helens	28.7	41.1	62.4	13	0.79
Salford	40.4	31.5	72.4	13	0.97
Sheffield	37.1	33.2	57.1	20	1.01
Smethwick	31.4	34.8	47.3	9	1.01
Southampton	22.4	28.5	33.1	30	1.13
Southend	25.1	22.8	29.3	43	1.15
Southport	38.7	29.1	34.8	64	1.32
South Shields	30.8	36.4	58.5	19	0:71
Stockport	43.4	34.2	52.6	17	1.12
Stoke	53.2	39.7	74.9	11	0.91
Sunderland	44.4	35.3	71.3	24	0.76
Tynemouth	30.4	34.3	56.1	23	0.78
Wakefield	38.2	41.1	51.0	19	0.96
Wallasey	10.4	27.1	33.8	35	1.26
Walsall	31.6	42.8	58.3	15	0.98
Warrington	43.6	31.9	50.9	11	0.91
W.Bromwich	33.6	35.9	55.5	12	0.88
W.Ham	26.8	26.1	45.2	11	0.85
W.Hartlepool	40.8	35.7	60.8	23	0.93
Wigan	41.8	49.3	58.3	11	0.87
Wolverhampton	31.4	30.8	52.1	22	1.06
Worcester	34.3	31.0	30.7	28	1.24
York	36.6	31.9	44.0	27	1.09
Cardiff	43.6	28.7	54.7	25	1.03
Merythr Tydfil	53.7	33.8	60.0	17	1.00
Newport	41.6	26.8	44.0	26	1.00
Swansea	42.9	28.1	48.4	24	1.00

Appendix XI. Showing (1) the Neonatal Death Rates and (2) the Post-natal Death Rates per 1000 Live Births and (3) the Number of Female Indoor Domestic Servants per 1000 Population and (4) the Number of Rooms per Person in Rural Districts of England and Wales 1921-23.

	Rural				Urban			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Bedford	27.4	31.7	31	1.29	31.6	35.7	30	1.29
Berkshire	24.9	25.9	65	1.33	26.4	30.7	53	1.30
Buckingham	28.6	21.1	55	1.33	23.6	26.3	37	1.27
Cheshire	27.9	30.2	49	1.24	33.6	42.8	28	1.15
Cornwall	36.2	27.3	35	1.41	34.4	34.5	41	1.37
Cumberland	31.2	40.9	41	1.19	37.7	56.8	24	1.07
Derby	29.8	42.5	25	1.11	33.1	43.7	19	1.08
Devon	25.4	29.5	49	1.37	25.6	30.2	59	1.42
Dorset	27.7	23.7	44	1.34	31.6	30.0	51	1.32
Durham	42.4	58.4	18	0.76	38.6	57.6	18	0.62
Essex	29.0	22.7	39	1.27	24.6	30.0	26	1.15
Gloucester	24.9	27.6	38	1.25	29.3	30.9	55	1.35
Hereford	33.4	23.7	51	1.35	31.1	38.1	47	1.30
Hertford	21.2	18.5	55	1.30	25.4	24.9	41	1.26
Kent	24.4	28.4	45	1.26	26.0	31.7	43	1.24
Lancashire	31.8	41.4	27	1.17	36.3	44.7	14	1.07
Middlesex	21.7	30.1	53	1.24	26.4	33.1	34	1.14
Norfolk	32.9	26.8	40	1.33	30.1	36.1	48	1.36
Northumberland	32.8	39.4	45	0.93	35.4	55.1	23	0.78
Nottingham	30.6	37.9	30	1.25	34.9	47.8	18	1.12
Oxford	28.8	24.7	52	1.33	31.0	27.4	40	1.35
Shropshire	32.9	28.8	48	1.21	28.7	33.1	40	1.18
Somerset	25.3	24.9	44	1.36	25.4	24.7	42	1.32
Stafford	32.6	34.8	34	1.13	35.9	51.8	15	0.95
Surrey	26.7	21.7	79	1.36	22.3	28.3	61	1.29
Warwick	27.9	33.2	32	1.15	30.6	34.3	39	1.24
Westmorland	30.3	27.8	55	1.40	36.6	35.8	53	1.33
Wiltshire	27.5	23.8	41	1.25	31.7	25.9	32	1.25
Worcester	26.1	32.1	36	1.21	28.6	40.6	28	1.13
York (E.R.)	31.8	37.5	43	1.27	28.9	27.0	52	1.34
York (N.R.)	29.6	33.9	46	1.31	36.2	50.7	34	1.12
York (W.R.)	34.9	54.1	27	1.08	34.6	52.9	18	1.01
Glamorgan	32.8	48.4	22	1.07	32.1	55.9	17	1.02
Monmouth	32.1	26.9	19	1.18	35.2	50.6	16	0.97
Cambridge	31.4	30.3	32	1.32	30.3	31.1	43	1.39
Lincoln	29.3	37.6	34	1.32	29.8	41.6	32	1.26
Northampton	27.9	27.9	37	1.32	37.5	32.4	20	1.28
Southampton	24.7	25.1	55	1.35	27.3	26.8	42	1.30
Suffolk	31.5	21.6	42	1.30	31.1	28.0	42	1.34
Sussex	26.1	19.2	68	1.37	25.1	26.8	84	1.35
Leicester	28.3	32.5	29	1.29	33.4	38.2	19	1.21
North Wales	31.7	47.4	39	1.20	31.1	45.0	49	1.29
South Wales	28.7	46.8	32	1.24	25.6	47.5	29	1.23