

An Enquiry
into
Infantile Mortality,
with special reference to its Causation
and Prevention.

By

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and the high infantile mortality. . . . Notice will be taken of the
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I N T R O D U C T O R Y

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The present paper is the result of an enquiry into Infantile Mortality with special reference to its Causation and Prevention. The importance of the subject is manifest to all whose attention has been drawn to it in even the most casual manner. The general death rate, and child mortality rate in England and Wales have fallen by almost regular descent during four decades, and this decline is co-incident with advances made by Sanitary Science and Preventive Medicine. But the mortality among infants under one year of age has shown little or no improvement during this period. Thousands of infants are dying year by year who ought in all reasonableness to live and grow up useful citizens.

In view of these facts any measures which promise a reduction of infantile mortality are worthy of the serious attention not only of the Student of Preventive Medicine, but also of the Social Economist and the Humanitarian.

Associated with, and, as the writer believes, very intimately connected with, a maintained high infantile mortality, there has been a pronounced and regular decline in the birth rate of all large civilized countries of the world. This is bringing us face to face with one of the greatest problems of modern times. In some nations this decline has reached such a position that the number of births will soon be less than the number of deaths, and obviously a continuation in that direction means eventually the complete disappearance of those peoples. Such a phenomenon has already occurred in the world's history.

It has been thought useful, therefore, to preface the discussion of this theme by considering the question of the declining birth rate at home and abroad; and to establish the relationship between the falling birth rate in England and Wales

and the high infantile mortality. Notice will be taken of the principal individual causes of infant deaths, giving such weight to each as the facts gathered together seem to warrant. Next there will be attempted an elucidation of the factors underlying and permeating all these more proximate causes; and this the writer regards as a most important aspect of the subject, involving as it does not only questions of general medicine, and of sanitary administration, but also wider questions of a moral and social kind. Finally, on the basis thus established, an attempt will be made to fix the principles to be observed in all measures of prevention, and, whilst in doing this the highest ideal will ever be kept in view, special emphasis will be laid on such means as lie within the region of practical medicine, and of practical politics.

It should be stated that all the figures here used are culled from reliable and easily verifiable sources, but many of the groupings of the figures are original to establish a certain line of reasoning.

(1) Infantile Mortality among the Illegitimate.

(2) Comparison of the Infantile Mortality, with the Child Mortality and the General Death Rate.

(3) The relation between the Birth Rate and Infantile Mortality.

(4) The Influence of the Birth Rate and Infantile Mortality on the General Death Rate.

(5) The Relation between the General Death Rate and Infantile Mortality.

1. Birth Rate.

(1) The Birth Rate in England and Wales.

1. BIRTH RATE.

(1) The Birth Rate in England and Wales.

(2) Illegitimate Birth Rate.

(3) Still Births.

(4) Remarks on the decline in the Birth Rate.

2. INFANTILE MORTALITY.

(1) General statistics of Infantile Mortality in England and Wales.

(2) Infantile Mortality among the Illegitimate.

(3) Comparison of the Infantile Mortality, with the Child Mortality and the General Death Rate.

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(5) The Influence of the Birth Rate and Infantile Mortality on the General Death Rate.

(6) The relation between the General Death Rate and Infantile Mortality.

1. Birth Rate.(1) The Birth Rate in England & Wales.

During the year 1903, 948,271 births were registered and the males were in proportion to the females as 1035 is to 1000. Calculated in proportion to total population at all ages these births were equal to a rate of 28.4 per 1,000. The birth rate in 1902 expressed in the same way was equal to 28.5, and the average birth rate for the ten years 1893 - 1902 was 29.4 per 1,000 persons living at all ages.

The birth rate is found to vary widely in different parts of the country. Among registration counties with populations exceeding 100,000, the birth rate ranged in 1903 from 21.9 in Sussex, 22.6 in Cornwall and 22.9 in Devonshire, to 35.2 in Monmouthshire and in Glamorganshire, and 35.5 in Durham. (1)

Among 33 large towns* in England & Wales the birth rate in 1903 ranged from 21.1 in Halifax, 23.3 in Bradford and 23.8 in Huddersfield, to 33.7 in West Ham, 35.1 in Sunderland, and 35.8 in Gateshead. (2)

The following table shows the mean birth rate of England & Wales, calculated per 1,000 total population at all ages, in 3 year periods, embracing the four last census years, and on the estimated population in 1903:- (3)

T A B L E 1.

| Three year periods. | | | | Year |
|---------------------|---------|---------|---------|-------|
| 1870-72 | 1880-82 | 1890-92 | 1900-02 | 1903. |
| 35.3 | 34.0 | 30.7 | 28.6 | 28.4 |

It will be seen that the decline in the birth rate from 1870 - 72 to 1903 is no less than 19.5 per cent.

- (1) Sixty sixth annual report Registrar General.
 (2) Annual summary of Registrar General. 1903.
 (3) Sixty sixth annual report Registrar General.

* Note:- The 33 large towns referred to here, and in subsequent parts of this paper are: London, Croydon, West Ham, Brighton, Portsmouth, Norwich, Plymouth, Bristol, Wolverhampton, Birmingham, Leicester, Nottingham, Liverpool, Manchester, Salford, Oldham, Bradford, Leeds, Sheffield, Hull, Sunderland, Gateshead, Newcastle-on-tyne, Derby, Berkenhead, Bolton, Blackburn, Burnley, preston, Huddersfield, Halifax Cardiff and Swansea.

To express birth rates, however, in terms of total population at all ages, is open to the objection that it does not take account of the age constitution of the population, and in particular that it does not have regard to the female population at conceptive ages. The birth rate, it may be taken, must needs be ruled by the number of women living aged from 15 to 45 years.

The importance of bearing this in mind in connection with birth rates is brought out by a consideration of the following facts.

The census returns from 1871 to 1901 show that both in 1871 and in 1881 the proportion of women aged 15 to 45 was 23.1 per cent of the total population; in 1891 the proportion was 23.8 per cent, and had increased to 25 per cent in 1901.

On the other hand the returns from 1871 to 1901 show that the female population aged 15 to 45 contained not an increasing, but a constantly decreasing, proportion of married women, and further that among these married women, the proportion of those at ages under 25 years has continuously decreased. Thus of the total number of married women (15 to 45 years) the proportion of those aged 15 to 25 years was 15.2 in 1871, 14.8 per cent in 1881, 13.7 per cent in 1891, and as low as 12.4 per cent in 1901.

It therefore becomes evident that a more accurate method by which to express the birth rate would be to take account, as far as possible, of these varying factors. But the age and marital condition of the female population is only known with accuracy at or about census periods. At these periods, however, 3 other methods of expressing the birth rate become possible. It may be expressed as:-

- (1) The proportion of total births per 1,000 women aged 15 to 45 years.
- (2) The proportion of legitimate births per 1,000 married women aged 15 to 45 years.
- (3) The proportion of illegitimate births per 1,000 unmarried and widowed women aged 15 to 45 years.

The following table gives the birth rates as calculated by these 3 alternative methods in three year periods, embracing the four last census years, and on the estimated population of each class in the year 1903. The percentage of decline of the birth rate from the three-year-period 1870 - 72 to the year 1903 is also set forth.(1)

T A B L E 2.

| Age 15 to 45 years. | Birth rate per 1,000. | | | | | Percentage decline 1870-72 - 1903. |
|---------------------------|-----------------------|---------|---------|---------|-------|---|
| | 1870-72 | 1880-82 | 1890-92 | 1900-02 | 1903 | |
| All women | 153.7 | 147.7 | 129.7 | 114.8 | 113.8 | 26.0 |
| Married women | 292.5 | 286.0 | 263.8 | 235.5 | 233.3 | 20.3 |
| Unmarried and Widowed. | 17.0 | 14.1 | 10.5 | 8.5 | 8.4 | 50.9 |

Calculated on the total population at all ages the decline per cent from 1870 - 72 to 1903 was shown to be 19.5. But the calculations by the more accurate methods, as have been done in the above table, prove that the true decrease which has occurred is not adequately shown by simply calculating the rate on the total population, and that it therefore fails to disclose the amount of decrease that has actually occurred. In the sixty-sixth annual report of the Registrar General, it is pointed out that if the average fecundity of the female population at ages 15 to 45 had remained constant, the births in proportion to the total population would have increased during the past 30 years by nearly 2 per cent. Stated in another way this means that had the ratio of births to the female population of conceptive ages been identical in 1871 and in 1903 the births registered in the latter year would have amounted to upwards of one and a quarter millions instead of 948,271 actually recorded.

(1) Compiled from Sixth sixth annual report Registrar General.

(2) Illegitimate Birth Rate.

During the last fifty years the number of illegitimate births per 1,000 population at all ages has varied from a maximum of 2.3 in the years 1859, 1863, and 1864 to a minimum of 1.1 in each of the years 1900 to 1903. In the latter year 37,302 illegitimate births were registered.

The illegitimate birth rate has declined with the legitimate birth rate, and the true extent to which this has occurred since 1870 - 72 is shown in Table 2, where the calculation is made as a proportion to unmarried and widowed women aged 15 to 45 years.

The decline in the illegitimate birth rate, though it contributes to a small extent to the decline in the general birth rate, cannot, of course, be regarded as other than satisfactory, not only on grounds of morality, but also on account of the important bearing which illegitimacy will be shown to have on infantile mortality.

(3) Still Births.

The consideration of this subject is closely connected with that of infantile mortality. Neech (1) from enquiries in Halifax over a series of years gives data which show that out of every 1,000 births 50 are still born; while Greenwood found that in Blackburn (2) in the year 1904, 64 still births occurred in a thousand births. No provision exists in England for the registration of still births. There can be no question that this is a condition of affairs calling for remedy. The report of the Committee of the House of Commons on Death Certification (3) says "There is reason to think that if the statistics

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- (1) Neech "Annual Report on the Health of the County Borough of Halifax for 1903"
- (2) Greenwood "Annual Report upon the Health of Blackburn for 1904"
- (3) "Report of the Select Committee of the House of Commons on Death Certification" September 1893.

(1) The difference between the birth rate and the death rate on the subject could be obtained, it would be found that the number of children buried in the United Kingdom annually as still born is enormous", and the Committee are further convinced that

"the absence of legal requirement that such still-births should be registered prior to disposal of the bodies is fraught with very serious danger to child life". That this danger is especially great in the case of illegitimate children can readily be understood. One of the recommendations of the Inter-Departmental Committee on Physical Deterioration is that still births should be registered. (1) The statutory rules under the Midwives Act of 1902, which came into force on 1st April 1905, make

a step in the right direction, by requiring Midwives to immediately give notice to the Authorities whenever a still birth occurs in their practice. What is necessary, however, is that all still births should be officially certified and registered, so that where desirable some inquiry could be made into the circumstances under which they occur.

An examination of the report on the census of 1901 discloses the fact that although the actual increase 12.16 per cent during 1891 - 1901 in England & Wales was at a higher rate than that during 1881 - 1891, when the rate of increase was 11.66 per cent; the growth in the population was not due to any greater rate of natural increase but is actually associated with a decline in that rate. In other words the higher rate of actual increase in the decade 1891 - 1901 is not due to a

(4) Remarks on the Decline in the Birth Rate.

A reference to the Registrar General's report shows that during recent years there has been a marked decline in the birth rate not only in England and Wales, but also in most British Colonies and other large civilised countries of the world. The extent to which this has occurred in England and Wales and the manner of the decline will be seen by a reference to Tables 1 and 2.

If the birth-rate equals the death rate, and immigration balances emigration, it is obvious that no numerical change occurs in a population. The increase or decrease of any population is governed therefore by two factors:-

| Period | Natural Increase | Actual Increase |
|-------------|------------------|-----------------|
| 1891 - 1891 | 12.33 | 12.16 |

(1) Report of the Inter Departmental Committee. Physical Deterioration 1904. p.88. characterized these periods.

(1) General Report on the Census - England & Wales 1901. p.16

- (1) The difference between the birth rate and the death rate.
- (2) The difference between immigration and emigration.

If the birth rate exceeds the death rate in a (stationary) population the excess of births over deaths gives the natural increase; and conversely if the death rate exceeds the birth rate the excess gives the natural decrease of that population. In the same way the difference between immigration and emigration produces a further change in one direction or the other. The net result between these two factors determines the actual (or total) increase or decrease.

An examination of the report on the census of 1901⁽¹⁾ discloses the fact that although the actual increase 12.16 per cent, during 1891 - 1901 in England & Wales was at a higher rate than that during 1881 - 1891, when the rate of increase was 11.66 per cent; the growth in the population was not due to any greater rate of natural increase but is actually associated with a decline in that rate. In other words the higher rate of actual increase in the decade 1891 - 1901 is not due to a higher rate of natural increase but to a decline in emigration, or an increase in immigration.

The natural increase as determined by the excess of births over deaths, and also the actual increase as finally determined by the other factor, in England and Wales from 1871, is shown in the following table.

T A B L E 3.

| Period. | Natural increase per cent. | Actual increase per cent. |
|-------------|----------------------------|---------------------------|
| 1871 - 1881 | 15.09 | 14.36 |
| 1881 - 1891 | 13.97 | 11.66 |
| 1891 - 1901 | 12.39 | 12.16 |

This result is due for the most part to the continuous decline in the birth rate which has characterised these periods,

(1) General Report on the Census - England & Wales 1901. p.16

and is arrived at in spite of the simultaneous decline in the general death rate which has occurred.

The following table (1) shows the average birth rate for 24 different Countries and British Colonies arranged in the order of highest birth rate. For convenience the average infantile mortality is also here set forth.

T A B L E 4.

Average Birth rates and Infantile Mortality for 10 years

| Country | 1893 - 1902. | | Country | Births per 1,000 Living | Deaths of children under 1 year per 1,000 births. |
|------------------|--------------------------|---|-------------------|-------------------------|---|
| | Births per 1,000 Living. | Deaths of children under 1 year per 1,000 births. | | | |
| Russia(European) | 48.6 | 272 | Scotland | 29.9 | 127 |
| Hungary | 40.0 | 224 | Tasmania | 29.6 | 93 |
| Jamaica | 39.1 | 171 | New South Wales | 29.1 | 111 |
| Prussia | 36.5 | 199 | Belgium | 28.9 | 157 |
| German Empire | 35.9 | 195 ⁽²⁾ | Western Australia | 28.9 | 146 |
| Ceylon | 35.6 | 170 | Switzerland | 28.3 | 145 |
| Chili | 35.6 | 333 | South Australia | 27.9 | 146 |
| Italy | 34.3 | 173 | Victoria | 27.1 | 109 |
| The Netherlands | 32.3 | 152 | Sweden | 27.0 | 99 |
| Norway | 30.2 | 94 | New Zealand | 26.3 | 81 |
| Denmark | 30.0 | 133 | Ireland | 23.1 | 104 |
| Queensland | 30.0 | 103 | France | 22.0 | 158 |

(1) For 10 years 1890 - 99 (2) For 2 years 1901-02.

Of these, the birth rate in Ireland in 1903 was the same as the average for the decade 1893 - 1902. In four British Colonies, namely, Ceylon, Jamaica, Western Australia, and New Zealand the rates in 1903 exceeded the average. The returns for the German Empire and for Tasmania are not to hand for the year 1903.

(1) Compiled from the International Vital Statistics Sixty sixth Annual Report Registrar General P.CLXXVI et seq.

Of the remaining 17 countries shown in the table the birth rate in 1903 was below the average.

Special interest attaches to the returns from New South Wales where the birth rate had declined from the average of 10 years, (29.1) to 25.3 in the year 1903 (1) The New South Wales Government appointed a Royal Commission in 1903 to enquire into the decline in the birth rate in that colony. The following table (2) from the report of this Commission indicates the manner in which the decline in the birth rate of the several colonies has come about. The birth rates per 1,000 population at all ages are shown in successive quinquennia from 1871 to 1900. The writer has added the rates for the Census year 1901 (3)

T A B L E 5.

| Period. | N. South Wales. | Victoria | Queens-land | S. Austl. | W. Austl. | Tasmania | New Zealand. |
|-----------|-----------------|----------|-------------|-----------|-----------|----------|--------------|
| 1871-1875 | 39.5 | 35.69 | 40.81 | 37.24 | 31.30 | 29.72 | 40.02 |
| 1876-1880 | 38.53 | 31.43 | 36.72 | 38.28 | 32.95 | 31.54 | 41.32 |
| 1881-1885 | 37.65 | 30.76 | 36.37 | 38.52 | 34.57 | 35.02 | 36.50 |
| 1886-1890 | 36.36 | 32.72 | 38.81 | 34.48 | 36.88 | 34.59 | 31.22 |
| 1891-1895 | 32.92 | 30.93 | 35.15 | 31.54 | 30.77 | 32.84 | 27.66 |
| 1896-1900 | 27.98 | 26.22 | 30.40 | 26.59 | 28.73 | 28.28 | 25.74 |
| 1901. | 27.6 | 25.7 | 28.3 | 25.4 | 30.4 | 28.4 | 26.3 |

The decline has been least marked in Western Australia and Tasmania, but in every other colony it has been considerable. The figures for New South Wales are very striking, a decline from over 39 to less than 28 having been arrived at in marked and successive downsteps unrelieved by even a pause.

- (1) International Vital Statistics Sixty Sixth Ann. Rep.Reg.Genl.
- (2) Report of the Royal Commission on the decline of the birth rate and on the Mortality of Infants in New South Wales 1904.
- (3) International Vital Statistics, Sixth Sixth Annual Report Registrar General.

Statistics from Canada leave little doubt that the birth rate among the inhabitants of British origin is remarkably low. In Ontario, where British stock predominates, the birth rate in 1901 was only 21.1; in the Province of Quebec, which is chiefly French Canadian, it was 35. In the year 1902 the mean birth rate of the 35 counties of which the Province of Quebec is comprised was 42.2, reaching no less than 53.2 in the County of Beauce (1) In the City of Montreal the population is divided into 3 classes, viz:- French Canadian, Other Catholics, and Protestants. The birth rate in 1902 for each class was as follows:- (2)

T A B L E 6.

| Three Classes. | Birth rate per 1,000 population. |
|----------------------------|-------------------------------------|
| French Canadian Catholics, | 43.5. |
| Other Catholics, | 22.4. |
| Protestants. | 23.7. |

The high birth rate of the "French Canadian Catholics," who are orthodox Roman Catholics, is remarkable. It should also be noted how closely the rate for "other Catholics", who are not orthodox Roman Catholics, approaches to that of the average for France 22.0. Newsholme draws an important conclusion from these facts which will presently be noted.

It is pertinent to enquire, what may be the causes of this decline in the birth rate?

For the purpose of statistics the child-bearing age may be considered as from 15 to 45 years. Therefore the age of women at marriage is the chief physiological factor determining the proportion of children to a marriage. The age of women at

(1) "Annual Report of the Board of Health of the Province of Quebec" 1902 - 1903.

(2) "Annual Report of the Medical Officer of Health of the City of Montreal" 1902.

marriage has been steadily rising in this country for over a quarter of a century. In the quinquennium 1876 - 80 the proportion of minors among wives was 217 per 1,000 marriages; and the proportion has successively declined from that period to 152 in 1903. The manner of the change is shown in the following table. (1)

T A B L E 7.

| Period. | Women under age per 1,000 marriages. |
|--------------|--------------------------------------|
| 1876 - 80. | 217.0. |
| 1881 - 85. | 215.0. |
| 1886 - 90. | 200.2. |
| 1891 - 95. | 182.6. |
| 1896 - 1900. | 168.0. |
| 1901. | 159.9. |
| 1902. | 153.7. |
| 1903. | 152.3. |

No reliable statistics exist in this country showing the age of mothers at the birth of their children, and so the fecundity of women at different ages cannot be determined.

M. Kőrösi, (2) however, has shown that the fecundity of the female in Budapest reaches its maximum between the 18th and 19th year, descending then in a regular line to the age of 45 - 50 when it ceases. Every hundred marriages of girls under 18 years of age only produce within a year 36 - 38 infants. From 18 - 20 years fecundity reaches its maximum of 40 per cent. i.e. 40 children within a year. At 25 years it is 32 per cent; at 30 years it is 24 per cent; at 35 years 17 per cent; at 40 years scarcely 7 per cent; at 50 years 0.1 per cent.

(1) Sixth Sixth annual report Registrar General, p.XI.

(2) Quoted by Newsholme "Vital Statistics", 1899. p.66.

It is significant to note that the decline in the birth rate in England & Wales is coincident with a change in the age constitution of married women, and from the researches of Kőrösi in Budapest it seems probable that this change in the age constitution of married women, and the decline in the birth rate in England & Wales may stand in some measure in the relation of cause and effect.

The marriage rate in England & Wales has been declining through three decades, though this is not obvious from the marriage rate as usually stated - that is persons married per 1,000 living at all ages. Thus the mean marriage rates (1) in the three year periods (containing in each period the census year) 1880 - 82, 1890 - 92, 1900 - 02, were respectively equal to 15.2, 15.5, and 15.9 persons married per 1,000 total population, and would suggest a steady rise in the marriage rate. But since a large majority of the population are either already married, or are below the minimum age at which marriages take place, the total population is not a satisfactory standard by which to measure the rate of marriage. If the rates be calculated on the unmarried and widowed portion of the population at ages above 15 years, the apparent increase is turned into a decrease thus:-

T A B L E 8.

| Three year periods. | Persons married per 1,000 unmarried and widowed above 15 years. |
|---------------------|---|
| 1880 - 82. | 51.5. |
| 1890 - 92. | 49.8. |
| 1900 - 02. | 48.7. |

The marriage rate in England and Wales has therefore decreased in proportion to that section of the population among which marriages take place. This must in some degree contribute

(1) Sixty sixth annual report Registrar General. p.VI.

to the decline in the English birth rate.

As is well known, France in regard to a falling birth rate is, and has for a long time been, in a much worse position than this country. One writer (1) (Emile Macquart) looks on the existing condition with Gallic complacency and suggests that civilization and a low birth rate go hand in hand, and that in this respect, as in others, France is simply in the van of civilization. Arseni Dumont, (2) on the other hand, looks at the subject more seriously, and, the writer would say, more sensibly. He finds that the age at marriage is steadily rising. Of the whole male population of France aged 15 to 24 years 3.6% are married; of those aged 20 to 24 years 7% are married; and at ages 25 to 29 years 50% are married. Again, amongst males from 18 to 49 years of age, 45.8% are unmarried, and amongst females between 15 and 49 years 44.9% are single. Why do not these two unmarried groups come together? Dumont enumerates several reasons:-

1. State of Society - increasing difficulty for young men to establish themselves in life.
2. Dotal difficulty.
3. Military service.
4. Celibate example of Church.
5. Tendency of the age to personal comfort.

There is reason to believe that drunkenness is on the increase among women. Several competent witnesses before the Inter-Departmental Committee on Physical Deterioration testified to this in no uncertain manner. The relation of "Cirrhosis of the liver" to intemperance is well recognised. The following table (3) gives the average male and female death rate per million living from this cause, in two quinquennial periods 25 years apart:-

(1) Bull. et Men. Soc. d'Anthrop. de Paris.
5S III. 1902. Noticed in B.M. Jour. 1903. Vol. 1. p. 267.

(2) *ibid.*

(3) Sixth-Fifth Annual Report. Reg. General. P. LVI.

The following statistics as to the births per 1,000 women

T A B L E. 9.

| Average. | Male death rate. | Female death rate. |
|-------------|------------------|--------------------|
| 1873 - 77 | 111 | 74 |
| 1898 - 1902 | 155 | 115 |
| Difference. | + 40% | + 55% |

It is well known that alcoholism is a cause of sterility, still births, and of premature births. It will at any rate be shown that the infantile death rates from premature birth, and from congenital defects, have enormously increased; and it has been shown that about 50 still births occur for every 1,000 infants born alive. This must in part be laid to the charge of alcoholism.

(1)

So far as the Registrar General's returns can show there is no reason to believe that Syphilis is more operative now than formerly, both the male and female death rates from syphilis having irregularly declined from 1884 to 1902. In 1903, however, there was a slight rise in the death rate from Syphilis for both sexes. The statistics for syphilis, however, are notoriously unreliable.

It has already been noted that the illegitimate birth rate in England and Wales has declined about 50 per cent, and this must in a small measure contribute to the general decline.

It would appear that the decline in the birth rate is not equally shared by all classes of the Community. Slumdom still makes a liberal contribution to the population of our great cities. ~~also~~ It will ^{also} be shown that this is the class of community in which infantile mortality is highest.

Bertillon, (2) at a meeting of the International Statistical Institute at St Petersburg, September 1897, gave

(1) Sixty Sixth annual Report Registrar General.

(2) Newsholmes Vital Statistics 1899. p.75.

the following statistics as to the births per 1,000 women aged 15 to 50 per annum in different quarters of the under noted cities:-

T A B L E 10.

| Classification. | Paris. | Berlin. | Vienna. | London. |
|-----------------------|--------|---------|---------|---------|
| Very poor quarters. | 108. | 157. | 200. | 147. |
| Poor quarters. | 95. | 129. | 164. | 140. |
| Comfortable quarters. | 72. | 114. | 155. | 107. |
| Very comfortable " | 65. | 96. | 153. | 107. |
| Rich Quarters. | 53. | 63. | 107. | 87. |
| Very rich quarters. | 34. | 47. | 71. | 63. |
| Average. | 80. | 102. | 153. | 109. |

If the marriage and birth rates of certain Registration districts in London, selected on social grounds, be calculated for the year 1903, on the census population of 1901, the following result is obtained. The infant deaths per 1,000 births in 1903 are also shown:- (1)

T A B L E 11.

| Rate per 1,000 persons living | St Georges Hanover Sq. | Kensington. | Hackney. | Stepney. | White-Chapel. |
|-------------------------------|------------------------|-------------|----------|----------|---------------|
| Marriage rate. | 21.3. | 18.4. | 14.8. | 15.1. | 14.4. |
| Birth rate. | 17.5. | 20.3. | 26.9. | 32.3. | 36.3. |
| Infantile Mortality. | 141. | 145. | 128. | 208. | 194. |

If other large towns be examined in the same way the same general tendency is found, namely, the lower the stratum of society, the higher is the birth rate, and the higher also is the rate of infantile mortality.

(1) Calculated from data in Sixth sixth ann Rep. Reg. General, and in Registrar General's Summary 1903.

It would therefore appear that those who can best afford to have large families and bring them up respectably have very small families, while the parents in the slums have as a rule very large ones. Since there is no reason to believe that social status per se has any effect upon fecundity, one is forced to the conclusion that much of the decline in the birth rate is due to deliberate restraint. Newsholme (1) from an examination of certain factors comes to the conclusion that it is quite clear that the main cause of the diminution in the birth rate is "the deliberate and voluntary avoidance of child-bearing on the part of a steadily increasing number of married people, who not only prefer to have but few children, but who know how to obtain their wish". That this is the chief reason is shown by the extremely high birth rate among the French population in Canada, and the abnormally low birth rate in France. The difference, he continues, is inexplicable on the score of climate, or, indeed, on any other known cause, except that the former, who are orthodox Roman Catholics, are prohibited by their religious belief from practising the artificial means of preventing large families which finds favour in France.

In support of this the writer would point out that in the orthodox Roman Catholic country of Spain the birth rate for the last quarter of a century has maintained a high level, being 35.8 in 1879, and 36.4 in 1903. (2).

It would therefore appear that the decline in the birth rate in England and Wales is due to the following factors:-

1. Rise in the age of women at marriage.
2. Decline in the marriage rate.
3. Increase of drunkenness among women leading to still births and sterility.
4. Decline in the illegitimate birth rate.
5. Deliberate restraint: perhaps the most important factor.

(1) Newsholme: "Vital Statistics", 1899. p.79.

(2) International Vital statistics; Sixty Sixth Annual Report, Registrar General.

2. INFANTILE MORTALITY.

(1) General Statistics of Infantile Mortality in England & Wales.

The rate of Infantile Mortality is of great interest from the point of view of Public Health, and is regarded by some as one of the most sensitive tests of the health of communities.

The Registrar General expresses the infantile mortality as the annual number of deaths of infants under one year of age to every thousand births during the same year. This method of calculation is rendered necessary on account of the difficulty of otherwise determining the infant population, since there is reason to believe that the ages of infants are frequently incorrectly returned at the census. A more accurate method, however, of determining the infantile population would be to take the mean of the births of the current and immediately preceding year, but as this is not usually done, the method of the Registrar General will be adopted in this paper.

During the year 1903, 948,271 births were registered in England and Wales; and during the same period the death of 124,718 infants under one year of age occurred. The infantile mortality is therefore obtained by the following proportion:-

$$948,271 : 124,718 :: 1,000 : 131.52.,$$

or in a round number as stated by the Registrar General the rate for the whole of England & Wales in the year 1903 was 132.

The infantile mortality, like the general death rate, is found to vary widely in different parts of the country, according as the place in question is either densely or sparsely peopled. In order to show the general effects of density of population upon mortality the Registrar General has made a selection from the Registration counties of England & Wales, and the selected counties are thrown into two groups. (1)

(1) Sixty-fourth Annual Report Registrar General.

The first group includes the chief industrial centres, and is for that reason mainly urban in character, and is designated in the reports of the Registrar General as the "Urban Counties". The group includes the counties of Glamorgan, Lancaster, London, Middlesex, Monmouth, Northumberland, Nottingham, Stafford, Warwick, and the East and West Ridings of Yorkshire, and has a population of over 18 millions.

The second group contains only a few relatively unimportant towns and villages, and is therefore mainly rural in character, and is designated in the reports as the "Rural Counties". The group includes the counties of Buckingham, Cambridge, Cornwall, Hereford, Huntingdon, Lincoln, North Wales, Norfolk, Oxford, Rutland, Salop, Somerset, South Wales (less Glamorgan) Suffolk, Westmorland, and Wilts, and has a population of over 4 millions.

From these two counties groups the infantile mortality is calculated, the object being to ascertain by appeal to facts sufficiently numerous the rate that may be considered for the time being normal in England and Wales, in Urban, and in Rural Areas respectively.

The following table (1) shows the infantile mortality in England & Wales, and in Urban and Rural Counties for each sex separately, and for both sexes together, in 1903, and the corresponding averages for the quinquennium 1898 - 1902.

T A B L E 12.

| | Males. | | Females. | | Both Sexes. | |
|-----------------|--------------------|-------|--------------------|-------|--------------------|-------|
| | 1898 I 1902. | 1903. | 1898 I 1902. | 1903. | 1898 I 1902. | 1903. |
| England & Wales | 167. | 145. | 137. | 118. | 152. | 132. |
| Urban Counties | 180. | 156. | 149. | 129. | 165. | 143. |
| Rural Counties | 139. | 120. | 111. | 94. | 126. | 107. |

(1) Compiled from Table J. Sixth sixth Ann. Rep. Registrar General.

On comparing the infantile mortality of the Urban with that of the Rural counties it will be observed that in the former area the rate is uniformly higher than in the latter; and further, that in England and Wales as a whole, and also in both areas, the male rates are considerably in excess of the female. This is true with respect to the year 1903 as well as to the quinquennial period 1898 - 1902. The table also shows that in both sexes, not only in England and Wales as a whole, but also in each counties group, there has been in 1903 a reduction in the infantile mortality rate.

In view of the consideration which has to follow, it may be here stated that with the single exception of the year 1881, when the infantile mortality in England & Wales was 130, the year 1903 with its rate of 132 is a record, just excelling the previous year 1902 when the rate was 133. In the annual Report for 1902 the Registrar General announced a general mortality for that year more favourable than any that until then had been attained since the inauguration of civil registration in 1837. This distinction now belongs to the year 1903. The low infantile mortality in 1902, and in 1903, has to be accounted for, in part at least, by the highly favourable conditions of weather which characterised these years. The summers of both years were remarkably cool and wet, with an absence of any long periods of heat and drought, which when present are generally associated with exceptional fatality from infantile diarrhoea.

Among the counties of England and Wales with populations exceeding 100,000 the infantile mortality in 1903 ranged from 84 in Hertfordshire and Oxfordshire, and 85 in Wiltshire, to 152 in Northumberland, 154 in Lancashire, and 156 in Durham(1).

Among the 33 large towns of England & Wales the infantile mortality in 1903 ranged from 108 in Croydon, and 114 in Brighton

(1) Sixty-sixth Annual Report. Registrar General. Table 11.

and Portsmouth, to 169 in Manchester, 182 in Sheffield, and 217 in Burnley. In London it was 131, as compared with an average of 158 in the ten preceding years. (1)

The infantile mortality in different countries and British Colonies is shown on Table 4 of this paper.

2. Infantile Mortality among the Illegitimate.

Newsholme (2) gives figures from the infantile mortality experience of Brighton, and summarises a large number of returns on the same subject by Dr Farr, which go to show that the chance of an illegitimate child reaching the end of its first year of life is very much less than that of a child born in wedlock.

The following table (3) compares the rate of mortality among legitimate and illegitimate infants in Manchester and was submitted by Dr Niven in his evidence before the Physical Deterioration Committee.

TABLE 13.

| Infant deaths per 1,000 births - Manchester. | | | | | |
|--|-------|-------|-------|-------|-------|
| Year. | 1898. | 1899. | 1900. | 1901. | 1902. |
| Legitimate. | 187. | 196. | 179. | 188. | 147. |
| Illegitimate. | 401. | 425. | 432. | 463. | 263. |

Data submitted to the same Committee by Dr Chalmers of Glasgow show that while both rates compare favourably with those for Manchester, a similar marked excess of illegitimate over legitimate death rate obtains(4).

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- (1) Registrar General's summary 1903. Table 3.
 - (2) Newsholme: "Vital Statistics" 1899.
 - (3) Appendix. Rep. Inter. Depart. Com. Phys. Deter. P.49.
 - (4) Ibid. p.24.

T A B L E 14.

| Infant deaths per 1,000 births. - Glasgow. | | | | | |
|--|-------|-------|-------|-------|-------|
| Year. | 1898. | 1899. | 1900. | 1901. | 1902. |
| Legitimate. | 147. | 143. | 145. | 141. | 126. |
| Illegitimate. | 302. | 286. | 286. | 269. | 244. |

The subject will be further discussed when considering the factors in the causation of infantile mortality.

(3) Comparison of the Infantile Mortality, with the Child Mortality and the General Death Rate.

The extent to which the infantile mortality rate, child mortality rate, and the general death rate have varied in England and Wales during the fifty years 1854 to 1903 is shown in the following table, the rates being expressed as averages in five successive decennia: (1) By child mortality the writer means the death rate at age group 0 - 5 years.

T A B L E 15.

Infantile Mortality, Child Mortality & General Death Rate
1854 - 1903.

| Period. | 1854-63. | 1864-73 | 1874-83 | 1884-93 | 1894-1903 |
|----------------------|----------|---------|---------|---------|-----------|
| Infantile mortality. | 151.4. | 155.4. | 143.9. | 146.6. | 149.5. |
| Child mortality. | 67.8. | 67.3. | 59.0. | 57.0. | 55.0. |
| General Death rate | 22.1. | 22.4. | 20.7. | 19.2. | 17.2. |

From the above table it will be seen that there has been no maintained decline in the infantile mortality during half a century; that the infantile mortality of the decennium 1894 - 1903 shows but little improvement upon that of the decennium 1854 - 63; and that the last two decades are characterised not

(1) Compiled from table 3, sixty sixth annual report, Registrar General.

Further by any decline, but by successive increase in that rate. On the other hand, child mortality, and the general death rate, show an almost unbroken decline, and it is significant to note that this decline is coincident with enormous advances in sanitary science and preventive medicine. *from 1874-83*

If the rates in the decennium 1854 - 63, be compared with the same rates in the decennium 1894 - 1903, it will be found that while the general death rate has fallen 22.2 per cent., and that of child mortality 18.9 per cent., the infantile mortality rate has only been reduced by 1.3 per cent.

The fact that this decline in the general death rate, and in child mortality has been coincident with, and probably in the main the result of, enormous advances in sanitary science and preventive medicine, cannot be better emphasized than by the following quotation from the Registrar General's report for 1881, for it applies to the present with even greater force than at the time it was written:-

"There is nothing in the series of annual reports issued by this office that comes out more distinctly and unmistakably than the wonderful effect which the sanitary operations of the last decade have had in saving life. The Public Health Act came into operation in 1872. The average annual death rate for the immediately preceding 10 years (1862 - 1871) had been 22.6 and there were no indications whatsoever of any tendency of the rate to fall lower. Indeed in 1871 the final year of this period, the rate was exactly the average, viz:- 22.6. The Act came into force, and at once the rate began to fall, and continued to fall year by year with almost unbroken regularity until in 1881 it was no more than 18.9. Once only in the ten years that had elapsed since the Act came into operation was the rate as high as the average for the previous decade. That was in 1875 when the rate was 22.7. In that year a second Public Health Act of more stringent character, came into opera-

tion, and from that date down to 1881 the death rate did not once reach 22.0 and averaged no more than 20.5. Had the fall in the death rate been limited to a single year, or to two years, or even to three, it might have been argued by sceptical persons that the improvement was due to a succession of seasons favourable to health, or to other causes unconnected with sanitary administration, and that the setting in of the fall coincidentally with the coming into operation of public health measures was no more than casual; but in face of a fall, lasting for 10 years in succession, and increasing each year in amount, no one can seriously maintain such a position. There can be no real doubt that the saving of life was the direct product of the money and labour expended in Sanitary improvements" (1).

(4) The relation between the Birth Rate and Infantile Mortality.

The writer attaches great importance to what he conceives to be the true relation between the birth rate and infantile mortality. It is proposed to show that counties and towns in England and Wales, which have birth rates higher than that in England and Wales as a whole, have as a rule infantile mortality rates, which are higher than that in England and Wales as a whole; and conversely that counties and towns which have lower birth rates, have as a rule lower rates of infantile mortality. The necessity of having some standard by which to disclose the true relation between the birth rate and infantile mortality rate can readily be understood, and that of England and Wales as a whole is the best that offers.

In order to eliminate accidental variations it is proposed to take for this inquiry the ten years 1893 - 1902.

The following table (2) has reference to the Registration Counties of England and Wales. The five counties with

(1) Forty fourth annual report, Registrar General.

(2) Compiled from table 11, sixty sixth annl. report. Reg. Gen.

the lowest average birth rates, and the five with the highest average birth rates, are compared with England and Wales as a whole. The corresponding average infantile mortality is shown:-

T A B L E 16.

Registration Counties in England & Wales.

| County. | Average birth rate 1893 - 1902. | Average infantile mortality 1893 - 1902. |
|------------------|---------------------------------|--|
| Rutland | 23.3 | 104. |
| Sussex | 23.6 | 116 |
| Westmoreland | 24.0 | 102. |
| Surrey | 24.3 | 121 |
| Dorset | 24.7 | 101 |
| England & Wales. | 29.4 | 152 |
| Northumberland | 32.3 | 162 |
| South Wales | 33.5 | 163 |
| Staffordshire | 34.2 | 169 |
| Monmouthshire | 34.4 | 150 |
| Durham | 35.6 | 167 |

It will be observed that this selection though determined entirely by the birth rate naturally resolves itself into five agricultural counties with comparatively low infantile mortality rates; and into ^{five} ~~six~~ industrial counties where the infantile mortality rates are comparatively high.

The following table shows a similar analysis of the 33 great towns. The five with the lowest birth rates, and the five with the highest, have been selected:-

T A B L E 17.

Large towns in England and Wales.

| Town. | (1) Average birth rate 1893 - 1902. | (2) Average infantile mortality 1893-02 |
|-----------------|---|---|
| Halifax. | 23.4 | 148 |
| Huddersfield. | 23.6 | 146 |
| Brighton | 24.9 | 156 |
| Bradford | 25.3 | 168 |
| Croydon | 25.4 | 141 |
| England & Wales | 29.4 | 152 |
| Salford | 34.1 | 202 |
| Cardiff | 35.0 | 159 |
| Sunderland | 35.6 | 175 |
| West Ham | 35.7 | 169 |
| Gateshead | 36.1 | 174 |

If the several districts of any large town be analysed, this close relation between birth rate and infantile mortality is even more strikingly demonstrated. Moreover by this means the phenomenon is shown to be essentially a social one. The birth rate and the infantile mortality rate will both be found to be lower among the well-to-do classes, than among the lower classes. This has already been shown by the examination of certain districts in London selected on social grounds. (3) For further illustration the towns of Huddersfield and Leeds have

(1) From figures furnished the writer by Dr Tatham; General Register Office, Somerset House.

(2) From Table 3 Registrar General's Summary 1903.

(3) Page 14 of this paper, table 11.

should be noted, however, that Scotland and Norway with average birth rates and ^{low} infantile mortality rates, are found associated in the better class districts, and the reverse holds true of the poorer districts.

T A B L E 18.

Huddersfield 1893 - 1902. (1)

| | Mean Population. | Birth rate. | Infantile Mortality. |
|----------------------|------------------|-------------|----------------------|
| District of Lindley. | 8,487. | 20.7. | 122. |
| Huddersfield. | 95,175. | 23.6. | 146. |
| Central District. | 24,616. | 24.2. | 169. |

T A B L E 19.

Leeds 1903. (2)

| | Population Middle of 1903. | Birth rate 1903. | Infantile Mortality 1903. |
|-------------------------|----------------------------|------------------|---------------------------|
| District of Chapeltown. | 38,046. | 24.82. | 105. |
| City of Leeds. | 443,559. | 29.40. | 153. |
| District of S. Leeds. | 34,474. | 36.62. | 184. |

It may therefore be concluded that relatively high birth rates are as a rule associated with relatively high rates of infantile mortality. Moreover a reference to table 4 page 7 will show that in countries where a high birth rate obtains, there is also a high rate of infantile mortality. It

(1) Calculated from data in the "Annual Report on the Health of Huddersfield" 1903.
 (2) Calculated from data in the "Annual Report on the Health of Leeds" 1903.

should be noted, however, that Scotland and Norway with average birth rates about 30, have the comparatively low average infantile mortality of 127 and 94 respectively.

The influence of the birth rate on infantile mortality will be discussed when considering the social factors in the causation of the latter.

5. The Influence of the Birth Rate and Infantile Mortality on the General Death Rate.

A popular writer (1) has recently pointed out that although the birth rate in England and Wales has fallen, the death rate has also fallen, and therefore he concludes, since the excess of births over deaths is much the same now as it was 50 years ago, the fall of the birth rate is of no importance. This is an example of one of the most erroneous ideas which prevail as to the relation between the birth rate and the general death rate.

The fallacy of the argument consists in disregarding the changes in the age constitution of a population which a continued low birth rate must in time produce. It therefore assumes that the tendency to death is the same at all ages, and this assumption is absurd.

The following table (2) shows the average death rates in England and Wales in decennial periods at twelve different age groups per 1,000 persons living at these ages. The general death rate per 1,000 persons living at all ages, and the infantile

(1) H. G. Wells. Mankind in the making p.88-90.

(2) This table is compiled from Table 3, Table 25, and Table 12, in the sixty-sixth Ann. Rep. Reg. General. The death rates at all ages are from Table 3, and are uncorrected for changes in age and sex constitution as disclosed by the census years. The infantile mortality is averaged from Table 25. The death rates for the age groups are calculated from Table 12, when the populations have been distributed among the several age groups according to the proportions found to prevail at the censuses of 1851, 1861, 1871 1881, 1891, and 1901.

mortality are also shown. The death rates at age group 0 - 5 includes of course the effect of the higher rates in the first year.

T A B L E 20.
Death rates at different age groups 1854 - 1903.

| Age group. | 1854-63. | 1864-73. | 1874-83. | 1884-93. | 1894-03. |
|---------------------|----------|----------|----------|----------|----------|
| All ages. | 22.1. | 22.4. | 20.7. | 19.2. | 17.2. |
| Infantile Mortality | 151.4. | 155.4. | 143.9. | 146.6. | 149.5. |
| 0 - 5. | 67.8. | 67.3. | 59.0. | 57.0. | 55.0. |
| 5 - 10. | 8.3. | 7.6. | 6.2. | 4.9. | 4.0. |
| 10 - 15. | 4.8. | 4.3. | 3.5. | 2.8. | 2.3. |
| 15 - 20. | 6.8. | 5.9. | 5.0. | 4.2. | 3.4. |
| 20 - 25. | 8.4. | 8.1. | 6.5. | 5.4. | 4.4. |
| 25 - 35. | 9.6. | 9.9. | 8.5. | 7.3. | 5.9. |
| 35 - 45. | 12.2. | 12.9. | 12.4. | 11.4. | 9.8. |
| 45 - 55. | 16.4. | 17.6. | 17.6. | 17.4. | 16.0. |
| 55 - 65. | 28.9. | 30.7. | 31.7. | 32.3. | 30.0. |
| 65 - 75. | 61.5. | 63.7. | 64.8. | 67.2. | 62.6. |
| 75 - 85. | 138.4. | 141.0. | 141.5. | 140.7. | 131.6. |
| 85 - . | 275.6. | 293.4. | 303.3. | 286.5. | 263.1. |

From this it will be seen that the tendency to death varies with each age group, and incidentally it will be noted that with the exception of infantile mortality, marked improvement has occurred in all age groups up to 45 years.

England and Wales and some other countries are, at the present day, on account of the series of low birth rates of recent years, beginning the experience which France has already had, namely a low birth rate with a low general death rate. If the low birth rate still continues, England and these other coun-

tries will eventually be in the position of France to-day, where a low birth rate, and a comparatively high death rate coincide.

In France (1) from 1879 till 1903 there has been a fall both in the birth rate and in the general death rate. In the former year the respective figures were 25.1 and 22.5; in the latter year 21.1 and 19.2. But the proportion between these rates has on many occasions been much less than these figures indicate, and in five instances between 1890 and 1900 inclusive, the death rate has actually been higher than the birth rate - varying from 0.3 to 1 per 1,000. The figures for the years referred to are:-

| Year. | B.rate. | D. Rate | Difference. |
|-------|---------|---------|-------------|
| 1890 | 21.8 | 22.8 | 1.0 |
| 1891 | 22.6 | 22.9 | 0.3 |
| 1892 | 22.3 | 22.8 | 0.5 |
| 1895 | 21.7 | 22.5 | 0.5 |
| 1900 | 21.4 | 21.9 | 0.5 |

The reason of this is not far to seek if regard be had to the varying death rates in the different age groups. A continued low birth rate, and more especially if accompanied by a high infantile mortality rate, alters the age constitution of a population and produces a smaller proportion of young adults, among whom the tendency to death is slight, and a larger proportion of adults and old people, among whom the tendency to death is greater. And so the phenomenon of a low birth rate and a high death rate, such as exists in France, is ultimately produced.

On the other hand a sudden rise in the birth rate alters the age constitution in an opposite direction and the immediate effect is to cause a rise in the general death rate.

(1) Table 69, Sixty sixth annual report of Registrar General.

Nevertheless a continued high birth rate should, other things being equal, be accompanied by a low death rate, because a high birth rate not only implies a large proportion of young adults in the population (among whom the tendency to death is slight), but also, since even under the worst conditions a large majority of children born survive, tends eventually to accentuate that proportion.

(6) The Relation between the General Death Rate and Infantile Mortality.

In the year 1903, 514,628 deaths occurred at all ages. These deaths were distributed in ages as follows:-

| | |
|-----------------------------|----------|
| Under 3 months. | 64,059. |
| 3 to 6 months. | 24,847. |
| 6 to 12 months. | 35,812. |
| <hr/> | |
| Total under one year. | 124,718. |
| Over one and under 5 years. | 55,622. |
| 5 years and upwards. | 334,288. |
| <hr/> | |
| Total deaths at all ages. | 514,628. |

From the above it will be seen that over 24 per cent. of the total deaths at all ages, occurred in the first year of life; and over 50 per cent. of the deaths in the first year occurred under 3 months of age. The general death rate was equal to 16.5 per 1,000 living at all ages; the infantile mortality was 132. The proportion between the two death rates was therefore as 1 is to 8.5.

The relation between the general death rate and infantile mortality is very complex. Any comparison instituted between the two rates is apt to be fallacious, since infantile mortality itself contributes largely to the general death rate. Sir

William Gairdner, however, believes that a kind of normal relation may be expected to exist between the general death rate and the infantile mortality of any district. "The proportion between the two death rates," writes Sir William (1) "may be expected (normally as it were) to rise with each successive rise in the general death rate, till in places where the conditions are unfavourable all round the proportion may come to be 1 to 8, or 9, or 10, or even 11, the presumption being that where insanitary conditions prevail generally, the infant death rate is a much more delicate record of such conditions, than even the death rate at all ages" However, that may be, and the writer is aware of many discrepancies, it can hardly be seriously contended that insanitary conditions have no effect upon infantile mortality. Surely the conditions which are summed up in the word insanitary cannot be expected to act prejudicially on all age periods save that under one. Nevertheless while the general death rate of England and Wales has fallen, that of infants under one year has hardly at all. It may be assumed therefore that the infantile mortality rate ought to have fallen, and the reason why it has not done so must be looked for in the more pronounced operation of other conditions which are specially inimical to infant life. To show what these other conditions may be will be a further purpose of this paper.

SUMMARY

(1) Not only has there been a remarkable decline in the birth rate in England and Wales and in other countries during recent years, but also the decline has been progressive and has therefore probably not yet reached its lowest point.

(2) The decline in the birth rate in England and Wales would appear to be most marked among the higher classes, and least so among the lower. This circumstance has probably some effect in contributing to a continued high infantile mortality.

(1) British Med. Jour. 1902. Vol. 11. p.642.

(3) The reason for the decline in the birth rate in England and Wales is probably to be found, for the most part, in causes which are outside the scope of preventive medicine.

(4) It has been shown that although the general death rate, and child mortality ^{rate} have almost continuously declined during the last four decades, that of infants under one year of age (infantile mortality) has not diminished in anything like a corresponding degree.

(5) It has further been shown that the fall in the general death rate, and child mortality ^{rates} is co-incident with, and mainly dependent upon, advances made in sanitary science and preventive medicine.

(6) The presumption is established that the infantile death rate ought to have improved under those same measures as have apparently benefited other age periods.

(7) The infantile mortality rate varies widely in different parts of England and Wales, being lower in rural areas, and higher in urban areas, than that which obtains in the country generally. It may be concluded, therefore, that the conditions which make for this higher rate are such as may for the present be regarded generally as "Urban conditions", though this does not imply that these conditions are only operative in Urban areas. It follows that in the proportion to which these "Urban conditions" can be discovered, and abolished or neutralised, so will the rate of infantile mortality diminish.

It is proposed to analyse and discuss the principal causes of infant deaths in the following order:-

- (1) (a) The Wasting Diseases of the Registrar General.
(b) Congenital Syphilis.
- (2) The Diarrhoeal Diseases of the Registrar General.
- (3) A group of causes of death including:-
 - (a) Convulsions.
 - (b) Teething.
 - (c) Rickets.
 - (d) Laryngismus.
 - (e) Scurvy.
- (4) (a) The Tuberculous Diseases of the Registrar General.
(b) Simple Meningitis.
- (5) Bronchitis and Pneumonia.
- (6) Measles and Whooping Cough.
- (7) Violent Deaths.

An attempt will be made from a consideration of the etiology and factors concerned in these causes of death to indicate what special significance should attach to each special death rate, from the point of view of Public Health.

Data. Female Births 406,042
 Male Births. 482,229 DEATHS OF INFANTS UNDER ONE YEAR OF AGE, OCCURRING IN ENGLAND
 AND WALES IN YEAR 1903.

Both Sexes. 948,271

| CAUSE OF DEATH. | Age in months | | | | | | 6 - 12 | | Total deaths under one year of | | Deaths under one year per 1,000 births of | | Group Totals Deaths per 1,000 births |
|---------------------------------|---------------|----------|-------|-------|---------|-------|--------|---------|--------------------------------|---------|---|------------|--------------------------------------|
| | 0 - 5 | | | 3 - 6 | | | Males | Females | Males | Females | Males | Both Sexes | |
| | Males. | Females. | | Males | Females | | | | Both Sexes | | | Both Sexes | |
| Premature Birth | 10,664 | 8,137 | 108 | 29 | 20 | 10801 | 8276 | 19077 | 22.4 | 17.9 | 20.1 | | |
| Congenital Defects | 1,971 | 1,526 | 158 | 172 | 123 | 2331 | 1812 | 4143 | 4.8 | 3.9 | 4.4 | | |
| Injury at birth and Atelectasis | 1,152 | 837 | - | 1 | - | 1163 | 837 | 2000 | 2.4 | 1.8 | 2.1 | | |
| Atrophy | 5,022 | 5,194 | 1594 | 895 | 760 | 9364 | 7224 | 16588 | 19.4 | 15.5 | 17.5 | 44.1 | |
| Syphilis | 417 | 357 | 188 | 81 | 83 | 686 | 585 | 1271 | 1.4 | 1.3 | 1.5 | 1.3 | |
| Diarrhoeal Diseases | 3,259 | 2,386 | 3658 | 3863 | 3376 | 10300 | 8795 | 19595 | 22.4 | 18.9 | 20.7 | 20.7 | |
| Convulsions | 4,845 | 3,394 | 1563 | 1226 | 997 | 7666 | 5817 | 13283 | 15.9 | 12.1 | 14.0 | | |
| Teething | 6 | 3 | 175 | 957 | 753 | 1138 | 865 | 2003 | 2.4 | 1.9 | 2.1 | | |
| Rickets | 41 | 9 | 85 | 269 | 175 | 396 | 229 | 624 | 0.8 | 0.5 | 0.7 | | |
| Laryngismus | 26 | 21 | 52 | 77 | 52 | 155 | 104 | 259 | 0.3 | 0.2 | 0.3 | | |
| Scurvy | 2 | 2 | 1 | 3 | 3 | 6 | 7 | 13 | 0.0 | 0.0 | 0.0 | 17.1 | |
| Tabes Mesenterica | 172 | 120 | 262 | 339 | 264 | 773 | 595 | 1368 | 1.6 | 1.2 | 1.4 | | |
| Tuberculous Peritonitis | 139 | 75 | 243 | 285 | 250 | 667 | 485 | 1152 | 1.4 | 1.0 | 1.2 | | |
| Tuberculous Meningitis | 72 | 56 | 223 | 525 | 465 | 820 | 703 | 1523 | 1.7 | 1.5 | 1.6 | | |
| General Tuberculosis | 125 | 84 | 206 | 297 | 258 | 628 | 509 | 1137 | 1.3 | 1.0 | 1.2 | | |
| Other forms of Tuberculosis. | 35 | 25 | 71 | 166 | 157 | 272 | 249 | 521 | 0.5 | 0.5 | 0.5 | 5.9 | |
| Meningitis (non-tuberculous) | 170 | 128 | 293 | 673 | 492 | 1136 | 886 | 2022 | 2.4 | 1.9 | 2.1 | 2.1 | |
| Bronchitis | 2,156 | 1,601 | 1631 | 2280 | 1938 | 6067 | 4725 | 10792 | 12.6 | 10.1 | 11.4 | | |
| Pneumonia | 1,236 | 902 | 1472 | 3382 | 2767 | 6090 | 4751 | 10841 | 12.6 | 10.2 | 11.4 | 22.8 | |
| Whooping cough | 433 | 473 | 578 | 1310 | 1399 | 2321 | 2452 | 4773 | 4.8 | 5.3 | 5.0 | | |
| Measles | 30 | 19 | 89 | 1042 | 888 | 1161 | 980 | 2140 | 2.4 | 2.1 | 2.3 | 7.3 | |
| Violent Deaths | 773 | 758 | 271 | 157 | 164 | 1201 | 1173 | 2374 | 2.5 | 2.5 | 2.5 | 2.5 | |
| All other causes. | - | - | - | - | - | - | - | - | - | - | - | - | |
| Total | 36,546 | 27,513 | 13827 | 19350 | 16462 | 69723 | 54995 | 124718 | 144.6 | 118.0 | 131.5 | | |

In 1903 for England & Wales and for the Urban & Rural Counties

1. Wasting Diseases.

The wasting diseases of the Registrar General include premature birth, congenital defects, injury at birth, atelectasis and atrophy. The term does not include tabes mesenterica.

The wasting diseases were together in 1903 the cause of death of 41,800 infants, the infantile death rate being equal to 44 per 1,000 births for the whole of England and Wales. About 90 per cent of the deaths occurred in the first three months of life.

The following table (1) shows the death rates from wasting diseases of children under one year per 1,000 births in England & Wales, in Urban, and in Rural counties for each sex separately, and for both sexes together, in the quinquennium 1898 - 1902 and the corresponding rates in the year 1903.

TABLE 22.

Wasting Diseases.

| | Males. | | Females. | | Both sexes. | |
|------------------|------------|-------|------------|-------|-------------|-------|
| | 1898-1902. | 1903. | 1898-1902. | 1903. | 1898-1902. | 1903. |
| England & Wales. | 50 | 49 | 40 | 39 | 45 | 44 |
| Urban Counties. | 50 | 50 | 40 | 40 | 45 | 45 |
| Rural counties. | 48 | 48 | 38 | 36 | 43 | 42 |

The outstanding feature of the table is the marked excess of the male rates over the female, an excess reaching as it does to not less than 20 per cent in each of the three divisions. It will also be observed that the urban rates differ but little from those in England & Wales as a whole, and that the rural rates for each sex are but little less than those which obtain in urban areas for the corresponding period. The rates

(1) Compiled from table J. sixty-sixth ann. rep., Registrar Gen. England & Wales.

It will be noted that a steady rise in the rates for in 1903 for England & Wales and for the Urban & Rural Counties are practically identical with those of the preceding quinquennium.

In view of the fact that the year 1903 has almost the lowest infantile mortality figure on record, and that therefore vicarious inclusion would be reduced to a minimum, this close correspondence of the rates in the year 1903 compared with the preceding quinquennium would suggest that here one is dealing with a "constant" in infantile mortality. The rate for wasting diseases has steadily increased during thirty years. This striking peculiarity of the rate for wasting diseases will be further referred to presently, but in the meantime it will be of interest to indicate the changes which have occurred in the rates in the three principal categories of this group, namely, premature birth, congenital defects, and atrophy, during recent years.

The following table (1) gives the infantile death rates from these causes from the quinquennium 1876 - 80, to 1903 - the quinquennial periods being expressed as averages.

TABLE 22a.
England & Wales. Deaths per 1,000 births.

| Period. | Premature births. | Congenital defects. | Atrophy |
|--------------|-------------------|---------------------|---------|
| 1876 - 80. | 13.32. | 1.28. | 23.4. |
| 1881 - 85. | 14.14. | 1.34. | 21.9. |
| 1886 - 90. | 16.10. | 1.34. | 21.9. |
| 1891 - 95. | 18.13. | 1.52. | 21.4. |
| 1896 - 1900. | 19.54. | 1.56. | 20.4. |
| 1901. | 19.1. | 3.8. | 20.0. |
| 1902. | 20.1. | 4.1. | 17.8. |
| 1903. | 20.1. | 4.4. | 17.5. |

(1) Abstracted from annual reports of Registrar General.

It will be noted that a steady rise in the rates for premature birth, and congenital defects, is associated with a steady fall in rate for atrophy; but to what extent, if any, this indicates a transference in certification it is difficult to say.

Premature Birth & Congenital Defects.

The principal factors in the production of premature births and congenital defects are syphilis, tuberculosis and alcoholism. The rôle of syphilis and tuberculosis though of the utmost importance are so well known in this connection that at present they need only be mentioned to be dismissed. It has already been shown that alcoholism is recognised as a cause of depopulation. Carpenter (1) is of opinion that parental alcoholism is one of the most potent factors in the production of premature birth and of various congenital malformations. He cites M. Nicloux who has demonstrated by experiment the influence of Alcohol in the production of deformities, more especially in fowls. From the experiments of M. Fere (2) there is good ground for believing that alcohol tends to produce malformation in the unborn child. It appears from statistics collected both in France and England that alcohol in this respect is more powerful than tuberculosis, though less, than syphilis(3).

It is difficult to say how far the industrial employment of married women, conduces to premature birth. It is generally held that it does do so, but the Registrar General's returns, read in the light of the Census, lend no support to this contention. For example in Lancashire, the manufacturing towns, such as Burnley, Blackburn, and Preston, have many married women engaged in occupation. The census report 1901, shows that in Lancashire 16.7 per cent. of the married or widowed female population are engaged in occupation. In the county of Durham, on the other hand, only 4.7 per cent, married or widowed females

(1) Carpenter "Alcohol & Children" Journal of State Med. 1904. p.604.

(2) Ballantyne: "Ante Natal Pathology & Hygiene"

(3) Carpenter: Op Cit. p.605.

The conditions included under the heading are usually are similarly returned. Yet the infant death rate in 1903 ascribed to premature birth was only 20.1 in Lancashire; and no less than 22.4 per 1,000 births in the County of Durham. A detailed examination of the returns for the different counties of England and Wales failed to disclose any regular association of High death rate from premature birth, and the industrial employment of women.

The deaths ascribed to premature birth and to congenital defects have both increased since 1876 - 80, and enormously so in recent years. So too have the deaths ascribed to injury at birth and atelectasis. In the absence of any requirement that still births should be registered a doubt must remain as to whether the increase is altogether real, or due in part to a registration of immature and congenitally defective children dying very soon after birth, who would formerly have been considered as still-born, and so escape registration altogether. The regular, and, in late years, the substantial increase which has occurred in both rates would, however, suggest that the increase is real and not merely apparent.

These rates must if considered by themselves be regarded par excellence as an index of the health conditions of the mothers in the community, and as such, they should suggest problems of much magnitude to those interested in the question of physical deterioration.

Atrophy. This cause was responsible for the death of 16,588 infants under one year of age in 1903. The male rate was in excess of the female. A reference to the reports of the Registrar General will show that over 98 per cent. of all deaths registered under this heading occur in children under 5 years of age, and of these no less than 95 per cent. occur in the first year of life. Of the deaths among infants ascribed to atrophy in 1903, 73 per cent. occurred under 3 months of age.

The conditions included under the heading are usually certified under such indefinite terms as inanition, malnutrition and marasmus, the outstanding symptom in all being wasting.

The condition can hardly be regarded as a clinical entity, but since the writer believes that a different interpretation has to be attached to the deaths occurring from atrophy in the early months of the first year, than what pertains to those occurring in the later months it will be of interest to consider a few points in the etiology of atrophy in general.

The cause of atrophy in infancy is frequently very obscure. Still (1) believes there would appear to be such a condition as athrepsia or marasmus which is not dependent upon any discoverable cause.

Ruhrah (2) has brought forward some observations showing that wasting is primarily connected with atrophy of the thymus gland.

Starr (3) says that atrophy arises both in breast fed babies and in those brought up by hand, being in either case due to insufficient nourishment. "The child wastes because he is starved". Vincent (4) holds the same opinion.

Ashby (5) regards atrophy as the result of improper feeding and unfavourable life conditions. Like Starr he has noted its occurrence in breast fed infants. "In these cases the children have been congenitally weak or premature and probably the mother's milk has been deficient in quality and quantity and they have ^{been} exposed to all the insanitary conditions which prevail in the crowded dwellings of the poorest and most ignorant of our citizens."

• Atrophy and Cachexia.

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- (1) Still: Medical Annual 1906. p.407.
 - (2) Brit. Med. Jour. Aug. 29. 1903.
 - (3) Starr: "Dis. of Digestive Organs" 1901. p.101.
 - (4) Vincent: "The Nutrition of the Infant" 1904. p.232.
 - (5) Ashby & Wright: "Dis. of Chn" 1899. p.104.

symptoms Hutchison (1) points out that marasmus is not a disease in itself, but a symptom.

From the foregoing consideration it would appear that the causes of atrophy may be divided into three broad classes:-

- (1) Simple atrophy due to indefinite causes and probably in fact syphilitic in the infant.
- (2) Atrophy incidental to improper feeding pure and simple.
- (3) Atrophy associated with improper feeding and bad hygienic conditions.

Atrophy & Diarrhoea.

Niven (2) has pointed out that the years in which mortality ascribed to atrophy have been highest, have been years of high diarrhoeal mortality; and that since diarrhoea in children is followed by enfeebled condition of the bowels, and by innutrition, it is possible that the mortality from atrophy is due to diarrhoea to such an extent as to make it difficult to use as a differential expression by itself of special factors, except in so far as these are causative also of diarrhoea. This no doubt to a certain extent does occur but it fails to completely account for the regular age incidence of atrophy. The large majority of deaths ascribed to this cause occur as has already been pointed out, in the first three months of life. Diarrhoea on the other hand, claims most victims at the age period 3 to 12 months, when 71 per cent of the total infantile deaths from diarrhoea occur.

Atrophy and Syphilis.

It is well known that the children of syphilitic parents are born with feeble resisting power and liable to manifest degenerative tissue changes. Definite signs or

(1) Clinical Journal. March 4. 1903. p. 333.

(2) Report on the Health of Manchester, 1903.

symptoms of congenital syphilis are not necessarily manifested in the first few weeks of life. (1). It is therefore conceivable that in many cases of congenital syphilis there may be no symptoms beyond progressive atrophy. In such cases, quite apart from any question of misrepresentation on the death certificate, it may well be that many early cases of atrophy are in fact syphilitic in origin. Support is lent to this contention by the fact that of the certified cases of syphilis occurring in children 61 per cent. of them were at the age period 0 - 3 months and only 39 per cent. at the age period 3 to 12 months, a distribution that follows closely on that of atrophy.

Atrophy & Tuberculosis.

Tuberculosis is not now regarded as a hereditary disease; but the tendency to tuberculosis, with all that this implies of depraved nutrition, and feeble resisting power, is looked upon as transmissible. If any cases of atrophy have to be attributed to tuberculosis, and probably a small proportion should be, it is only in the latter months of the first year that this is likely to occur; because a reference to the Registrar General's returns show that of all tuberculous affections occurring in the first year, only 13 per cent. occur in the first three months of life, and 87 per cent. occur at the age period 3 to 12 months, and in any case it is doubtful how many of these deaths are really due to tubercle.

Atrophy & Parental Alcoholism.

The part which parental Alcoholism plays in the production of infantile atrophy is not capable of complete statistical demonstration; but there is little doubt that it is an important factor, especially when occurring in the mother. Such children are born with feeble constitution and are liable to fall victims to various degenerative changes.

(1) Still: Congenital Syphilis. Med. Ann. 1905. p.555.

The following table embodies the principal points in the foregoing argument. The data on which the calculations are based are set out in Table 21.

T A B L E 22b.

Percentage of Infant Deaths from certain causes at different age periods. 1903.

| Diseases Groups. | Age period. | |
|------------------|-------------|-----------|
| | 0 - 3 mos. | 3-12 mos. |
| Atrophy. | 73% | 27% |
| Syphilis. | 61% | 39% |
| Diarrhoea. | 29% | 71% |
| Tuberculosis. | 13% | 87% |

In reading this table it must be borne in mind that one is dealing with the figures in the official returns and no allowance is made for imperfect certification. There is no doubt that many deaths from syphilis are deliberately returned as atrophy, since, for reasons which need not here be discussed, it is only exceptionally that syphilis will be returned as the cause of an infant death. One is not at present so much concerned, however, with the question of correct certification, the object rather being to read beyond the medical certificate in order that the true significance of the infantile death rate from atrophy may be indicated. Indeed it appears to the writer, having regard to the dominant position of syphilis as the underlying cause of other members of the wasting diseases group, a truer index of infantile atrophy would be gained by its inclusion.

The table also demonstrates that it is rather in the later age period than in the earlier, that the statistics of infantile atrophy will tend to be vitiated by diarrhoea and tuberculosis.

On the whole, therefore, early atrophy may be regarded as an index of inherent weakness in the infant, due in large measure to parental conditions and perhaps especially syphilis, tuberculosis, and alcoholism. Later atrophy, on the other hand, has to be regarded mainly as an index of improper feeding and bad hygienic conditions, and this further implies parental neglect and want of cleanliness.

The infantile death rate from atrophy has considerably declined during recent years and this has probably to be accounted for in part by more precise certification - the wasting incidental to more definite causes such as diarrhoea being now included under that heading.

The rate for the wasting diseases of the Registrar General taken altogether, and having regard to its increase and to its general and nearly equal distribution, would seem to imply a marked and increasing physical deterioration of the people; a point which the writer thinks was not sufficiently emphasised in the evidence submitted to the Inter Departmental Committee. Congenital syphilis, so far as interpretation is concerned, should be included in this group.

(b) Syphilis.

The infantile deaths ascribed to syphilis have varied from a rate of 2.0 per 1,000 births in 1883, to 1.2 in 1901 and in 1902. In 1903, 1,271 infant deaths were ascribed to this cause, equal to a rate of 1.3 per 1,000 births. The percentage of deaths were distributed in age periods as follows:-

| | 0 - 3 months | 3 - 6 months | 6 - 12. months |
|-----------|-----------------|-----------------|-------------------|
| Syphilis. | 60.9 | 26.2 | 12.9 |

There is no sort of doubt that the official returns enormously understate the true mortality from this cause. The significance

of the rate is identical with that for wasting diseases and the remarks already made under that heading have to be considered as equally applying to syphilis. *expressed as averages.*

T A B L E 23.

2. Diarrhoeal Diseases.

Under this heading the Registrar - General includes deaths from epidemic diarrhoea, infective enteritis, ill-defined diarrhoea, gastric catarrh, other diseases of the stomach (mainly gastritis), enteritis, and gastro-enteritis. These diseases were together in 1903 responsible for the death of 19,595 infants under one year, the rate being 21 per 1,000 births for the whole of England & Wales. About 29 per cent. of the deaths occurred in the first 3 months of life; 34 per cent. at the age period 3 to 6 months; and 37 per cent. between the age of 6 and 12 months.

The following table (1) shows the diarrhoeal death rates of children under one year per 1,000 births in England & Wales, in Urban, and in Rural Counties, for each sex separately, and for both sexes in the quinquennium 1898 - 1902, and the corresponding rates for the year 1903.

T A B L E 23.

Diarrhoeal Diseases.

| | Males. | | Females. | | Both sexes. | |
|------------------|------------|-------|------------|-------|-------------|-------|
| | 1898-1902. | 1903. | 1898-1902. | 1903. | 1898-1902. | 1903. |
| England & Wales. | 35. | 22. | 30. | 19. | 32. | 21. |
| Urban Counties. | 39. | 26. | 35. | 23. | 37. | 24. |
| Rural Counties. | 21. | 13. | 16. | 10. | 19. | 11. |

It will be observed that the rates in urban areas are about double those in the rural; that the male rates are in excess of the female; and that the rates in 1903 are in every detail a marked improvement upon the averages of the preceding quinquennium.

(1) Compiled from table J, Sixty-sixth ann. rep, Registrar General. England & Wales.

The following table (1) shows the changes which have occurred in this rate from the quinquennium 1876 - 80, to 1903, the quinquennial periods being expressed as averages.

The infantile death rate from diarrhoeal diseases

T A B L E 23a.

England & Wales. Diarrhoeal Diseases.

| Period. | Deaths under one year per 1,000 births. |
|--------------|---|
| 1876 - 80. | 17.0. |
| 1881 - 85. | 14.6. |
| 1886 - 90. | 17.5. |
| 1891 - 95. | 20.9. |
| 1896 - 1900. | 33.3. |
| 1901. | 34.5. |
| 1902. | 17.0. |
| 1903. | 20.9. |

As had already been indicated the meteorological conditions in the years 1902 and 1903 were exceptionally favourable for a low rate from diarrhoea, and much of the improvement seen in these years had to be attributed to this circumstance. With these exceptions however, it will be noted that the general tendency of the infantile diarrhoeal death rate is towards a substantial increase, and this is most probably to be accounted for by the steady increase in artificial feeding.

It can be shown that for the most part the rate for diarrhoeal diseases governs the infantile mortality figure for the year. For example from the year 1876 to 1900, the lowest rate for diarrhoeal diseases was 9 in 1879, and the highest 41.7 in 1899; and the corresponding infantile mortality figures were 135 and 163 respectively; - These figures being the lowest but one and the highest recorded during that period. So too the

(1) Calculated from Registrar General's reports.

favourable infantile mortality figures for the years 1902 and 1903 are due for the most part to the diminution in the rates for diarrhoeal diseases.

The infantile death rate from diarrhoeal diseases possesses special interest for the sanitarian. It varies more widely in regard to place, season, and year than does any other infantile death rate. Table 24 shows it to be in towns about double that which obtains in the country; late summer and early autumn are the special seasons of its incidence, aggravated in years of special heat and drought. Its relation to meteorological conditions is shown in the appendix to this paper.

There can be no doubt that the principal cause of diarrhoea in infants is improper food. Out of nearly 2,000 fatal cases of diarrhoea recorded by Emmet Holt, only some 3 per cent. had been breast fed; and a similar result has been arrived at by Niven of Manchester. (1). ~~and~~ Hope (2) in Liverpool in 1899, which was a year of high diarrhoeal mortality, found that among 1,096 deaths from diarrhoea 20.5 per cent. had been breast fed. Richards (3) found at Chesterfield that only 11 per cent. occurred among children fed from the breast; at Croydon he found the percentage 12. Newsholme in Brighton from the investigation of 191 fatal cases of diarrhoea in 3 years 1900 - 02, which were years of moderate diarrhoeal mortality, found that 9.4 per cent. were breast fed:(4), whilst of 44 infantile deaths from diarrhoea in 1903, which was a year of low diarrhoeal mortality, he found that only 6.8 per cent. had been entirely breast fed.(5)

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- (1) Ashby & Wright: Op. Cit. p.92.
 - (2) Dr Hope's report quoted by Dr Waldo, Lancet May 14. 1900. p.1427.
 - (3) Transactions of Epidemiological Society of London. 1902-03 Vo. XXII. p.43.
 - (4) Ibid. p.37
 - (5) Report on the Health of Brighton 1903.

Probably the explanation of these varying results is to be found in the natural history of the disease, the breast fed children being the last to suffer under the conditions generally favourable to diarrhoeal mortality. At any rate the figures amply demonstrate that hand feeding (and therefore it is to be feared improper feeding) is largely responsible.

The *raison d'être* of improper feeding practically opens up the whole question of the factors underlying infantile mortality in general and these it is proposed to discuss in more detail later on, but a few points in connection with the etiology of infantile diarrhoea may be here briefly indicated,

Ballard first drew attention to the connection between earth temperature and diarrhoea. He pointed out in particular that the summer rise of diarrhoeal mortality does not commence until the mean temperature recorded by the 4 foot earth thermometer has attained somewhere about 56°F., no matter what may have been the temperature previously attained by the atmosphere, or recorded by the 1 foot earth thermometer; and he concluded that the essential cause of diarrhoea resides ordinarily in the superficial layers of the earth, where it is intimately associated with the life process of some micro-organism. This view has been very generally accepted until recent years. It fails, however, to completely explain the varying incidence of summer diarrhoea in children and can therefore only be regarded as one of perhaps many other dominant factors. Waldo (1) considers that infantile diarrhoea must be regarded first and foremost as the result of strictly local conditions. Newsholme (2) after a careful examination of available data has satisfied himself that the incidence of diarrhoea follows more closely the rainfall than the mean temperature of the air. He believes the relationship of rainfall and

(1) Waldo. Epidemic Diarrhoea, Lancet. May 14th 1900.

(2) Newsholme Transactions of Epidemicological Soc. of London Vol. XXII. 1902-03.

diarrhoea mortality to be so close that towns may be classified meteorologically in the order in which they ought to stand in reference to diarrhoea, and their true relative position as to domestic and municipal sanitation may be ascertained when we know whether they occupy a better or worse position on the list of towns than that which their meteorological place would indicate as rightly belonging to them. The greater the rainfall, especially in the third quarter of the year, the lower is the diarrhoeal death rate.

Waldo (1) suggests that diarrhoea is largely caused by the pollution of street dust by horse dung. He says "In casting around for a possible source of what may be regarded as a manifold infection of epidemic channels the idea occurred to me, as it has to others that organically polluted dust may be the vehicle of distribution. A further consideration of the circumstances of the case led me to the opinion that horse dung may be the specific polluting material." Admitting this theory the pollution of milk is readily understandable; the special incidence among hand fed children is explained; and the decline of diarrhoea after rain (which lays the dust and washes away much of the poisonous material) follows naturally. Town dust is more highly charged with horse dung than obtains in rural districts, and so the special incidence of infantile diarrhoea in towns is also explained.

Nash (2) whilst admitting the coincidence of a rise in earth temperature and diarrhoeal mortality joined issue with Ballard in his conclusion that the essential cause of diarrhoea is a specific micro-organism residing in the superficial layer of the earth whose vital manifestations are dependent upon conditions of season. He believed all evidence went to show that there is

(1) Waldo: Op. Cit.

(2) Nash: Transactions of Epidemiological Society of London 1902 - 03. p.44.

No one specific bacterium of diarrhoea. Nash advanced the hypothesis that the common house fly is the principal cause of summer diarrhoea, and supported it by his experience of epidemic diarrhoea at Southend in 1902. During July and August there was no mortality among infants under one year from diarrhoea as compared with 23 deaths during the same period of 1901. July and August of 1902 were comparatively cool months and rain fell on 22 out of the 62 days. The most remarkable phenomenon of these months was, however, the almost complete absence of Musca domestica. Niven (1), whilst emphasising the importance of other factors, considers it conceivable that house flies are a means of transmission and admits that the experience of Manchester in 1903 is in accordance with such a hypothesis.

All observers, however, are agreed that the essential and fundamental cause of epidemic diarrhoea is bacterial, and that in the case of infants the most common vehicle of this bacterial invasion is milk. It is probable that further bacteriological research will show that each of the factors, temperature, soil, dust, flies, play their part in its production, and that the rainfall determines the degree to which they operate. Delopine (2) isolated from milk which caused an epidemic of diarrhoea several bacilli belonging to the Colon group. Some of these were very virulent and closely resembled the Bacillus Enteritidis of Gäertner. In other cases he found a bacillus more closely resembling the Bacillus Coli of Escherich. He came to the conclusion that the varieties of those bacilli which are most important sources of infection are those which resemble the bacillus of Gäertner, and which therefore (and this is a point of much importance) produce no permanent acidity, coagulation, or distinct smell when grown in milk; so that absence of acidity in milk is not, as generally believed, an index of safety.

(1) Niven: "Report on the Health of Manchester" 1903. p.168.

(2) Delopine: Transaction of Epid. Soc. of Lond. Vol. XXII. p.p. 11 - 31.

As regards the source of bacterial infection of milk, Delépine while admitting that this might occur at the retailers, or in the consumer's home, believed (as the result of his experiments) that it more frequently occurred at the farm or (through vessels) in transit. Newsholme, (1) on the other hand, is of opinion that milk is generally affected during storage at home in places where it is exposed to infective dust. He investigated into the milk supply of 226 fatal cases of diarrhoea which occurred in Brighton in the three years 1900 - 02. In 35 of these cases the milk supply could not be ascertained, or (in 4 of the 35 cases) was derived from mixed sources. Of the remaining 191 cases 18, or 9.4 per cent, were breast fed, and 84, or 44 per cent., were fed on condensed milk. Thus in over 53 per cent. of the cases of epidemic diarrhoea in Brighton with known milk supply domestic infection as far as milk is concerned was alone possible. Great care was taken to exclude from these groups cases in which other sources of milk than the breast or condensed milk were on any occasion employed. The fact also that breast fed children suffer from epidemic Diarrhoea proves that infection can occur in the home. Newsholme's observation further does away with the common belief that condensed milk is a safe guard against epidemic diarrhoea.

From the foregoing etiological considerations of infantile diarrhoea it can readily be understood that most, if not all, of the associated factors act in the main through the agency of food; these are; overcrowding, imperfect ventilation, insanitary conditions in and around the house, want of personal cleanliness on the part of attendants and of the infant itself. The probability of insufficient clothing in predisposing to diarrhoea must also be borne in mind.

A high rate from infantile diarrhoea is almost regularly associated with adverse social, hygienic, and industrial

(1) Newsholme: Trans. of Epi. Soc. of Lond. Vol. XXII. p.34.

Deaths from these causes according to the age period of the first conditions acting either directly or indirectly, and goes hand in hand with poverty, ignorance, and neglect.

This rate must therefore be regarded as indicating with peculiar sensitiveness the general hygienic conditions of a community, and above all is an index of the intelligence, solicitude, and morale of mothers.

(a) Convulsions.

Taylor (1) summarises the circumstances under which 3. Convulsions, Teething, Rickets, Laryngismus, Stridulus, and infantile convulsions occur as follows:-
and Scurvy.

- (1) The onset of acute diseases, such as scarlatina, measles, and pneumonia.
 - (2) Local diseases of the brain of which acute meningitis is the most frequent.
 - (3) Great exhaustion as after prolonged diarrhoea.
 - (4) Vascular congestion of the brain, such as may be caused by an attack of whooping cough.
- These conditions, which are here arranged in the order of their fatality as shown in the returns of the Registrar General, are so intimately associated and related one with another that they may conveniently be considered together. In 1903 they were together responsible for the death of 16,172 infants, equal to a rate of 17.05 per 1,000 births as shown in the following table:-

T A B L E 24.

Convulsions and "Rickets group"

| Cause of Death. | No. of deaths. | Deaths per 1,000 births. |
|-----------------|----------------|--------------------------|
| Convulsions. | 13,283. | 14.01. |
| Teething. | 2,003. | 2.11. |
| Rickets. | 624. | 0.66. |
| Laryngismus. | 259. | 0.27. |
| Scurvy. | 13. | 0.00. |
| | 16,172. | 17.05. |

It is proposed to show that the underlying or predisposing condition is probably in each case more or less closely related to, and dependent upon, improper food, acting either as an irritant or by producing malnutrition. It is further proposed to show that rather a different significance should attach to the

(1) Compiled and calculated from Sixty sixth Ann Rep. Registrar General.

deaths from these causes according to the age period of the first year at which they occur, and more especially of the deaths in the first 3 months of life as distinct from those occurring at the age periods 6 - 12 months.

It will first be necessary to indicate a few points in the etiology of each of these causes under their separate headings.

(a) Convulsions.

Taylor (1) summarises the circumstances under which infantile convulsions occur as follows:-

- (1) The onset of acute diseases, such as scarlatina, measles, and pneumonia.
- (2) Local diseases of the brain of which acute meningitis is the most frequent.
- (3) Great exhaustion as after prolonged diarrhoea.
- (4) Venous congestion of the brain, such as may be caused by an attack of whooping cough.
- (5) Rickets is now held responsible for the majority of causes of infantile convulsions, not included in the above groups. Often the fit is induced by some peripheral irritation, such as indigestible food; intestinal worms; especially lumbrici; cutaneous irritation such as pins in the clothing instanced by Trousseau; or the process of dentition. Perhaps too much has been made of teething as a cause of convulsions, since delayed dentition is a constant result of rickets and so would co-exist with convulsions in a large proportion of the cases. Sometimes no exciting cause for the fit can be discovered.

(6) Some infantile convulsions must be regarded as really epileptic, since epilepsy may begin in infancy.

As regards the age incidence of convulsions this author only generally remarks "convulsions occur with much greater readi-

(1) Taylor: Practice of Medicine 1904. p.366.

purpose of etiological consideration, because all observers are in agreement that it occurs almost exclusively in rickety infants. Ashby (1) is more definite and recognises that while the whole period of childhood predisposes to convulsions, certain factors operate more especially during the first few months of life.

(b) Teething.

Teething is a physiological process and as such is attended by but little or no irritation. Taylor as already quoted suggests that too much has been made of teething as a cause of convulsions. All observers however are agreed that teething is attended by special danger to infants the subjects of rickets or otherwise enfeebled. In rickets the process of dentition is generally delayed and may be complicated by severe nervous or intestinal symptoms.

Ashby (2) says a strong vigorous infant which has been brought up at the breast will cut its teeth one after another without trouble. On the other hand if the infant is rickety, weakly, or of inherited or neurasthenic tendencies, the period of dentition will be a period of danger, the process of dentition acting rather as the exciting than the predisposing cause.

Starr (3) says many diseases occurring in infancy were formerly attributed to dentition, but as pediatrics has been more carefully studied and better understood, one disorder after another has been relegated to its proper etiological class, and teething is now regarded as a purely physiological process unproductive of symptoms.

It may be taken then that the deaths attributed to teething are in the large majority of cases due to rickets, and will occur for the most part after the sixth month of life.

(c and d) Rickets & Laryngismus.

Laryngismus is here included with rickets for the

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- (1) Ashby & Wright: Op. Cit. - p.532.
 - (2) Ashby & Wright: Op. Cit. - p. 60.
 - (3) Starr: Dis. of Diges. Organs. 1901. p.208.

purpose of etiological consideration, because all observers are agreed that it occurs almost exclusively in rickety infants.

The etiology of rickets, which is essentially a condition of malnutrition may be considered under three headings: Parental, Dietetic and Hygienic.

A want of domestic and personal cleanliness, and an absence of fresh air, must therefore be regarded as potent factors.

Parental Causes. These in the main imply the inheritance of depraved constitution. Ashby (1) in this respect instances syphilis as predisposing to rickets rather than as an essential cause.

Starr (2) mentions both syphilis and tuberculosis with a like reservation. Weakly and premature infants, and the offspring of hard working mothers living under unhealthy conditions, would appear to be specially predisposed to rickets.

Dietetic causes. These play most part in the production of rickets, and if coupled with unhygienic conditions their effect is manifoldly increased.

Although occasionally seen in breast-fed children, especially in cases of overlactation, it is on the hand-fed that the chief incidence of the disease is found. In these the principal cause is the deprivation of fresh milk, and its substitution by unsuitable artificial food such as farinaceous and proprietary foods, condensed milk etc., almost to the total exclusion of fat. Starr (3) believes that a deficiency of animal fat, and to a less extent that of proteids and salts is the chief dietetic cause. That improper feeding plays an important part in its production has been shown in the rearing of the young lions at the Zoological Gardens, and in the feeding of puppies and other animals on lean meat. These animals developed rickets but improved at once when given milk and pounded bones(4).

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- (1) Ashby & Wright: Op. Cit. p.198.
 - (2) Starr: Op. Cit. p.131.
 - (3) Starr: Ibid. p. 131.
 - (4) Ashby & Wright: Op. Cit. p.198.

Hygienic Causes.

It may be taken therefore that the infantile deaths due to rickets will fall in the age period 6 to 18 months. Rickets shows a special incidence among infants housed in ill ventilated, damp, dark, and overcrowded dwellings, such as are only too frequently found in many of the slums of great towns. A want of domestic and personal cleanliness, and an absence of fresh air and sunlight must therefore be regarded as potent factors in its production.

These various factors may be summed up as follows:- Hereditary weakness, feebleness of the digestive powers, improper food, breathing vitiated air, exposure to cold and damp, will, together, in some instances perhaps singly, produce rickets. Rickets abounds where the lower classes of the population are crowded together in courts and slums, where the mothers, from necessity or choice, are unable to suckle their infants, where fresh milk is dear and of poor quality, and infant life is exposed to the various bad influences which poverty and ignorance are certain to produce.

(3) As regards the age incidence of rickets both Starr (1) and Ashby (2) state that rickets may begin during intra-uterine life. Vincent (3) on the other hand doubts if any foetal condition exists to which the term rachitis can be legitimately applied. Ashby (4) considers the commonest time for rickets to manifest itself is from the first six months to the end of the second year. Starr (5) states that usually the initial symptoms are not observed before the seventh month. Vincent (6) says the disease is most commonly seen towards the end of the first year, and quotes Gee from which it appears that of 176 cases occurring under one year of age, only 32, or 18% were under the age of six months.

(1) Starr: Op. Cit. p.131.
(2) Ashby & Wright: Op. Cit. p.198.
(3) Vincent: Op. Cit. p.246.
(4) Ashby & Wright: Op. Cit. p. 197.
(5) Starr: Op. Cit. p. 131.
(6) Vincent: Op. Cit. p.259.

months old fed on Mellin's Food. In the majority of instances the disease develops between the age of six months and the end of the second year (1).

(e) Scurvy. The infantile deaths ascribed to scurvy in the year 1903 are numerically insignificant, but in view of the importance of the condition in relation to the question of sterilising infant foods it was thought well to include them in the consideration of this group. Starr (1) says scurvy may occur in the best or worst hygienic surroundings, and the sole factor which was uniformly present in the reported cases analysed was absence of the quality of freshness in the food. The food was not "live." He classes faulty foods in the order of their potency thus:-

- (1) Proprietary infant foods administered without the addition of cows' milk.
- (2) Proprietary infant foods employed with addition of insufficient cows' milk.
- (3) Farinaceous foods (oatmeal - barley etc) administered with water alone, or with water and insufficient cows' milk.
- (4) Condensed milk and water.
- (5) Sterilised milk.
- (6) Too dilute milk and cream mixtures.

Barlow in the Bradshaw Lecture of 1895 defined scurvy as "a constitutional disease due to prolonged improper diet in infants"

Tullis (2) has seen cases arise from the prolonged use of farinaceous food and states that Eustace Smith held that boiling and sterilising of milk removes some antiscorbutic property; Kellett Smith (3) believes scurvy is related to insufficient fat in infant dietary; Rogers (4) reported a case in an infant 9

(1) Starr. Op. Cit. P. 111 et seq.
(2) Brit. Med. Jour. 1903. I. P.82
(3) Brit. Med. Jour. 1901. I. p.201
(4) Brit. Med. Jour. 1903. II p.1276

months old fed on Mellin's Food. In the majority of instances the disease develops between the age of six months and the end of the second year(1).

Having now considered the etiological factors in the production of these causes of death, and having established by the evidence of independent observers their relative age incidence, quite apart from mortality statistics, it will be of interest to discuss in what degree it is probable that the official returns overlap or vitiate each other, the object again being to read behind the medical certificate in order that the true significance of these death rates may be approximately appreciated.

And since argument is easier by contrast the age-periods 0 - 3 and 6 - 12 months will be selected for this purpose.

(1) Deaths at 0 - 3 months.

Of the total infantile deaths ascribed to convulsions 62 per cent. occurred in the first three months of life; 21 per cent. in the second three months; and 17 per cent. at the age period 6 to 12 months. Of the total infantile deaths ascribed to rickets, the proportion, as one would expect from what is known of its age incidence, are relatively inverted. Only the small proportion of 8 per cent. occurred in the first three months of life; 21 per cent in the second three months; and no less than 71 per cent. at the age period 6 to 12 months. If, however, instead of (considering) the infantile deaths definitely ascribed to rickets in the returns of the Registrar General, the deaths ascribed to teething, laryngismus, and scurvy, be included, forming what may provisionally be called the "rickets group", and contrast be made of the ages at which deaths from convulsions and from the "rickets group" occur, something approaching a statistical demonstration of their relative age incidence will be obtained, and will of course be especially trustworthy as regards the age period 0 - 3 months. Having regard to the etiology of

(1) Starr. Op. Cit. p.111.

to say, the predisposition to convulsions is inherited. As regards the exciting cause, the initial stage of acute diseases, especially whooping cough, bronchitis and pneumonia will account for some of the deaths ascribed to teething and laryngismus their inclusion in the "rickets group" can only render the result the more accurate. Carrying the calculation to the first decimal the following result appears:-

| Cause of death. | Percentage of total deaths from each cause at different age periods. | | |
|-----------------|--|-------|--------|
| | 0 - 3 | 3 - 6 | 6 - 12 |
| Convulsions. | 62.0 | 20.9 | 17.1 |
| "Rickets group" | 3.7 | 17.2 | 79.1 |

The point which the writer wishes to establish, and which he thinks these figures support, is that if any confusion exists between the certification of convulsions and rickets during the first three months of life it can only be so to a relatively insignificant extent, and cannot vitiate the molar significance of the deaths ascribed to the former; since rickets at this age period has hardly begun to make its influence felt. Moreover, the percentage in the "rickets group" under 6 months of age, 20.9, closely approaches the actual relative age incidence of rickets as determined by the observations of Gee. A healthy infant does not suffer from convulsions unless the stimulus is strong, and one must therefore look for a predisposing as well as an exciting cause. At later age periods, these are only too easily found in rickets as the predisposing cause, and in (either) teething, acute illnesses, or improper food as exciting causes. At this age period however the rôle of rickets and teething are practically eliminated. To what then must these early infantile convulsions be attributed? Ashby (1) would look to hereditary influences as largely responsible for early convulsions. He states that the infants of those who have suffered from epilepsy, or who are of a highly nervous disposition are more especially liable to convulsions in the first few months of life. That is

(1) Ashby & Wright: Op. Cit. p.532.

to say, the predisposition to convulsions is inherited. As regards the exciting cause, the initial stage of acute diseases, especially whooping cough, bronchitis, and pneumonia will account for some, but as deaths from these causes will mainly be returned under their proper headings the proportion cannot be a large one.

Therefore The writer does not wish to exaggerate the importance of improper food as a factor in infantile mortality especially at the early age period; indeed it is chiefly in the hope of avoiding any such exaggeration that this somewhat detailed analysis has been considered necessary. But after making due allowance for the operation of other external causes, one must perforce accept this factor, improper food pure and simple, as by far the chief exciting cause of convulsions in infants under 3 months of age. When one reflects that 62 per cent. of all infantile deaths from convulsions occur at this age period, it follows that a huge proportion of infants are improperly fed from the earliest days of life. That many who escape death at this age succumb to rickets and other diseases of malnutrition at later age periods, the mortality returns leave hardly any doubt.

The relation of respiratory diseases to rickets will be considered Deaths at the age period 6 to 12 months.

In considering the etiology of convulsions, it was shown that besides rickets, certain other conditions, more especially measles, pneumonia, diarrhoea and whooping cough, are attended by convulsions.

Leaving rickets out of account for the moment, the returns of the Registrar General do not suggest that these other causes of deaths are understated, and it is therefore fair to assume that deaths from convulsions, due to measles, pneumonia, diarrhoea and whooping cough, will, for the most part, be correctly returned under these headings, and that it is only when the cause of the convulsions is less apparent, or for other reasons, that a death will be certified simply as due to convulsions.

On the other hand the relation between convulsions and rickets is very close, and the Registrar General's returns do emphatically suggest that rickets as a cause of death is enormously

understated. Ashby(1) believes that in the large majority of children who suffer from convulsions between the age of 6 months and three years the signs of rickets are present. Probably therefore the great majority of deaths ascribed to convulsions at this age period are in fact due to rickets. Although rickets is only too common a disease, and is a well recognised cause of convulsions, it would appear that only with reluctance will medical men certify the condition on a death certificate. For example in 1903, at the age period 6 - 12 months, 2,255 deaths were registered as due to convulsions, but only 444 deaths were definitely ascribed to rickets. If one includes with rickets the deaths ascribed to teething and laryngismus, the number becomes 2,283, but even then the mortality of rickets must be enormously understated. It is well known, for instance, that rickety infants are peculiarly liable to bronchitis, and that in these the disease tends to be fatal, and such deaths will probably appear in the mortality returns as bronchitis, rather than as rickets. The relation of respiratory diseases to rickets will be considered later. It is here merely mentioned to indicate that the true extent to which rickets operates in the mortality at this age period is by no means adequately disclosed by the conditions now under consideration.

There can be little doubt, therefore, that the deaths included under convulsions, teething, rickets and laryngismus at this age period must be regarded in the main as due to rickets, and dependent upon those hereditary, dietetic, and hygienic factors which have already been considered. Of all those factors, improper feeding takes the first place. Moreover, the deaths in this group do not mean merely an error in diet, as may conceivably be the case in many of the deaths attributed to diarrhoea, but rather a long continued course of improper feeding culminating

(1) Ashby & Wright: Op. Cit. p.532.

in malnutrition. Nor can it be doubted that many other infants who escape death at this age, enter the later age periods handicapped in vitality, and largely contribute to what we may regard as child mortality (i.e the deaths of children under 5 per 1,000 living at that age period).

4. (a) Tuberculous Diseases.

Under this heading the Registrar General includes all forms of tuberculosis. The deaths among infants under one year from tuberculous diseases amounted in the aggregate in 1903 to 5,701, being equal to a rate of 6.01 per 1,000 births, for the whole of England and Wales.

The following table (1) shows the average infantile death rates ascribed to these diseases in England and Wales, in Urban, and in Rural counties for the quinquennium 1898 - 1902, and the corresponding rates for the year 1903.

T A B L E 25.
Tuberculous Diseases.

| | Males. | | Females. | | Both sexes. | |
|------------------|------------|-------|------------|-------|-------------|-------|
| | 1898-1902. | 1903. | 1898-1902. | 1903. | 1898-1902. | 1903. |
| England & Wales. | 7. | 7. | 6. | 5. | 7. | 6. |
| Urban Counties. | 8. | 7. | 7. | 6. | 7. | 7. |
| Rural Counties. | 5. | 4. | 4. | 4. | 5. | 4. |

It will be observed that the rates in rural areas are markedly lower than those which obtain in urban areas, and that these latter are higher on the whole, than for England and Wales generally. It will also be noted that in each area the female rates are lower than the male, both in the quinquennium 1898 - 1902 and in the year 1903, and that in both sexes, and in each sex separately, the

(1) Compiled from Table J. sixty-sixth ann. rep. Registrar General.

rates in 1903 compare on the whole favourably with the average in the preceding quinquennium.

The following table (1) shows the changes which have occurred in this rate in England and Wales since the quinquennium 1876 - 80:-

T A B L E 25a

Tuberculous Diseases.

| Period. | Deaths of children under 1 year per 1,000 births. |
|--------------|---|
| 1876 - 80. | 9.7. |
| 1881 - 85. | 8.6. |
| 1886 - 90. | 8.9. |
| 1891 - 95. | 8.3. |
| 1896 - 1900. | 7.1. |
| 1901. | 6.4. |
| 1902. | 5.9. |
| 1903. | 5.9. |

It is satisfactory to note that the rate is on the decline.

From a consideration of the Registrar General's returns, it would appear that tuberculous diseases are very fatal in infancy; rather more so, for example, than whooping cough, and more than twice that of measles. It will be necessary, however, before attaching any significance to this infantile death rate, to discuss briefly the nosology and age incidence of the special forms of tuberculosis to which the infantile deaths are more frequently ascribed, and more especially to the manifestations in abdomen and brain.

Tuberculosis in whatever form it occurs is a specific disease and for its production two conditions are essential:-

- (1) The soil - a predisposed state of the tissues.

(1) Compiled from Registrar General's reports.

(2) The seed - the actual causal agent, the tubercle bacillus.

Ashby (1) points out that anyone living under present conditions in a large city has plenty of chances of becoming tuberculous, and if he does not become so it is not so much from lack of opportunity as from the fact that his tissues are incapable of playing the part of host. The question of the inheritance of Tuberculosis is of special interest in connection with a consideration of its mortality in infancy, and the accepted opinion of to-day is ruled by an appreciation of the two conditions just mentioned. It was at one time, however, commonly held that tuberculosis was directly transmissible from parent to child. This is not now regarded as probable. If it does occur at all, it must be very rarely. Coats (2) says it has not yet been proved that, in man, tuberculosis is ever communicated from parent to offspring; and Ashby (3) states, "the foetus very rarely suffers from Tuberculosis, and newly born infants rarely suffer". This does not mean that inheritance plays no part. On the contrary it would appear that inheritance plays a very important part; but this it does not by actual transmission of the disease or virus, but of a special quality of tissue in which the bacillus may find a congenial soil. It is the vulnerability or predisposition which is inherited. It would also appear that certain diseases weaken the natural resistant power of the tissues. Measles and whooping cough are examples of such diseases in infant life.

The principal forms of infantile tuberculosis as disclosed by the returns of the Registrar General are tabes mesenterica, tuberculous peritonitis, tuberculous Meningitis, and general tuberculosis as shown in the following table:- (4)

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- (1) Ashby & Wright: Op. Cit. p.228.
 - (2) Coats: Manual of Pathology. 1895. p.224.
 - (3) Ashby & Wright: Op. Cit. p.228.
 - (4) Compiled and calculated from Registrar General's Report (66th) p.p. 144 - 145.

T A B L E 25b

Infantile Deaths from Tuberculous Diseases in England
and Wales - 1903 -

| Cause of Death. | No. of deaths. | Deaths per 1,000 births. |
|------------------------------|----------------|--------------------------|
| Tabes Mesenterica. | 1368. | 2.69. |
| Tuberculous Peritonitis. | 1152. | |
| Tuberculous Meningitis. | 1153. | 1.61. |
| General Tuberculosis. | 1137. | 1.20. |
| Other forms of Tuberculosis. | 521. | 0.51. |
| All forms. | 5701. | 6.01. |

Tabes Mesenterica and Tuberculous Peritonitis.

It is proposed to discuss these conditions together, since their separation, so far as the special object in view is concerned, is of no importance. Much confusion seems to exist as to what is "tabes mesenterica" and what "tuberculous peritonitis". Tabes mesenterica strictly speaking should mean tuberculosis of the mesenteric glands. It is doubtful if the condition exists to any great extent as a primary affection. Starr (1) however believes that it does sometimes occur as a primary affection, and suggests that in these cases the bacillus may find entrance into the system in contaminated food. Ashby (2) on the other hand states that it is by no means common to find tubercular disease beginning with the symptoms of tabes mesenterica, as is commonly believed; but given a tuberculous focus elsewhere, tubercular ulceration of the bowels, or tabes mesenterica may subsequently develop, either together or separately.

Tatham (3) commenting on the deaths annually ascribed to "Tabes Mesenterica" asks, how many are really due to tubercle?.

- (1) Starr: Op. Cit. p.376.
- (2) Ashby & Wright: Op. Cit. 1899. p.144.
- (3) Tatham's letter to Registrar General, sixty fifth annual rep. Registrar General. P.IV.

He continues:- "it is obvious that by reason of the vague and irregular manner in which the name is used, no satisfactory answer to this question can be given. But with regard to its present employment by the medical profession I have recently ascertained by personal correspondence that the term "Tabes Mesenterica" has long been discarded by the medical staffs of the principal hospitals in London". For this reason its use in death certification is now discouraged by the Registrar General. Tuberculous peritonitis, on the other hand, is of more definite nosology and it is probable that the condition formerly returned under the unsatisfactory but time honoured heading "Tabes Mesenterica" will in future be increasingly included under the former, or other more definite, headings. At any rate, it appears that at present the same essential condition, whatever that may be, is returned under either the one or other of these names, not on any very definite clinical distinctions, but merely as a matter of predilection on the part of the certifying practitioner. Both conditions are included in the popular term "consumptive bowels".

This form of tuberculosis occurs for the most part in enfeebled children living under unhygienic conditions. Tuberculous cows' milk is regarded by some as the principal causal agent.

As regards age incidence, Starr, (1) who recognises tabes mesenterica as distinct from tuberculous peritonitis, states that the majority of the former occur after the third year, while the latter is stated to be quite common after the age of seven years, but is rare in early childhood and infancy. Ashby (2) says that while Tuberculosis of intestine and glands occurs at all ages it is less common before the age of one year.

It has already been indicated that the Registrar-General's returns would suggest that tuberculosis in one or other of its

(1) Starr: Diseases of Digestive Organs, 1901. p.377. and 421.

(2) Ashby & Wright: Diseases of Children 1899. p.145.

forms is very common in infancy. The relative mortality of the particular forms now under consideration as disclosed by the returns in 1903 may now be examined, regard being had to the age incidence of these conditions proper as determined by competent clinical observers.

T A B L E 25c.

Age distribution of deaths from Tabes Mesenterica and Tuberculous Peritonitis in England & Wales in 1903 (1)

| Age period. | 0 - 1. | 1 - 2. | 2 - 3. | 3 - 4. | 4 - 5. | 5 years & upwards. |
|----------------|--------|--------|--------|--------|--------|--------------------|
| No. of deaths. | 2520. | 891. | 333. | 181. | 106. | 1552. |

From the above table it can be shown that of the total deaths of all ages, ascribed to these causes 72 per cent, occurred at ages under 5 years; and similarly that of the total deaths at all ages no less than 45 per cent. occurred in the first year of life. It is well known that a large proportion of children suffering from tuberculous peritonitis recover. It would therefore follow that the mortality of these conditions under one year of age is large out of all proportion to that which obtains at later age periods, and so cannot be taken as a measure of comparative morbidity, or else that these statistical results are untrustworthy. There are good reasons to believe that the latter alternative is the correct one. One must again fall back upon clinical experience in order to explain the anomaly these statistics would suggest.

Starr (2) says a frequent mistake is to attribute every case of abdominal distention to disease of the mesenteric glands, and remarks that prominence of the belly is a frequent symptom in children, and in the vast majority of cases depends upon

(1) Compiled from sixty sixth ann. rep Reg. General p.p.144-145.
 (2) Starr: Op. Cit. p.379.

intestinal catarrh. ~~hydrocephalus, nor simple meningitis.~~

Ashby's (1) observations lead to the same conclusion. He says "in practice it is constantly found that infants and children who have habitually distended abdomens, with more or less wasting, are put down as suffering from "consumption of bowels". In the greater number of these cases there is no mesenteric disease, but a chronic and obstinate catarrh of the intestines". Again, "Mesenteric disease is much more frequently diagnosed, than discovered post mortem". In the second year, 18 in the third

year and Such being the statistical and clinical data one is forced to the conclusion that the infantile death rate from these conditions is vitiated to an indefinite degree by the inclusion of deaths from other causes not of the nature of tuberculosis, and the question arises what significance has to be attached to this rate? This can only be answered by determining to what category of causation the deaths wrongfully included in the rate should be relegated. There can hardly be any doubt that a large majority should be referred to simple marasmus due to deficient or defective feeding, hereditary syphilis or other obscure inherent weaknesses, dependent on previous health of parents or family diathesis. The wasting incidental to chronic or subacute intestinal catarrh would probably claim the greater portion, and improper food must again be held responsible. Even assuming that a tolerable proportion of the cases are in fact tubercular, this only further suggests the factor, ^{of} improper, or, at any rate, artificial, feeding as the fundamental cause of the conditions.

On the whole therefore this rate must be regarded as another index of improper feeding under ^{un-}hygienic conditions, and in a lesser degree, perhaps, of inherent weakness in the infant.

Tuberculous Meningitis.

Under this term the Registrar General includes tuberculous meningitis and acute hydrocephalus. The term does not

(1) Ashby & Wright. Op. Cit. p.p.144, 147

include congenital hydrocephalus, nor simple meningitis.

This disease may arise apparently as a primary affection, but is most usually associated with tuberculosis elsewhere.

As regards age incidence, Ashby (1) states that Tubercular Meningitis is less common in children, under the age of one year than in older children, and that between the age of one year and the commencement of puberty it is a common disease. Armstrong (2) states that of 85 necropsies where tubercular meningitis was found, 10 were in the second year, 18 in the third year and so on, "there was not a single case in the first year". He also states that of 70 infants brought to the post mortem room, where a previous diagnosis of meningitis had been made, only 9 of these showed meningitis at all, and in none of these was it tubercular. At Guy's Hospital (3) there were only three cases of infantile tuberculous meningitis in forty years.

Such being the clinical and pathological evidence as to the age incidence of this disease it will be of interest to examine the relative age mortality of tuberculous meningitis as disclosed by the returns of the Registrar General. The following table (4) shows the age distribution of deaths ascribed to Tuberculous Meningitis in England and Wales in 1903.

T A B L E 25d.

Age distribution, Tuberculous Meningitis.

| Age period. | 0 - 1. | 1 - 2. | 2 - 3. | 3 - 4. | 4 - 5. | over 5 years. |
|---------------|--------|--------|--------|--------|--------|---------------|
| No of deaths. | 1523. | 1302. | 700. | 479. | 387. | 2085. |

From this table it will be seen that of the total deaths ascribed to tuberculous meningitis at all ages, 4391 or 68 per

- (1) Ashby & Wright: Op. Cit. p.468.
- (2) Armstrong: Brit. Med. Jour. 1902. I. p.1024.
- (3) Fagge and Pye Smith, Principles and Practice of Medicine 3rd Edit. Vol. 1. p.639.
- (4) Sixty-sixth ann. Rep. Reg. Gen. pp.144 - 145.

cent. occurred under 5 years of age, and that no less than 23 per cent. of the total deaths at all ages occurred in infants under one year.

It would therefore appear that contrary to the clinical and pathological evidence already adduced, in the early years of life tuberculous meningitis is most fatal in the first, gradually diminishing in mortality in each succeeding year up to the fifth. Stated in another way it follows, that if these figures are trustworthy, either tuberculous meningitis is most common in the first year of life, or else that at that age period it is fatal out of all proportion to morbidity. But if one can rely on clinical testimony, this hypothesis will not hold good. Taylor (1) says "undoubtedly tubercular meningitis is in nearly all cases fatal". Ashby's (2) testimony is to the same effect, "a permanent recovery from an attack of tubercular meningitis means in the vast majority of cases a recovery from a general tuberculosis a result which is improbable". It may be taken then that a true record of mortality from tuberculous meningitis is also a record of its age incidence. From this it follows that either the clinical and pathological evidence as to age incidence and prognosis are at fault, or that the infantile deaths ascribed to tuberculous meningitis are vitiated in a high degree by the inclusion of deaths from other causes. Considering the many sources of error in the practical diagnosis of tuberculous meningitis there seems ample reason to regard the latter alternative as the only correct one. The question again arises as in the case of tabes mesenterica, what significance has to be attached to this infantile death rate?

The more important infantile conditions which are likely to be more or less frequently clinically confounded with tuberculous meningitis are the following:-

(1) Taylor: Practice of Medicine. 1904. p.335.

(2) Ashby & Wright: Op. Cit. p.473.

It will be seen that of the total deaths at all ages 3175 or 51 per cent. occurred under 5 years of age, and that the high proportion of 25 per cent. of total deaths at all ages occurred in the first year.

- (1) Simple (non tuberculous) meningitis.
- (2) Certain acute diseases - more particularly pneumonia and broncho-pneumonia.
- (3) The exhaustion following malnutrition, bad feeding, and severe diarrhoea in quite young infants - the so called pseudo-hydrocephalus.

There can hardly be any doubt that many deaths which ought to be referred to one or other of these categories go to swell the record of tuberculous meningitis. The significance to be attached to the rate is therefore highly indefinite, and one can only hazard the opinion that in some degree at least it must be regarded as an index of bad feeding and of want of care.

Meningitis (Simple).

Simple meningitis in England & Wales caused a death rate of 2.1 per 1,000 births in 1903. Although not included in the tuberculous diseases of the Registrar General this cause of death may be mentioned here. The age distribution of the deaths as disclosed by the Registrar General's returns is identical with that of tuberculous meningitis. The significance attaching to this death rate probably in no wise differs from that of tuberculous meningitis.

General Tuberculosis.

The following table shows the age distribution of deaths ascribed to this cause in 1903.

T A B L E 25 e.
General Tuberculosis. England & Wales.

| Age period. | 0 - 1. | 1 - 2. | 2 - 3. | 3 - 4. | 4 - 5. | 5 & over. |
|----------------|--------|--------|--------|--------|--------|-----------|
| No. of deaths. | 1137. | 596. | 224. | 137. | 82. | 2089. |

It will be seen that of the total deaths at all ages 2176 or 51 per cent. occurred under 5 years of age, and that the high proportion of 25 per cent. of total deaths at all ages occurred in the first year. These returns would suggest that general tuberculosis

is most frequent in the first year of life, regularly declining in each succeeding year up to the fifth. If these statistics be tested in the light of clinical experience the same discrepancy already noted in the other forms is again found. Ashby (2)

for example states that while general tuberculosis is perhaps commoner in early life than it is in after years, and though it occurs at all ages during childhood, it is rare before the end of the second year. For reasons which have already been sufficiently indicated it is probable that the returns under this heading, as in the others considered, are vitiated by the inclusion of deaths from other causes.

From the foregoing consideration of the principal infantile forms of tuberculosis it is clear that no very definite significance can attach to this infantile death rate.

When one reflects that, together, these diseases in 1903 contributed to over 6 of the infantile mortality rate, this is a matter for regret. Having regard to all the circumstances, however, the writer believes three principal indications stand out:-

- (1) The part food plays is sufficiently indicated by the fact that 44% of the infantile deaths have reference to the bowels.
- (2) The part played by heredity determining an inherent weakness in the infant is indicated by the fact that 16% of the infantile deaths occurred under 3 months of age.
- (3) Having special regard to the probable etiology of the conditions included under tuberculous diseases,

(1) Sixty sixth ann. rep. Reg. Gen. pp. 144 - 145. (Table 15c, p. 68)

(2) Ashby & Wright: Op. Cit. p.232.

The relationship between bronchitis and pneumonia in infancy is so close, the former so frequently passing on to the latter, that no good purpose would be served by discussing these causes of death separately. The following remarks therefore

5. Pneumonia and Bronchitis.

These diseases were in the aggregate responsible for the death of 21,633 infants in the year 1903, 10,841 being due to pneumonia and 10,792 to bronchitis. The following table (1) shows the average infantile death rates for these diseases in the quinquennium 1898 - 1902 and in the year 1903, in England and Wales as a whole, in Urban, and in Rural Counties respectively, for each sex separately, and for both sexes together,

T A B L E No. 26.
Deaths under 1 per 1,000 births.

| | Pneumonia. | | | 1903 | | | Bronchitis. | | | 1903 | | |
|------------------|------------|----|-------------|------|----|-------------|-------------|----|-------------|------|----|-------------|
| | M. | F. | Both Sexes. | M. | F. | Both Sexes. | M. | F. | Both Sexes. | M. | F. | Both Sexes. |
| England & Wales. | 12. | 9 | 11 | 13 | 10 | 11 | 15 | 12 | 14 | 13 | 10 | 11 |
| Urban Counties. | 14. | 11 | 12 | 15 | 12 | 13 | 16 | 13 | 15 | 13 | 11 | 12 |
| Rural Counties. | 9 | 7 | 8 | 9 | 7 | 8 | 12 | 10 | 11 | 9 | 7 | 8 |

The infantile deaths from both diseases are pretty evenly distributed through the whole period of infancy; both are everywhere more fatal in the male sex and both claim relatively very many mere victims in the town than in the country. It will thus be evident, as indeed might have been anticipated, that there is a close parallelism between these two causes of infantile deaths.

The combined rate for England and Wales in 1903 was equal to 22.8 deaths per 1,000 births.

(1) Compiled from table J., sixty sixth ann. rep., Registrar General.

The relationship between bronchitis and pneumonia in infancy is so close, the former so frequently passing on to the latter, that no good purpose would be served by discussing these causes of death separately. The following remarks therefore have to be taken as applying generally.

The exciting cause of these diseases is in a very large majority of cases, no doubt, exposure to cold, and so one finds them most frequent and most fatal in the late autumn or early winter. But in order to determine with any degree of accuracy what significance should attach to the gross rate, it is of primary importance to indicate some of the principal pre-disposing causes, for on these for the most part must that significance depend.

Among the more immediate predisposing causes may be mentioned dentition, rickets, measles, whooping cough, and intestinal catarrh. For reasons which have already been sufficiently indicated, it is probable that deaths from bronchitis and pneumonia secondary to measles and whooping cough, will be correctly returned under the primary cause. The consideration of the other

factors, namely teething, rickets and intestinal catarrh opens up the question of how far food is a factor. Granted that rickets is a cause of respiratory disease, the importance of the food factor goes without saying, for rickets is essentially a disease of malnutrition, and the question may conveniently be examined from that standpoint. Ashby (1) says rickets frequently plays an important part in the production of bronchitis. Again, "rickety children are specially prone to suffer from bronchial affections, and in them it is especially serious on account of the softness of the ribs, and the weakness of the muscles of respiration". Taylor (2) says that next to fits and laryngismus the most serious result of rickets in childhood is the aggravation of bronchitic attacks which the soft state of the ribs causes. It will be noted that both these authorities emphasise

(1) Ashby & Wright: Op. Cit. p.351.

(2) Taylor: Op. Cit. p.954.

the importance of rickets in predisposing to a fatal issue in these respiratory diseases. Vincent (1) says "Clinical experience is sufficient to prove that by far the greatest incidence of these diseases is among infants the subject of rachitis or general malnutrition. Diseases of the lungs are almost invariably secondary to malnutrition".

The food factor, as has already been repeatedly shown, largely dominates infantile mortality and there is perhaps a tendency to exaggerate, rather than to underestimate its importance. This the writer is anxious to avoid. It will therefore be of interest to examine Vincent's statement "diseases of the lungs are almost invariably secondary to malnutrition", in the light of the Registrar General's returns for 1903. If the age incidence of the deaths from bronchitis and pneumonia together be worked out for the three age periods of the first year, as a percentage of the total deaths from these combined causes in the first year, the following result appears:-

T A B L E 26a.

| Age period. | 0 - 3. | 3 - 6. | 6 - 12. |
|-----------------------|--------|--------|---------|
| Percentage of deaths. | 27. | 25. | 48. |

It would thus appear that bronchitis and pneumonia are more fatal in the first three months of life, than in the second three months, and if the deaths which fall in the age period 6 to 12 months be considered as equally distributed through that age period, these diseases are at least not more fatal at this later period than in the earlier. It is not claimed that these figures prove malnutrition to have nothing to do with bronchitis and pneumonia; nor on the other hand do they disprove it. But it is claimed that they indicate the operation of at least other factors. For if infantile deaths from bronchitis and pneumonia

(1) Vincent: "The nutrition of the Infant" 1904. p.286.

were "invariably secondary to malnutrition" this would imply a cumulative effect in the first year. That is to say, the deaths would be least in the first three months, greater in the second three months, and most of all at age period 6 to 12 months, just as was found to be the case with the "rickets group" already discussed. The above result is therefore against any invariable association of malnutrition with these causes of death. Moreover, the writer has abundantly seen fatal bronchitis and pneumonia in infants where the factors of malnutrition or rickets could be absolutely excluded.

What then are the other factors which may be in operation? Ashby (1) says "some children seem to inherit a tendency to bronchial catarrh, which passes into bronchitis with great readiness." Again, "that the larger number of cases should occur among the lower and worst housed classes is only what is to be expected, inasmuch as the lives of the infants and children are spent either in the foul and stuffy atmosphere of an overcrowded and ill ventilated house, or they are exposed imperfectly clad to all sorts of weather in the streets". Here then is an indication of two factors, exposure on the one hand, and domestic unhygienic conditions on the other, which may be operative from the moment of birth. The infants with an inherent tendency would suffer most and earliest, and so the early incidence and excessive mortality in towns is understandable apart altogether from the food factor. At later age periods however the more resistant would begin to suffer as the result of a predisposition induced by continued malnutrition.

The gross rate may therefore be regarded as indicating the operation of three principal factors which the writer would arrange in the following order:-

1. Exposure - this implies unsuitable or insufficient clothing.
2. Unhygienic surroundings in the home.
3. Malnutrition.

(1) Ashby & Wright: Op. Cit. p.351.

6. Measles and Whooping Cough.

Measles caused the death of 2,141 infants, and whooping cough that of 4,773 in 1903. The following table (1) shows the average infantile death rates from these causes in the quinquennium 1898 - 1902 and the rates in the year 1903 in England and Wales, in Urban, and in Rural Counties respectively, for each sex separately, and for both sexes together.

T A B L E. 27.

Measles and Whooping cough.

| | Measles. | | | | | | Whooping Cough. | | | | | |
|------------------|-------------|----|------------|-------|----|-------------|-----------------|----|-------------|-------|----|-------------|
| | 1898 - 1902 | | | 1903. | | | 1898 - 1902 | | | 1903. | | |
| | M. | F. | Both sexes | M. | F. | Both sexes. | M. | F. | Both sexes. | M. | F. | Both sexes. |
| England & Wales. | 3. | 3. | 3. | 2. | 2. | 2. | 5. | 6. | 5. | 5. | 5. | 5. |
| Urban Counties. | 4. | 3. | 3. | 3. | 3. | 3. | 5. | 6. | 5. | 5. | 6. | 5. |
| Rural Counties. | 2. | 2. | 2. | 1. | 1. | 1. | 5. | 6. | 5. | 4. | 4. | 4. |

The outstanding features of the table are:-

- (1) Measles is much more fatal in towns than in the country, and affects both sexes nearly equally.
- (2) Whooping cough is more fatal in females. This is brought out more clearly in the average rates for the quinquennium, when it will also be observed that the Urban and Rural rates were identical. In 1903, however, whooping cough, like measles, was more fatal in town than in the country.

The infantile death rates from both these causes have varied but little during half a century.

Measles and whooping cough are acute infectious disorders and prevail in wide spread epidemics, recurring every two or three years. Measles is peculiar in having in addition to the usual recurrence major epidemics at intervals of 5 or 6 years. Epidem-

(1) Compiled from table J., sixty sixth ann. rep. Registrar Gen.

ics of measles and whooping cough may co-exist, or the one may follow the other.

It is questionable if either disease shows any marked seasonal variation, though, from their liability to be attended with pulmonary complications, they are more fatal in the spring and winter months of the year. Although both diseases contribute sensibly to the infantile mortality year by year, there is reason to believe that these disorders are only too frequently regarded with indifference, with the result that in many cases medical aid is not invoked until fatal complications supervene.

Moreover among the lower classes, practically no effect is made to guard the infant against infection, apparently acting on the pernicious theory that (they) are inevitable, and that the sooner they are got over the better. How unfounded this notion is will be apparent when the case mortality, (as far as can be determined) at different ages, is considered.

| | |
|--------------|---------------|
| Under 1 year | 9.6 per cent. |
| 1 - 2 | 19.7 |
| 2 - 3 | 10.2 |
| 3 - 4 | 4.8 |
| 4 - 5 | 1.5 |

The importance of measles and whooping cough, as causes of death contributing to infantile mortality, lies in a consideration of the circumstances which in associated with these diseases make for a fatal issue. In children aged 1 to 2, under 22 percent; in children 2 to 3, under 11.3 per cent; in children aged 3 to 4, 3.6 per cent; in children 4 to 5, under 4.1 per cent; in children aged 5 to 6, under 2.9 per cent, while under 1.90 known cases at ages 6 and upwards no deaths occurred.

Measles.

The following table shows the age distribution of infantile deaths from measles in England & Wales in the year 1903.

T A B L E 27a.

| Age period: months. | 0 - 3 | 3 - 6 | 6 - 12 |
|---------------------|-------|-------|--------|
| Percentage deaths | 2.3 | 7.6 | 90.1. |

From this it will be seen that measles in infancy is chiefly fatal after the 6th month. Taylor (1) believes, and these figures would appear to bear him out, that very young infants are less susceptible, and have the disease, when caught, in a milder form than children somewhat older.

(1) Taylor: Practice of Medicine 1904. p.62.

The mortality of measles varies in different epidemics; ^{and} (but) in the absence of compulsory notification, it is evident that statistics of case mortality are at best but approximate.

Taylor (1) gives the mortality in England and Wales as from 1 to 2 per cent. at all ages. The mortality varies from a very small figure among well nourished, well-cared-for infants in hygienic surroundings, to about 9 to 10 per cent. among the class from which dispensary patients are drawn (2). Dr Theodore Thompson (3) gives for a district in which measles was compulsorily notifiable the following fatality:-

| | |
|----------------|---------------|
| Under 1 year., | 9.6 per cent. |
| 1 - 2 " | 19.7 " |
| 2 - 3 " | 10.2 " |
| 3 - 4 " | 4.9 " |
| 4 - 5 " | 1.5 " |

Newsholme (4) in Brighton from the analysis of 1,234 known cases of measles in 1904, found the fatality at all ages to be something under 7.6 per cent. In children under 1 year it was something under 25 per cent; in children aged 1 to 2, under 22 per cent; in children 2 to 3, under 11.3 per cent; in children aged 3 to 4, 3.6 per cent; in children 4 to 5, under 4.1 per cent; in children aged 5 to 6, under 2.5 per cent, while among 270 known cases at ages 6 and upwards no deaths occurred. Newsholme remarks that these fatality rates are probably somewhat too high for each of the ages under 6 years, since the number on which they are based probably understates the actual number of cases which occurred. Nevertheless, it would appear that if children could be prevented from catching measles until they are six years of age, the mortality from this disease would almost if not quite

(1) Taylor: Op. Cit. p.65.
(2) Ashby and Wright: Op. Cit. p.268.
(3) Quoted by Newsholme: Annual Report on the Health of Brighton 1904.
(4) Newsholme: Ibid. p.26.

disappear. The point to be noted at present is that measles is a very fatal disease in infancy. The fatal issue is usually through some pulmonary complication such as bronchitis (and) bronchopneumonia, and the conditions which make for this fatality may be summed up in the words insanitation and poverty, implying as they do overcrowding, deficient clothing, and malnutrition. Of these perhaps the most important is overcrowding, and this explains the excessive mortality among town infants as compared with those in the country.

Whooping cough.

The following table shows the age distribution of infantile deaths from whooping cough in England and Wales in 1903.

T A B L E 27.b.

| Age period in months. | 0 - 3. | 3 - 6. | 6 - 12. |
|-----------------------------|--------|--------|---------|
| Percentage of total deaths. | 18.9. | 24.2. | 56.9. |

It will be seen from this table, which may usefully be compared with that for measles already given (table 27a) that whooping cough is a fatal disease through the whole period of infancy. Ashby (1) found that of 3,669 cases of whooping cough treated in connection with a children's dispensary, 281 died, equal to a mortality of 7.6 per cent. Of these, 217, or 77 per cent. were under two years of age; 63, or 13 per cent. were from two to 5 years of age; and only one fatal case occurred in a child over five years of age. It would therefore appear that whooping cough in the first year of life is more fatal than measles. Unlike measles, the fatal issue would appear to be less dependent upon unhygienic conditions. Whooping cough during the winter months is always more likely to be complicated with chest disease than in the summer, and while this is especially true of the poorer classes, it holds good also to a lesser extent in the better

(1) Ashby and Wright: Op. cit. p.313.

housed classes of the population. This is borne out by the similarity of the death rate from whooping cough, in urban and rural areas in the quinquennium 1898 - 02, though the parallel fails in 1903, when the disease was distinctly more fatal to both sexes in town. On the whole, therefore, it may be assumed that the same conditions as make for a fatal issue in measles do so, though in a less marked degree, in the case of whooping cough.

Both diseases are especially fatal in infants the subjects of rickets, and both are liable to be followed by tuberculosis, so that the returns probably fail to disclose the true mortality to which they give rise.

Measles and whooping cough belong to the class of diseases usually described as preventable - but yet they would seem to be among the least preventable diseases to which infancy is liable. It is probable, however, that a high infantile rate of mortality from these diseases has to be taken as evidence of ignorance, want of care, and of the operation of unhygienic conditions.

7. Violent Deaths.

In the year 1903 no less than 2,374 infants under one year of age died violent deaths. Of these 730 or over 31 per cent. occurred under the age of one month.

The principal cause of death was suffocation in bed. This claimed 1,796 victims, of which 516, or about 30 per cent. occurred under the age of one month; 1,205, or over 67 per cent. occurred under the age of three months.

It is a truism that accidents will happen, but, nevertheless, the significance of the deaths included in this category can only be regarded as sinister, amounting as it does in many cases to criminal negligence or worse. That these deaths are very intimately associated with intemperance can hardly be doubted. Newsholme(1) records that Dr Ogle found that deaths

(1) Newsholme: "Vital Statistics" 1899. p.128.

of infants from suffocation in bed occurred chiefly on Saturday nights, the night on which there is a maximum amount of drunkenness.

Conclusions.

Having now considered in some detail the principal causes of death which contribute to the infantile mortality rate, the writer believes, having regard to the attempt which has been made to get close, so to speak, to each cause, that the following conclusions are warranted.

Infantile mortality is largely influenced by:-

- (1) Inherent weakness of the infant.
- (2) Improper food.
- (3) The effect of unhygienic (insanitary) surroundings, both domestic and otherwise.
- (4) Improper and insufficient clothing.

These are here arranged in what the writer considers to be the order of their importance, from the point of view of public health. These influences overlap, but general examples can be given of the special operations of each and may be briefly noticed here.

(1) Inherent weakness of the infant.

The first place is occupied by the wasting diseases of the Registrar General, to which the writer would add congenital syphilis. This influence also makes itself more or less felt in the several other causes which contribute to death in the first three months of life. More particularly may be mentioned convulsions, tuberculous diseases, bronchitis, and pneumonia, occurring at that age period.

(2) Improper food.

This closely follows inherent weakness, and is only considered less important as an influence making for high infantile mortality, because it is, or should be, more preventable than

the former. Improper food so largely dominates infantile mortality in general that the difficulty is not to understate but rather to avoid exaggerating its importance. Occupying the first place in diseases due to improper food come the diarrhoeal diseases, followed by convulsions, the 'rickets group', and the tuberculous diseases from the third month of life onward. In a lesser degree the influence of improper food contributes to deaths from bronchitis, pneumonia, whooping cough, and measles.

(3) Unhygienic (Insanitary) surroundings both domestic & otherwise

The importance of this influence has been amply illustrated in considering the several causes of death. It is one which the writer believes is apt to be overlooked. A witness(1) before the Physical Deterioration Committee gave it as his opinion that sanitation had nothing to do with infantile mortality. This statement will be examined later. At present it will be sufficient to indicate that the influence of this factor is most decidedly apparent in diarrhoea, convulsions, 'rickets group', and measles. In a lesser degree it contributes to death from tuberculous diseases.

(4) Insufficient clothing.

Many deaths from bronchitis, measles, and whooping cough, not to speak of the predisposition to other fatal diseases, can be traced to this influence. Like insanitation, its importance is apt to be underestimated.

It is difficult to dissociate these influences the one from another, but for the purpose of answering the question, ^{What} reduction of infantile mortality is reasonably possible, a broad classification with this object in view is desirable. If, therefore, the infantile deaths occurring in 1903 be divided into classes:-

Class (1) Deaths due chiefly to inherent weakness of the
infant.

(1) Vincent: Physical Deterioration Committee. Minutes of evidence.

Class (2) Deaths due chiefly to improper food and want of care. To be included under those due to

Class (3) Deaths due to other causes, but on the other hand

Some indication of the extent to which reduction is possible will be made. Taking the causes of death as they occur in the returns, and having regard to the points already discussed, they more or less naturally fall chiefly into one or other of three classes as follows:-

| Class 1. | | Class 2. | |
|-------------------|------------------------------|------------------------------|------------------------------|
| Cause of death. | Death rate per 1,000 births. | Cause of death. | Death rate per 1,000 births. |
| Wasting diseases. | 44.1 | Diarrhoeal diseases. | 20.7 |
| Syphilis. | 1.3 | Convulsions & Rickets group. | 17.1 |
| | | Tuberculous diseases. | 5.9 |
| | | Meningitis. | 2.1 |
| | | Violent deaths. | 2.5 |
| Total. | 45.4 | Total. | 48.3 |

| Class 3. | |
|-------------------|------------------------------|
| Cause of death. | Death rate per 1,000 births. |
| All other causes. | 40.3 |

On this basis of calculation, if for the present the deaths in Class 1. be regarded as unavoidable, and those in Class 2 equal to 48.3 which may reasonably be regarded as representing a loss of life which is more or less distinctly preventable. It may be objected that this grouping is artificial, but the more one considers the underlying factors concerned, the more certain it is that it is a

natural one. No doubt some of the deaths here included in the Class 2 might more properly be included under those due to inherent weakness or, "all other causes". But, on the other hand, it is equally true that many deaths in these latter ought properly to be included in Class 2. The net result, however, appears to be that class 2, as it stands, may be taken as an index of the saving which might have occurred in 1903. Applying this to the infantile mortality of 1903 we have:-

| | | |
|----------------------------------|---|--------------|
| <u>Infantile mortality. 1903</u> | - | 131.5. |
| <u>Class 2.</u> | - | 48.3. |
| | | <hr/> |
| <u>Difference.</u> | - | <u>83.2.</u> |

This is what the infantile mortality of 1903 would have been, if deaths due to improper food and want of care had not occurred. Food diseases are preventable, and therefore an infantile mortality figure of, say, 80 becomes possible. That the above is not mere theory is almost capable of proof from the returns of the Registrar General. In the year 1903 six counties had infantile mortality rates of less than 90:- Flintshire 84, Hertfordshire 84, Oxfordshire 84, Wiltshire 85, Radnorshire 87, and Somersetshire 88, and the writer is not aware that in these places any special attempt ^{was} (has been) made to limit the mortality among infants. Hope of Liverpool, after making due allowance for what may be regarded as unavoidable deaths in infancy, came to the conclusion that a mortality of anything above 80 to 100 per 1,000 births is preventable (1). The object at present, however, is to establish the premise that the infantile mortality of England & Wales is capable of reduction. To what extent this reduction is hindered by the operation of other factors will be indicated when discussing the subject from the point of view of the factors in its causation, and to what extent these latter may be counteracted will be discussed when considering measures that may be taken for prevention.

(1) Report on the Health of Liverpool 1903. p.17.

The Factors in the Causation of Infantile Mortality.

So far, there has been examined the question of infantile mortality from the point of view of the more immediate causes, The Factors in the causation of Infantile Mortality.

the causes, that is, which figure in the death certificates. It is now proposed to take a survey of it from another side, and one which will lay the basis of a rational conception of methods of prevention. It is desired to examine into the various factors which lie outwith, and to a great extent unexplored, the more immediate causes of death already discussed. An attempt will be made to indicate as far as possible the special operation of the more important of these factors. Obviously this will not always be easy, and many discrepancies must needs appear, besides it is often practically impossible to dissociate one factor from any others which may act simultaneously.

"A" Factors acting intrinsically:-

(1) Parental Syphilis.

(2) Parental Tuberculosis.

(3) Parental Alcoholism.

"B" Factors acting extrinsically:-

1. Proximate:

(1) Moral

(2) Educational.

(3) Social.

2. Remote:

(1) Sanitary.

(2) Meteorological.

(A) Factors acting intrinsically.

These act in the infant essentially through the parents. Their consideration has to do with the influence of inheritance, either immediate or from more remote ancestry, and more particularly of the influence of parental disease and deformed constitution upon the vitality of the infant.

(B) Factors acting extrinsically.

These arise in the environment of the infant after birth, hence the term environment here in its strict significance. The intrinsic factors in the causation of infantile mortality. It is difficult to estimate the influence of heredity as a factor in infantile mortality, but it is probable that while it plays some part its importance in this respect has been over-estimated. The first essential to the birth of a healthy child

The Factors in the Causation of Infantile Mortality.

So far, there has been examined the question of infantile mortality from the point of view of its more immediate causes, the causes, that is, which figure in the death certificates. It is now proposed to make a survey of it from another side, and one which will give a wider view of the subject, and lay the basis of a rational conception of methods of prevention. It is desired to examine into the various factors which lie outwith, and to a great extent give rise to, the more immediate causes of death already discussed. An attempt will be made to indicate as far as possible the special operation of the more important of these factors. Obviously this will not always be easy, and many discrepancies must needs appear, because it is often practically impossible to dissociate one factor from many others which may act simultaneously, and therefore only the broad tendency of any one factor can be expected to be demonstrated. Thereafter, it is proposed to study by statistics from large towns, the effect of some factors in complex operation.

The factors in the causation of infantile mortality may be broadly divided into two classes:-

(A) Factors acting intrinsically.

These act on the infant essentially through the parents. Their consideration has to do with the influence of inheritance, either ^{from} immediate or from more remote ancestry, and more particularly ^{with} (of) the influence of parental disease and de-
praved constitution upon the vitality of the infant.

(B) Factors acting extrinsically.

These arise in the environment of the infant after birth, using the term environment here in its widest significance.

The intrinsic factors in the causation of infantile mortality.

It is difficult to estimate the influence of heredity as a factor in infantile mortality, but it is probable that while it plays some part its importance in this respect has been over-estimated. The first essential for the birth of a healthy child

is that it should have a healthy parentage. Experience proves that if either parent has a damaged vitality, the child is very liable to start life badly. This however does not necessarily imply the transmission of actual disease; but rather of the inheritance of a constitution, the measure of whose vitality is in some way related to that in the parents. Inheritance, it would appear, so far as disease is concerned, probably seldom implies more than susceptibility to disease - that is to say, the infant enters life with a tendency to more or less readily succumb to unfavourable environment. Coats (1) says "if we define the constitution as the inherent structure and powers of the organism then we shall recognise that the constitution of the individual is made up of an immense number of particulars of structure and function each of which has been transmitted from a parent or ancestor. These peculiarities include susceptibility to disease, so that we speak of constitutional susceptibility. Each of these peculiarities is inherent in the fertilized ovum, when it enters on its career of development".

In this consideration it is not proposed to arbitrarily divide the factors into those whose effects are manifest before birth, and those in which the effect is not manifest until some time after birth; for though these effects may manifest themselves either in one, or other, or both of these ways, no strict delimitation for the present purpose is practical or desirable. Among those, however, which act for the most part before or at the time of birth may be mentioned all the conditions which lead to premature birth, to congenital malformations or defects, and to injury at birth, including atelectasis. Premature birth may be caused by disease or accident to the pregnant woman; congenital defects to causes too obscure to dogmatise upon; while injury at birth may arise when the child is proportionately large - as when a broad Scandinavian head has to pass through a narrow Gallic pelvis.

(1) Coats: "Manual of Pathology" 1895. p.23.

The more important factors are those which make for an inherent want of vitality in the infant. Among these, indefinite ill health in either parent; great disparity of age; industrial female labour, (e.g. lead poisoning); unhealthy environment; malnutrition of the prospective mother; and certain mental states, may be mentioned as liable to exert an injurious influence on the unborn child, though not necessarily manifest at the moment of birth. More important still, however, is the influence of parental syphilis, tuberculosis, and alcoholism, and it is proposed, having regard to their own relative importance, to limit the discussion to these as representative at least of the principal factors making for want of vitality in the infant.

(1) Parental Syphilis.

Syphilis stands out as the most prominent example of the intrinsic factors. It may show itself sometimes in a child born diseased, but more often by the development of symptoms after birth. In either case, however, the factor has been at work antenatally.

Ashby (1) sums up the modes of infection in hereditary syphilis as follows:-

- (1) The ovum may be infected by the spermatozoa of the father (Paternal heredity).
- (2) The ovum may be infected by the mother (Maternal heredity).
- (3) The ovum may be infected by both (Mixed heredity).
- (4) The foetus may suffer by the mother becoming infected during pregnancy.

Ashby regards the mixed infection as the most serious, and considers that the more recently the parents have suffered from syphilis the more severely will the infant suffer. He cites Fournier who found in four-fifths of the fatal cases of hereditary syphilis, ^{that} the infants had been born within three years of the parents being syphilised. Syphilis derived from the mother alone is more serious than syphilis from the father alone.

There is no sort of doubt that the deaths of infants

(1) Ashby & Wright: Dis. of Chn. 1899. p.448.

duly returned under syphilis in no way sufficiently indicates the operation of this factor in infantile mortality. It is well known that syphilis is a very common cause of abortion, and of still births, in which respects it does not at present call for consideration. There can be no doubt, however, that it is largely responsible for many deaths due to premature birth; since pregnancy is perhaps more frequently interrupted by syphilis than by any other single cause. Syphilitic infants are liable to all sorts of degenerative changes; they are frequently anaemic; have feeble powers of digestion; frequently suffer from broncho-pneumonia; and from various nervous manifestations, especially eclampsia. One must therefore read between the lines, and apportion a share of the infantile deaths ascribed to such diseases as marasmus, convulsions, and broncho-pneumonia, as due primarily to this cause.

(2) Tuberculosis in the parents must also be regarded as a very potent factor, whether one inclines to or denies the possibility of actual tubercle being hereditary. Tuberculous parents are deficient in vital tone, and experience proves that their offspring start life handicapped, more especially if the mother is diseased. It has already been shown that the infantile deaths ascribed to various forms of tuberculosis are probably overstated. This in no way invalidates the importance of tuberculosis in the parent as a potential factor in infantile mortality; since it does not assume that the offspring of such, must necessarily die of tuberculosis. The factor may simply express itself in the infant by feeble resisting power, and the death may be, and probably mostly is, due apparently to one or other of the infantile causes of death, such as marasmus, diarrhoea, convulsions etc.

(3) Parental Alcoholism is a most important factor in the production of children of enfeebled constitution. The disastrous influence of alcohol on the vital cell can be demonstrated by

direct biological experiment. Ridge, (1) Richardson, and M. Fera, have shown that even infinitesimal proportions of alcohol retard the growth of both animal and vegetable protoplasm.

Legrain, in "L'Alcoolisme en France", (1897) gives the results of periodical investigations of 215 alcoholic families, comprising 814 descendants spread over three generations, showing that 32 per cent. of the total died in infancy or early childhood. Out of a total of over 800 children born of alcoholic parents, Legrain noted that 21.3% included either still births, miscarriages, or deaths in infancy and early childhood.

It would appear that alcoholism in the parent may express itself as tuberculosis in the child, and that in this respect a history of parental alcoholism is not even second in importance to that of an immediate family history of tuberculosis. Imbault (2), from a careful study of the frequency of tubercle in children whose parents were alcoholic, (These de Paris 1901), found tuberculosis very frequent. Tuberculous meningitis was the most frequent manifestation. He quotes Arrivés' observations on 1506 children in whom he found tuberculous meningitis ^{to be} twice as frequent in those of alcoholic parentage, ^{as} (than) in those the children of tuberculous parents. Sullivan, (3) Deputy medical officer of H.M. Prison Pentonville, in a paper read before the Society for the Study of Inebriety, stated that the death rate among infants of inebriate mothers was nearly two and a half ^{higher} times that among the infants of sober mothers of the same stock. In the ^oalcoholic family, there was a decrease of vitality in successive children, e.g. in one family the earliest born children were healthy; the fourth was of defective intelligence; the fifth, an epileptic idiot; the sixth, still-born. Of 219 children, of drunken mothers, which survived, nine became epileptic. Taking women of the same class, he found that of 21 drunken mothers with

(1) Appendix to the Report Physical Deterioration Committee. p.71.

(2) B.M. Jour. 1902. I. Epit. 83.

(3) Excerpted in Appendix to Report Inter. Department Committee Physical Deterioration p.68.

125 children, sixty-nine died under 2 years; whilst of 28 sober mothers with 138 children, thirty-three died under 2 years.

Shuttleworth (1) came to the conclusion that parental intemperance is a large factor in the degeneracy of offspring both mental and physical.

The influence of alcohol as an intrinsic factor in infantile mortality may be summed up as follows:-

- (1) There is the direct effect of over-indulgence on the part of the parents:-
 - (a) In enfeebling the parental organism.
 - (b) In transferring toxic material (Alcohol) by means of the sperm and germ cell, either, or both, of which, may have suffered protoplasmic change.
 - (c) In the case of alcoholism in the woman there is continuous poisoning of the foetus-in-utero by alcohol and other secondary toxins.
- (2) There is the obvious danger from accidents of all sorts to a drunken pregnant woman before full term, but whilst the child may be viable, leading, it may be, to premature birth.
- (3) Alcohol and poverty are linked together, acting and reacting as cause and effect. Alcohol in families of precarious position leads to poverty; poverty in turn leads to further drinking; and the operation of both together too frequently means poverty of nutrition. Domestic unhygiene in this combination plays its most powerful part.

The effect of the intrinsic factors must therefore be looked for not only in the wasting diseases of the Registrar General, but also in syphilis, early convulsions, and other diseases dependent upon an initial want of vitality.

(1) Excerpted in Appendix to Report Inter. Department Committee
Physical Deterioration. p.69.

B. Extrinsic Factors.

B. Extrinsic factors in the causation of infantile mortality.

of the infant after birth. What then is the relation of the infant to Proximate:-

- (1) 1. Moral: (1) Alcohol and Poverty. (2) Illegitimacy.
- (2) 2. Educational: (1) Illiteracy (2) Inexperience.
- (3) 3. Social: (1) Industrial employment of married women. (2) Overcrowding. (3) High birth-rate.
- (4) 4. Improper food:

- (4) of? (1) To what extent artificial (as largely presumptive (or) improper) feeding prevails.
- (2) The underlying conditions which make artificial feeding necessary.
- (3) The qualities of an artificial food which make it an improper food.
- (4) The relation of artificial feeding to infantile mortality.

2. Remote:

- 1. Public Health: Sanitation.
- 2. Meteorology: (1) Rainfall. (2) Temperature.

Factors in the environment which may have indirectly or exercised on the infantile organism:

B. Extrinsic Factors.

These are the factors which arise in the environment of the infant after birth. What then is the relation of the infant to its environment?

- (1) The first instinctive act of the newly born infant is to breathe, so it must have Pure Air.
- (2) The maintainance of a certain temperature is necessary to life. This has hitherto been ^{maternally supplied} (automatically) attained, but now the external forces must be met by suitable Clothing.
- (3) The time has come when (its) ^{of the infant} pabulum is no longer supplied directly, so it must exercise the function of digestion. Under normal, and, therefore, the best circumstances, Food is still supplied by nature through the Mother. But if this is impossible for any reason, a substitute must be devised, and this implies the consideration of Proper feeding.
- (4) Since vitality consists in balancing of intake (assimilation), with growth and output (excretion), there must be adopted methods of Cleanliness.
- (5) In the perfect life there must be seasons of labour and refreshment, of work and repose, therefore the infant must have due periods of Sleep.

Considering these necessities of the infant, it will be seen that in order to satisfy them some must be provided privately - food, clothing, cleanliness (domestic and personal), and sleep; while others - pure atmosphere, and general cleanliness; are matters of public moment. Meteorological influences are beyond the control of the individual, but demand attention. Having regard to this consideration, it becomes possible to classify the factors in the environment which may operate injuriously or otherwise on the infantile organism:-

1. Proximate.
2. Remote.

1. The proximate factors depend on the ability and the willingness of the parents or guardians to observe the duties devolving on them, ^{These} and imply the consideration of:-

1. Morality.
2. Education.
3. Social condition.
4. The question of proper feeding.

2. The remote factors are matters of:-

1. Public Health: sanitation.
2. Meteorology.

It is not proposed to limit the discussion to this hard-and-fast classification, though for the most part it will be followed.

1. Moral. Under this heading it is proposed to discuss the influence of alcohol, illegitimacy, infant insurance and crime upon infantile mortality.

(1) Alcohol as an extrinsic factor.

It can readily be understood that the effect of alcohol as an extrinsic factor in the causation of infantile mortality can only be broadly indicated. Alcohol may affect the infant after birth in at least three ways:-

- (A) Indirectly through the secretion of a nursing mother.
- (B) Directly by exhibition.
- (C) Indirectly through the operation of environment evolved by alcohol.

(A) Indirectly through the secretion of a nursing mother.

It has already been pointed out in this paper that there is reason to believe that alcoholism is increasing among women. That this, if so, is in many ways a menace to infant life can hardly be doubted. As regards its rôle in this respect in the nursing mother, Vincent(1) believes that no definite or specific

(1) Vincent. "The nutrition of the Infant" 2nd Ed. p.35.

effect can be attributed to it. He cites in support of this, experiments by Klingemann which went to show that alcohol is not excreted by the mammary gland, unless the woman takes such an amount as to produce a state of intoxication. He admits, however, that in regard to lactation itself alcohol is of no value. Carpenter, (1) on the other hand, states that alcohol can be traced in the milk within twenty minutes of its ingestion and for seven or eight hours after. This has been done in the case of women as well as in animals. Clinically, many cases of infants have been reported in which both acute and chronic alcoholic poisoning was due to the passage of alcohol into the milk. "The possibility of such an occurrence", he continues, "cannot be too widely known among the medical profession. Any practitioner who is alive to the possibility of this will be surprised on investigation to find that this occurrence is by no means rare, and I recommend such an one to put to the test the truth of these assertions. Conviction will quickly follow on his clinical researches, and he will become a firm advocate of alcoholic abstention for nursing mothers".

When one has regard to the experiments of Ridge (2) -- who showed that even infinitesimal quantities of alcohol can produce protoplasmic change, and retard physiological growth, the sensible presence of alcohol in the maternal secretion would appear to be an amount far in excess of what is required to act prejudicially on the delicate organism of the growing infant.

It may be taken then that alcohol, even when used by a nursing mother in moderate amount (whatever that may be), is in part excreted by the mammary gland. Moreover, intoxicated mothers are unfortunately no rarity among the classes in which infantile mortality is highest.

Alcoholism in mothers, from whatever point it is viewed, can only be regarded as a grievous calamity. In those addicted to excess, an appreciable quantity is excreted in the mammary secretion, and so the infant imbibes alcohol with its natural

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- (1) Carpenter. Alcohol & children. Journal of state Medicine Vol. XII No.10. p.605.
 - (2) Ridge: Alcohol. Appendix Physical Deterioration Committee p.71.

food. But apart from actual alcoholism as a vice, many nursing mothers resort to stimulants under the mistaken notion that they thereby increase the quantity and quality of their secretion; or (they) may be resorted to simply on account of insufficient maternal nourishment, in which latter case the result, so far as the infant is concerned, is doubly deplorable. Not only must the milk under such circumstances be poor in quality, and so the nutrition of the infant must suffer, but also the presence of alcohol in the secretion, though small in amount, is sufficient to retard what growth might otherwise have occurred. A vicious circle enclosing both infant and parent is thus established.

(B) The effect of alcohol directly by exhibition.

The effect of alcohol by direct imbibition if long continued differs in no way from the effect produced by indirect imbibition. It is not suggested that alcohol has no place in the treatment of infantile ailments. Nevertheless, the pernicious practice of giving infants alcohol in any form apart from direct and specific medical advice, cannot be too strongly condemned. Indeed it would be a good plan, when the medical attendant considers alcohol necessary for infants, to prescribe and handle it in the same manner as he does other active therapeutic agents, and it would doubtless be wise in the great majority of cases to withhold information respecting even the nature of the remedy employed. The faith of the mothers (in) the lower classes in alcohol for all and sundry ailments of infancy is simply unbounded, and if once the agent is recommended by a medical man, this recommendation is commonly handed on from one mother to another, without any due regard being had to the original circumstance of its employment; and so the practice of dosing babies with alcohol is carried on under the aegis of a quasi-medical opinion. Happily, however, there is reason to believe that the promiscuous recommendation of alcohol on the part of the medical profession is becoming a thing of the past, but unfortunately there is still great scope for active advice in the opposite direction.

(C) The effect of Alcohol indirectly through the operation of environment evolved by it, has to do with the consideration of other social, industrial, and hygienic factors which will be discussed later. In this place however may be mentioned one outstanding effect of alcohol through the operation of environment evolved by it, and that is the infant deaths which are the result of suffocation in bed. As has already been pointed out, Dr Ogle found that the great majority of such deaths occurred on Saturday nights, the night on which there is a maximum amount of drunkenness; and the writer's personal experiences shew the festive seasons, such as Christmas and Bank holiday times, to be similarly fertile in such cases.

(2) Illegitimacy.

It has already been shown that the infantile mortality among illegitimate children is as a rule about twice as great as that among infants born in wedlock. The infantile death rate among illegitimate children can reach an astounding figure.

Ashby (1) records that Tatham has found the illegitimate infantile mortality in some districts of Salford to rise to 710 per 1,000. Such facts only too clearly indicate the operation of indifference and neglect, and show that, while it cannot be doubted that one of the strongest characteristics of nature is the maternal love for children, that even this, strong as it is, can be overborne. It is not proposed to labour the point, but the fact of this enormous difference between the mortality of legitimate and illegitimate infants is capable of no other sufficient explanation, than the pronounced operation of the factors of passive indifference or active neglect amounting as it does in many cases to nothing short of culpable homicide.

Happily, illegitimacy is on the decline in England and Wales, but it must still exercise an appreciable effect on the gross infantile mortality of the country. The following remarks

(1) Ashby & Wright: Dis. of chn. 1899. p.15.

by Van Bermouth (1) are, therefore, still worthy of serious attention to-day:-

"The invariable fact that the mortality among the illegitimate is far greater than among the legitimate, and that many more of them are still-born, shows clearly enough how much more unfavourable their position is from the first. Who can doubt that their bringing up is much harder and more difficult? That the existence of a class of men, bound to society by few or no family ties, is not a matter of indifference to the State? The great majority of foundlings are illegitimate, which of itself shows how little, as a general rule, the mothers can or will care for these children. It is beyond doubt that fewer illegitimate children grow up to maturity - that they get through the world with more trouble - than children born in wedlock, that more of them are poor, and that therefore more of them become criminals. Illegitimacy is in itself an evil to a man, and the State should seek to diminish the number of these births, and carefully inquire to what circumstance any increase is to be ascribed". The writer believes that in view of the high mortality among illegitimate infants, and of the declining birth rate in this country, the time has come when such infants should in fact become the legitimate children of the State.

Educational

(3) Infant Insurance and Crime as a Factor in Infantile Mortality.

It is well known that among the industrial classes of all large towns infant insurance is a common practice, and the question arises has this practice any effect upon infantile mortality? Newsholme (2) from an examination of a table of The Prudential Assurance Company based on the experience of 9 million insured lives, with which is contrasted the experience of Farr's English Life Table, came to the conclusion that it appears fairly clear that after free allowance for selection of insured lives, and for the fallacies connected with the extremely high mortality

(1) Quoted by Newsholme: "Vital Statistics". 1899. p.131

(2) Newsholme: DO p.133.

soon after birth, there is no trustworthy statistical evidence of the ill effect on the life prospects of children from life insurance. There is no proof, he believes, that neglect and crime have been greater in their incidence upon insured children, and that it can scarcely be held that the prospective receipt of insurance money has been the incentive to child neglect, and child murder, in more than a very small number of cases.

The writer is loathe to assert that Infant insurance in general leads to criminal neglect, but still he can recall many cases where at least there has not been that alertness to summon medical assistance in serious illness which might otherwise have obtained. Many times measles has been allowed to drift into fatal bronchitis or broncho-pneumonia; diarrhoea has been allowed to persist until hopeless collapse occurred; and many other illnesses, trivial in their beginnings, have been on the point of claiming their victims before advice has been sought. In such cases there was hardly room positively to assert active neglect or cruelty, but there has remained a grave suspicion of passive negligence, and of a visit to the doctor merely to procure a certificate, and so prevent trouble, and ensure payment of insurance money.

2. Education.

Under this heading may be considered the relation of infantile mortality to the ignorance, inexperience, and prejudice of mothers.

(1) Illiteracy.

Dr J. Milsom Rhodes (1) has found a connection between the illiteracy of women, as evidenced by inability to sign the marriage register, and a high infantile mortality. He quotes statistics, which the writer has verified, from the Registrar General's returns to show that in only one of twelve counties where the infantile mortality was lowest, did the number of

(1) Lancet: 1902. Vol. 2. p.524.

illiterate women in a thousand marriages exceed 30; whilst of twelve counties with the highest infantile mortality, in three counties only, was the number of illiterates in a thousand marriages less than 30, ^{while} (and) in four it exceeded 40. The evidence, therefore, is not very strong against illiteracy, but on the other hand it in no way shows that illiteracy conduces to a low rate of infantile mortality, as the writer believes has sometimes been argued.

(2) Inexperience.

The relation of inexperience, as evidenced by the number of women under age at marriage, ^{to} (and) a high rate of infantile mortality is more close. The following table (1) shows the average number of women per 1,000 marriages, under 21 years of age in 1893 - 1902 in the 5 counties in which the average number was lowest, and in the 5 counties in which the average number was highest, together with the average rates of infantile mortality in the same period:-

T A B L E 28.

| L O C A L I T Y. | Out of 1,000 marriages the average number occurring under 21 among women was | The average number of deaths of children under one year of age per 1,000 births was |
|------------------|--|---|
| North Wales. | 87. | 136. |
| Westmorland. | 101. | 102. |
| Herefordshire. | 103. | 109. |
| Shropshire. | 109. | 112. |
| Oxford. | 112. | 111. |
| Staffordshire. | 208. | 169. |
| Derbyshire. | 217. | 145. |
| Monmouthshire. | 219. | 150. |
| Nottinghamshire. | 233. | 164. |
| Durham. | 238. | 167. |

(1) Compiled from table 10 & 11 Sixty sixth ann. rep. Reg. Genl.

to swell. But the effects of Ignorance are not limited to the illiterate and inexperienced, and at best can only feebly be indicated by statistics. Moreover these factors are so inextricably associated with social and industrial conditions that it is questionable how much value can be attached to these figures as they stand. One has to have regard to the deep-rooted wrong-headedness, and prejudice which only too strongly prevail among all classes of society, but especially in the lower, in everything pertaining to the nurture and well-being of infancy.

Sheer ignorance exacts its highest toll amongst the lowest classes, (in which the birth rate is highest). But along with a certain degree of ignorance in the upper classes, there is, unfortunately, an increasing neglect of the higher functions of parenthood. This shows itself first of all in unwillingness to bear children, and the adoption of means to secure their wish. When a child is born, the mother is only too often disinclined, even when perfectly able, to suckle it. Desire for ease, social engagements, the general pursuit of pleasure, these all make the modern high class mother disregard the natural claims of her babe. The widespread advertisement of numberless and ever-increasing proprietary foods - many of them excellent in their place, but none of them by any means perfectly supplying the want of the natural food - makes it easy for the mother to salve her conscience by giving the infant what she may consider as being just as good for it. Even so the methods of giving artificial food are often deplorable, and at best this can only be attributed to ignorance. The long india rubber-tubed, stinking, fermenting, bacteria-breeding bottle still holds sway. Moreover, with the best of bottles there is not always that care bestowed upon them necessary to secure absolute cleanliness; ^{neither} ~~not~~ is that intelligent regard paid to the proper quantities and proportions to be given; ~~not~~ to the necessary intervals of feeding. All these points, and many others, small in themselves but most vitally important, become factors in the production of disease, and help

to swell the roll of Infantile mortality, and will be more particularly discussed when considering the operation of improper food.

3. Social.

It is proposed now to discuss as factors in the causation of infantile mortality, the industrial employment of married women, overcrowding, and high birth rate. These factors will first be briefly considered separately, the object being to establish that each tends to a high rate of infantile mortality. Thereafter, the effect of these three factors in complex operation will be studied, a method by which it is hoped to clear up certain discrepancies which the individual consideration of each factor discloses.

(1) Industrial Employment of married women.

The industrial employment of married women conduces to the neglect of infants. It is quite exceptional to find a woman who can carry on hard work and nourish her child in the manner Nature intended, not to speak of the satisfactory performance of other less direct duties, involved in the care and attention which the well-being of every infant demands. The following occurs in the Report on the Health of Burnley (1) for 1903:-
"Burnley is the largest textile manufacturing town in Europe, that is, it contains more looms for the weaving of cloth than any other town or city, and, as a larger number of women than men are employed in weaving, it follows that many infants are put out to nurse whilst the mothers are engaged in the weaving shed. When infants a few weeks old are thus put out into the hands of unskilful nurses it becomes certain that the food will be at times unsuitable, and the natural requirements of the infant not attended to. A sensible mother's care is necessary for the upbringing of a healthy child, and this motherly care cannot be obtained where mothers are extensively employed in factories. It

(1) Dean: "Health Report County Borough of Burnley" 1903 p.5-6.

This shows a very regular association of high infantile need excite no surprise, then, that in manufacturing towns the infantile mortality is large, very much greater than in non-textile towns where mothers usually nurse their own children, and are not compelled to put them out to nurse". Again, "I consider the factory life of mothers and the bad nursing of children to be the principal causes of this high infant mortality; surely Nature intended mothers to suckle their own infants".

Greenwood's (1) observations in Blackburn lead to the same conclusion. He points out that employment conduces to neglect in different ways; but by far the most important is the absence of the mother from home and from the child, which involves artificial feeding. This, he concludes, may be called involuntary neglect, for in the main it is so, but it is sometimes deliberately increased.

Dr Reid (2) enquired into the mortality of children under one year of age, in three classes of artisan towns in Staffordshire, in relation to the employment of married women in factories. His statistics cover a period of 20 years, and only towns of distinctly artisan population were included. In the first class were included towns with many married women engaged in work; the second class included towns with fewer married women engaged in work; and the third class, those in which practically no married women were engaged in work. The following table shows the infantile mortality of these three classes with the census population of 1901.

T A B L E 29.

| Blackburn | Class 1. Many women Engaged in work. | Class 2. Fewer women Engaged in work | Class 3. Practically no women en- gaged in work |
|-------------------------|---|---|--|
| (2) Overcrowding | | | |
| Census population 1901. | 147,281. | 198,955. | 182,864. |
| 10 years 1881 - 90. | 195. | 166. | 152. |
| 10 years 1891 - 1900. | 211. | 177. | 167. |

(1) Greenwood. Annual Rep. upon the Health of Blackburn 1904. p.27.

(2) Reid. Brit. Med. Jour. 1901. vol. II p.410.

This shows a very ^{and close} regular association of high infantile mortality and the industrial employment of married women. The figures are all the more valuable when one has regard to the fact that other general conditions were similar.

Of the 15 County Boroughs (1) of England and Wales in which the proportions of occupied females were 40 per cent. or more, Blackburn, Burnley, and Preston are not only the 3 with the highest percentage of occupied females, but ^{they} also have the highest percentage of married or widowed women employed. Thus at the census (2) 1901, Blackburn had 37.9 per cent. of its married or widowed females engaged in occupation; Burnley had 33.8 per cent., and Preston 30.5 per cent. These towns are invariably among the large towns with the highest infantile mortality rates. The averages for the decennium 1893 - 02 were: Blackburn 199, Burnley 210, and Preston 232.

It may therefore be fairly concluded that prima facie the industrial employment of married women tends to a high rate of infantile mortality. Nevertheless, if Blackburn be compared with Salford, which has relatively fewer married women employed, their position as regards infantile mortality is reversed.

T A B L E 29a.

| T O W N. | (3) Average infantile mortality 1893 - 1902. | (4) Percentage married or widowed females employed (census 1901) |
|------------|--|---|
| Salford. | 202. | 16.6. |
| Blackburn. | 199. | 37.9. |

(2) Overcrowding only too frequently sums up the factors of

(1) Census Report 1901. p.80.
 (2) Ibid. Table 31.
 (3) From Registrar General's summary for 1903. Table 3.
 (4) From Census Report, Table 31.

poverty, intemperance, crime, and domestic unhygiene. This cannot be better expressed than in the words of the Registrar General:-(1) "The direct consequences of close aggregation are probably as nothing in comparison with its indirect consequences or concomitants. The more crowded a community the greater, speaking generally, is the amount of abject want, of filth, of crime, of drunkenness and of other excesses; the more keen is the competition, and the more feverish and exhausting the conditions of life. Moreover, and perhaps more than all, it is in these crowded communities that almost all the most dangerous and unhealthy industries are carried on. It is not so much the aggregation itself as these other factors which are associated with aggregation that produce the high mortality of our great towns, or other thickly populated areas".

Newsholme (2) has shown that the true density that should be considered is the number of persons to each room, not the number of persons on a given area. The average density of London (1881 - 1890) was 58 persons to an acre; the Peabody Buildings had an average density of 751 persons to an acre. Yet the average infantile mortality of the Peabody Buildings for the nine years 1882 - 90 was only 139 as compared with 152 for the whole of London. In the Peabody Buildings, however, the average number of persons to each room was only 1.8, which compared favourably with London as a whole.

Sir Shirley Murphy has shown a very close connection between overcrowding and infantile mortality. The following table (3) is given in the appendix to his evidence before the Inter Departmental Committee on Physical Deterioration.

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- (1) Supplement to Forty-fifth annual report of the Registrar General p.XXI.
 - (2) Newsholme: "Vital Statistics" 1899. p.165.
 - (3) Inter Departmental Committee - Appendix to Report p.52.

T A B L E 30.

London Infantile Mortality 1891 - 1900.

| Proportion of total population living more than two in a room in tenements less than 5 rooms. | Deaths under 1 year of age 1891-1900. | Deaths under 1 year of age per 1,000 living 0 - 1. |
|---|---------------------------------------|--|
| T O W N | | |
| Districts with under 10% | 13,533. | 142. |
| " 10 - 15% | 56,208. | 180. |
| Leicester " 15 - 20% | 42,158. | 196. |
| Gateshead " 20 - 25% | 36,521. | 193. |
| " 25 - 30% | 23,219. | 210. |
| (3) High " 30 - 35% | 22,580. | 222. |
| " over 35% | 16,800. | 223. |

The period of time covered is sufficiently long, and the numbers dealt with are sufficiently large, to yield trustworthy results. The nearer one can, so to speak, approach a factor, the more clearly will its tendency be apparent. This analysis gets very close to the factor of overcrowding, and the association is almost absolutely regular, amounting as it does to a demonstration.

Of the County Boroughs (1) of England and Wales, the three with the greatest proportion of their population living under overcrowded conditions - the census standard is 2 persons to a room, anything over that is "overcrowding" - are Gateshead with 34.54 per cent; Newcastle on Tyne with 30.47 per cent; and Sunderland with 30.10 per cent. of the total population **living** under overcrowded conditions. The average infantile mortality of these three towns for the decennium 1893 - ¹⁹02 was: Gateshead 174; Newcastle 173; and Sunderland 175.

It may therefore fairly be concluded that overcrowding tends to high infantile mortality. If, however, Gateshead be

(1) Census Report 1901. Table 42.

compared with Leicester, which is comparatively free from overcrowding, the position of these towns as regards infantile mortality is reversed. Thus:-

T A B L E 30a.

| T O W N. | (1) Infantile Mortality 1893 - 02 | (2) Percent total population overcrowded. |
|------------|---|--|
| Leicester. | 187. | 1.05. |
| Gateshead. | 174. | 34.54. |

(3) High birth rate.

It has, in a former part of this paper (3), been shown that Counties and towns with a birth rate higher than ^{that for} England & Wales had also, as a rule, an infantile mortality higher than ^{that for} England & Wales; and conversely, it was shown that counties and towns with a birth rate lower than for England and Wales as a whole, had also, as a rule, a lower rate of infantile mortality. It was also shown that if the several districts of large towns, be examined as to their birth rates and infantile mortality rates, this relationship between birth rate and infantile mortality is even more strikingly demonstrated.

It remains here to establish the relationship between a high birth rate and a high infantile mortality rate. Shadwell (4) has shown that the decline in the birth rate in England and Wales is most marked in the textile manufacturing towns, and least marked in the metal towns. In the former, the women go into the mills and therefore do not want to have children. Moreover, in textile towns the standard of comfort is higher than

(1) Registrar General's summary for 1903. Table 3.

(2) Census Report 1901. Table 42.

(3) Page. 22. et seq.

(4) Evidence before Inter Departmental Committee on Physical Deterioration p.450.

the highest average infantile mortality, and the ten towns that of metal towns - the towns in which the birth rate has least diminished. This only broadly indicates what a closer analysis of birth rates and infantile mortality rates of the several districts of any one great town demonstrates, namely, that the birth rate has apparently most declined amongst the classes of the community in which the standard of comfort is highest, and has least declined, if at all, among those whose standard of comfort is lower. That is to say, the birth rate has declined most in the class of the community in which infantile mortality is relatively lower, (that is relative to the standard of England & Wales) and has least declined among the class of the community among which infantile mortality is relatively higher.

It may therefore be concluded that a high birth rate tends to a high rate of infantile mortality. But of the large towns in England and Wales, in 1893 - ¹⁹02 West Ham had a birth rate of 35.7, whilst that of Blackburn was only 28.8. Their infantile mortality figures are shown in the following table:-

T A B L E 31.

| T O W N | (1) Infantile Mortality 1893 - 1902. | (2) Birth rate 1893 - 1902 |
|------------|--|----------------------------------|
| Blackburn. | 199 | 28.8 |
| West Ham. | 169 | 35.7 |

Having now indicated the tendency of each of these three factors, namely, industrial employment of married women, overcrowding, and a high birth rate, one is in a position to study them in complex operation. The following table is made up from the statistics respecting the thirty three large towns in England & Wales. The selection is entirely ruled by the average infantile mortality rates in the decennium 1893 - ¹⁹02. The ten towns with

(1) Registrar General Summary 1903.

(2) From figures furnished the writer by Dr Tatham, Register Office. Somerset House.

the highest average infantile mortality, and the ten towns with the lowest average infantile mortality, are shown, together with census data as to the percentage of married or widowed females engaged in occupation, and the condition of each town as to overcrowding. The birth rates in the decennium 1893 - 1902 are also given.

T A B L E 32.

Ten towns with the highest average infantile mortality 1893 - 1902.

| T O W N. | Average infantile mortality 1893 - 02. | Percentage of married or widowed females engaged in occupations | Percentage of total population living under overcrowded conditions. | Average birth rate 1893-02. |
|---|--|---|---|-----------------------------|
| | (1) | (2) | (3) | (4) |
| Preston. | 232. | 30.5. | 2.64. | 32.3. |
| Burnley. | 210. | 33.8. | 7.14. | 32.3. |
| Salford. | 202. | 16.6. | 7.54. | 34.1. |
| Blackburn. | 199. | 37.9. | 3.92. | 28.8. |
| Liverpool. | 189. | 14.5. | 7.94. | 33.9. |
| Manchester. | 188. | 19.3. | 6.28. | 32.8. |
| Wolverhampton. | 188. | 11.9. | 4.67. | 33.5. |
| Birmingham. | 188. | 19.0. | 10.33. | 32.8. |
| Leicester. | 187. | 25.2. | 1.05. | 30.9. |
| Sheffield. | 186. | 11.0. | 9.50. | 33.6. |
| <u>Average.</u> | 196.9. | 22.9 | 6.10. | 32.5. |
| <u>England & Wales.</u> | 152.2. | 13.2 | 8.20. | 29.4. |
| <u>Ten towns with the lowest average infantile mortality 1893 - 1902.</u> | | | | |
| West Ham | 169. | 9.4. | 9.27. | 35.7. |
| Bradford. | 168. | 18.1. | 14.62. | 25.3. |
| Swansea. | 165. | 8.7. | 5.57. | 32.4. |
| Cardiff. | 159. | 8.4. | 2.92. | 35.0. |
| Brighton. | 156. | 18.8. | 3.07. | 24.9. |
| Derby. | 154. | 9.2. | 1.18. | 28.8. |
| Halifax. | 148. | 12.4. | 14.49. | 23.4. |
| Huddersfield. | 146. | 12.9. | 12.88. | 23.6. |
| Bristol. | 144. | 15.9. | 3.55. | 28.6. |
| Croydon. | 141. | 11.8. | 2.74. | 25.4. |
| <u>Average</u> | 155.0. | 12.56. | 7.02. | 28.3. |

(1) From Registrar General's summary 1903. Table 3.
 (2) From General Report on the Census 1901. Table 31
 (3) do do Table 42
 (4) From figures furnished writer by Dr Tatham, of the General Register Office, Somerset House.

This is an attempt to measure as it were the intensity with which each separate factor acts, and the writer thinks that it supports his hypothesis "that the position of each town is determined, within small limits, by the degree to which these three factors operate in any given instance"; In other words, that the position of each town on either list is more or less what one would, having regard to the tendency of each factor, expect it to be. A few examples may be pointed out. It will be granted that the closer one town resembles another in one or two of the factors, the more apparent will become the effect of the remaining factor or factors. Thus, Blackburn, according to its figure as to married women engaged in occupations, should have a higher infantile mortality than either Preston, Burnley, or Salford - *but* the lower birth rate of Blackburn places it below. Burnley and Salford have about the same degree of overcrowding; the occupied married women figure of the latter should place it far below the former; but the birth rate of Salford determines their relative positions. Liverpool and Manchester have three factors pretty much in common, yet the lesser degree of overcrowding in the latter, and its slightly lower birth rate, give it at least as favourable a position in spite of having a larger proportion of married women engaged in occupation. If Leicester be compared with Burnley it is found that both birth rates are high, but the Leicester figures for married women engaged in occupation, and its condition as to overcrowding, compare favourably with Burnley, and hence their relative positions. The effect of the high birth rate and overcrowding in Sheffield is sufficient to give it an infantile mortality comparable to Leicester, although the latter has more than twice as many married women engaged in occupation as Sheffield has.

Taking the low mortality towns, it will be seen that Bradford, according to its figure for married women engaged in occupation, and on account of its overcrowding, should have a higher infantile mortality than West Ham; but the birth rate

places it below. Both Swansea and Cardiff, because of their favourable figures for married women engaged in occupation, and position as to overcrowding, should occupy better places than they do. Their birth rates determine their position. Both Bradford and Halifax have about the same degree of overcrowding; but the more favourable figures for married women occupied, and of birth rate, in the latter, places it below. Bristol, on account of married women engaged in occupation, and relatively high birth rate, should compare unfavourably with Huddersfield as regards infantile mortality; but it is placed below the latter on account of immunity from overcrowding. The factors generally conspire to place Croydon in its favourable position. If it be compared with Cardiff, the effect of its lower birth rate is well brought out.

Excursions from one list to another all point to the same conclusion, that in the operation of these three factors the infantile mortality for the most part arises. West Ham and Liverpool have birth rates and overcrowding fairly comparable. The position of West Ham is determined by having a lesser proportion of married women engaged in occupation. Leicester and Bristol are similarly placed both as regards birth rate and degree of overcrowding. Bristol owes its more favourable infantile mortality to a less pronounced operation of the remaining factor. Blackburn and Derby have the same birth rate. The other two factors are in favour of Derby and against Blackburn. The only discrepancy the table discloses is in the position of Preston and Burnley relative to each other. The averages are but an epitome of teaching of the whole table:-

T A B L E 32 b.

| | Infantile Mortality. | Percentage married or widowed females engaged in occupation | Percentage of total population living under overcrowded conditions. | Birth rate. |
|-----------------------|----------------------|---|---|-------------|
| High Mortality Towns. | 196.9 | 21.90 | 6.10 | 32.5 |
| England & Wales | 152.2. | 13.20 | 8.20 | 29.4 |
| Low Mortality Towns. | 155.0 | 12.56 | 7.02 | 28.3 |

The factors are mutually related, where one is low another may be high, and according to the separate degree with which these operate, so is the infantile mortality determined. The effect of the rural element in the case of England and Wales as a whole, gives it, as one would expect, a slightly better infantile mortality than that for the low mortality towns.

(4) Improper Food.

Improper feeding is not only in itself a proximate cause of infantile mortality, but ^{it} also so focalises the factors implied in social status, the concomitants of over-crowding, and the industrial employment of married women, that this may be the proper place in which to indicate:-

- (1) To what extent artificial (as largely presumptive of improper) feeding prevails.
- (2) The underlying conditions which make artificial feeding necessary.
- (3) The qualities of an artificial food which make it an improper food.
- (4) The relation of artificial feeding to infantile mortality.

(1) To what extent artificial (as largely presumptive of improper) feeding prevails.

No very comprehensive statistics exist as to the extent to which breast feeding is carried on, but the following recent figures may be taken as a fairly reliable index of its prevalence under urban conditions of life. It may be here stated that there is reason to believe that in country districts breast feeding prevails to a much larger extent than in towns(1).

Newsholme (2), in Brighton, during 1903 and 1904, as the result of a census of 5,358 houses, ^{from} in house to house inspection, found that ^{of} 608 infants under one year of age 62.8 per cent.

(1) Minutes of evidence: Physical Deterioration Committee.

(2) Newsholme: "Annual Report on the Health of Brighton" 1904. p.47.

were entirely breast fed; 13.2 per cent. were fed partly on the breast, and partly by hand; and 24 per cent. were entirely hand fed. Calculated in three monthly age periods the percentage of breast fed infants was as follows:-

| | | |
|---------------------------|-----|------------|
| Of infants under 3 months | 82% | breast fed |
| " " " aged 3 to 6 months | 63% | " " " |
| " " " " 6 to 9 " | 61% | " " " |
| " " " " 9 to 12 " | 42% | " " " |

This indicates in Brighton the gradual abandonment of feeding entirely by the breast as the infant grows older. Most significance attaches to a fall from 82 per cent. in the first three months to 63 per cent. in the second. A fall from 61 per cent. at age 6 to 9 months, to 42 per cent. at 9 to 12 months, is of less significance, since the importance of breast feeding is relatively greater in the first, than in the second, six months of life.

Howarth (1) from a very complete investigation among all infants born in Derby during the three years November 1900 to November 1903 - an investigation including no less than 8,343 infants - found that 63.3 per cent. were breast fed; 19.5 per cent. were hand fed; and 17.3 per cent. were breast fed at first and afterwards wholly hand fed, or were partly breast fed, and partly hand fed, from a very early stage of their existence. The number on which these percentages are calculated did not include infants dying early, and in which the kind of food given could have no influence, such as deaths from premature birth, congenital defects and malformation, and those occurring before any nourishment was given.

Greenwood (2) from an inquiry in Blackburn in 1904, ascertained the kind of feeding of 1,333 infants under seven months old. The number did not include infants who only lived a day or two. He found that 49.5 per cent. were entirely breast

(1) Howarth: "The influence of feeding on the mortality of infants" Lancet 1905. Vol. II p.211.
 (2) Greenwood: "Annual Report Health of Blackburn" 1904. p.29.

fed; 17.5 per cent partly at the breast, and partly by hand; and 33 per cent. were wholly fed by hand. It would be interesting to know what percentage of infants in Blackburn at the age period 3 to 6 months were entirely breast fed - the presumption being that the percentage would be much less than 49.5.

These figures are from the three urban districts which may be said to represent the extremes and mean of the employment of married women. Brighton has 18.8 per cent; Derby 9.2 per cent; and Blackburn 37.9 per cent. of married or widowed females engaged in occupation.

It is very questionable whether any great advantage accrues to infants partly breast fed, as compared with those entirely hand fed. Hutchison (1), a recognised authority on dietetics, is of opinion that less than six months' suckling does not count for much; and, ⁱⁿ his experience, if mixed feeding is attempted for more than a few weeks, ^{the} the mother's milk tends to disappear altogether. Howarth, (2) on the other hand, believes that the risks of hand feeding are considerably minimised by mixed feeding, and that every mother who is unable to satisfy her infant should be encouraged to continue to feed her child, and to supplement any deficiency by means of artificial food.

(2) The underlying conditions which make artificial feeding necessary.

Von Bunge (3) of Bâle asserts that the deficiency in maternal milk, which is such an important predisposing cause at the root of infantile mortality, is due to the imbibing of alcohol by the parents. His statistics, drawn from all Europe, show that women with an insufficient supply of milk are usually the daughters of alcoholics. He asserts that if two generations

(1) Hutchison, Minutes of Evidence Physical Detern. Committee. p.366.

(2) Howarth: Lancet 1905. Vol. II p.211.

(3) Cited by Carpenter: Alcohol & Children, Journal of State Medicine, Vol.XII, No.10, p.605.

have been alcoholic, the women of the third generation will almost certainly be unable to nurse their children. However that may be, probably few medical men would be found to challenge the statement that breast feeding in England and Wales is on the decline, at any rate under urban conditions of life. This may arise apparently from sheer physiological inability, from simple ennui, or from the force of circumstances, such as the industrial employment of women in the lower classes, and the social engagements, and distractions, of those in the upper. The loss of the function would appear to be one of the concomitants of a spurious civilization. Starr (1) has noted that in his experience, while there are few American women, especially in the well-to-do classes, who do not look upon the duty of nursing their babies as a pleasant one, yet there are many who are completely unable to do so, and a vast number in whom the secretion of milk fails after a few weeks or months of lactation. Holt, (2) speaking specifically of New York, says that in that City at least three children out of every four born in the homes of the well to do, must be fed at some other font than the maternal breast. Competent observers have testified to the same tendency of affairs in England (3), the inability being found both in the upper and lower classes of Society. No medical man can fail to have had the fact impressed upon him that the mothers in the working classes have many incentives to continue breast feeding if possible. It is easier, and more economical than artificial feeding, and the practice is popularly believed to delay the chance of subsequent pregnancies, a circumstance they would appear often anxious to encompass. It should be stated in this connection that Jewish mothers in England, though they tend to concentrate in urban areas, seem peculiarly exempt from this growing disability; moreover, they are more prolific than their Gentile sisters; and this circumstance has lead Hutchison (4) to the

(1) Starr: "Diseases of Digestive Organs: 1901. p.29."

(2) Holt quoted by Vincent: "The Nutrition of the Infant" 1904. p.30.

(3) Minutes of evidence, Physical Deterioration Committee.

(4) Hutchison. Minutes of evidence Physical Deter. Com. p.366.

opinion that the ability to produce children, and the ability to suckle them, are in some way related, quite apart from any racial consideration.

Want of sufficient maternal nourishment must interfere with the due discharge of this duty, and to this circumstance is probably due the fact that even breast fed children occasionally suffer from marasmus.

That the factory employment of women is one of the factors in the decline of breast feeding can hardly be doubted. The writer is aware that many mothers in textile districts return to work as soon as the law will permit. In consequence, suckling in many cases is reduced to a matter of weeks, or simply ^{to} no attempt at all is made to encourage the function of the breast; the mother feeling that for the short time it could conveniently be carried on, it really is not worth while to begin. Some few do attempt a degree of mixed feeding with but indifferent results. The figures given for Blackburn should be read in this connection.

It is believed ^{that} the decline in breast feeding is little, if at all, marked in country districts; the phenomenon being essentially an urban one.

(3) The qualities of an artificial food which make it improper.

In order to indicate the qualities of an artificial food which make it improper, one must have regard to the fact that the natural food of the infant is its mother's milk. What constitutes a proper substitute for this, when it, or the milk of some other woman, cannot be obtained, is rather difficult to determine. Unanimity on this subject is hardly to be looked for. It is to be feared that until quite recently the question of what constitutes a proper artificial food for infants, has received but scant attention on the part of medical practitioners; and even at the present time, it is a matter for regret that the

position of human milk, the milk of some other animal must be
 opinion of the profession on this subject should be so divided.
 requisitioned. For all practical purposes, one may consider that
 It is not contended that any hard and fast method of artificial
 this will be the milk of the cow, for though that of the goat,
 feeding will meet each and every case; but surely on a question
 ass, and here have been used, the milk of the cow ^{referring} in the elemen-
 remain the all but universal substitute. The following analysis
 of three different milks may be taken as fairly representative
 of the composition of cow's milk:-
 increasing attention which the subject is now receiving from the
 scientific physician, will establish these principles on a firm
 physiological basis; for until this is done, the profession is in
 no secure position to rail at the ignorance of untutored mothers.
 It is not enough to determine which food, or method of feeding,
 is better than something worse, or which will not produce this
 or that illness - it must also satisfy the physiological require-
 ments of the growing infant. Important as correct feeding is at
 all ages, it is yet not too much to claim, considering the enor-
 mous structural development which takes place during the first
 year of life, that on successful physiological feeding in infancy,
 much of the future physical well-being of the child depends.

Without at present entering into the debatable points
 of artificial feeding, it may be said that the principles of all
 correct physiological feeding of infancy must have regard, first
 and foremost, to the normal composition of human milk as a stand-
 ard. Human milk varies within wide limits as the following
 analysis of different qualities will show:- (1)

T A B L E 33 - Human Milk.

| | Normal | Poor. | Over rich. | Bad. |
|---------------|--------|--------|------------|--------|
| Fat. | 4. | 1.50. | 5.10. | 0.80. |
| Proteids. | 1 - 2. | 2.40. | 3.50. | 4.50. |
| Lactose. | 7. | 4.00. | 7.50. | 5.00. |
| Ash. | 0.2. | 0.09. | 0.25. | 0.09. |
| Total solids. | 12-13. | 7.99. | 16.35. | 10.39. |
| Water. | 88-87. | 92.01. | 83.65. | 89.61. |

In order to provide a food approaching the normal com-

(1) After Rotch, Ashby & Wright, Diseases of Children. 1899. p.43

position of human milk, the milk of some other animal must be requisitioned. For all practical purposes, one may consider that this will be the milk of the cow, for though that of the goat, ass, and mare have been used, the milk of the cow is likely to remain the all but universal substitute. The following analyses of three different milks may be taken as fairly representative of the composition of cow's milk:- (1)

T A B L E 34. Cow's milk.

| | Leeds. | Langlois. | Langlois. |
|-------------------|---------|-----------|-----------|
| Specific gravity. | 1029.7. | 1031.7. | 1033. |
| Vol. of cream. | - | 10. | 7.7. |
| Fat. | 3.75. | 4. | 3.34. |
| Lactose. | 4.42. | 5. | 4.92. |
| Proteids. | 3.76. | 3.4. | 3.4. |
| Ash. | .68. | .6. | .57. |
| Total solids. | 12.61 | 13.0. | 13.23. |

The following figures, according to Leeds, represent the principal differences between cow's and woman's milk (2)

T A B L E 35.

Cow's and Human Milk compared.

| | Sound Dairy milk. | Average woman's milk. |
|------------------|-------------------|-----------------------|
| Re-action. | Acid. | Alkaline. |
| Special gravity. | 1029. | 1031. |
| Fat. | 3.75. | 4.13. |
| Lactose. | 4.42. | 7.0. |
| Proteids. | 3.76. | 2.0. |
| Ash. | 0.68. | 0.2. |
| Bacteria. | numerous. | absent. |

(1) Ashby & Wright: Op. Cit. p.45.

(2) Ashby & Wright: Op. Cit. p.46.

It is obvious that cow's milk must be modified before it can approach the human standard. Not only are the proteids in excess, but the difference between those of cow's milk and woman's milk are considerable. In both cases, the proteid consists of caseinogen and lactalbumen, the former in cow's milk being in much larger quantities than in woman's. It is the excess of this caseinogen in cow's milk which causes it to form a hard curd in the stomach, differing in this respect markedly from the light flocculent precipitate which is characteristic of woman's milk. According to Hirt⁽¹⁾, the amount of curd in cow's milk is 3 per cent. (lactalbumen, .75 per cent); in woman's milk, it is only 0.63 per cent. (lactalbumen, 1.5 per cent); so that the amount of curd is nearly five times as great in the former as in the latter. (2) Cow's milk contains a smaller quantity of lactose. (3) The fat is about the same. (4) The ash is greater in cow's milk. (5) By the time cow's milk reaches the consumer, it is slightly acid, and contains numerous bacteria, while woman's milk is supplied direct to the child, and is alkaline and sterile.

The first essential in successful feeding is a pure milk supply. Assuming that a milk of reasonable bacterial purity and chemical quality can be obtained, there are three other essentials for its modification to the normal standard of human milk:-

(1) Reduction of the proteids. This may be accomplished by dilution with plain (boiled) water or thin barley water, a procedure which at the same time renders the caseinogen less liable to form a hard curd, on coming in contact with the acid gastric juice.

(2) Increase of fat. This is best done by the addition of sound dairy cream free from preservatives. A due proportion of fat is very essential in infant dietary.

(3) Increase of Lactose. This is best done by the addition of pure sugar of milk. Sugar is important as an energy producer.

Into the question of the merits or demerits of sterilisation or pasteurisation it is not at present proposed to enter. Until an artificially fed infant is seven months old, it should be fed on a food modified on the above principles. It is hardly necessary to add that the feedings should be regular as regards time and quantity; and at blood heat; that all milk employed should be carefully stored and handled; used as fresh as possible; and that every care should be taken to keep all bottles and utensils scrupulously clean. Aware of many imperfections in this sketch, the writer would yet advance it as embodying the principles- as illustrated by minimum requirements - of anything claiming to be a proper artificial food - that is a food which will satisfy the physiological requirements of a growing infant.

As illustrating how the domestic modification of cow's milk may be carried out, and ^{and} incidentally filling in other particulars, the following table from Starr is of interest:-

(1).

Table of ingredients, hours and intervals of feeding, and total quantity of food for a healthy artificially fed infant from birth to end of the seventh month.

| Age. | Cream. | Whey. | Milk. | Milk Sugar. | Salt. | Water. | Hours for feeding. | Intervals of feeding. | Total quantity. |
|-------------------------------|------------------|---------------|------------------------|--------------|----------|-----------------|----------------------|-----------------------|-----------------|
| During first week. | 2 fluid drams. | 3 fluid drams | - | 20 grains. | - | 3 fluid drams. | 5 a.m. to 11.p.m. | 2 hours | 12 fluid ozs |
| Second to sixth week. | 2 fluid drams. | - | Half an ounce (fluid). | 20 grains. | a pinch. | 1 fluid oz. | do | do | 17 fluid ozs |
| 6th week to end of 2nd month. | Half a fluid oz. | - | 10 fluid drams. | Half a dram. | do. | 10 fluid drams. | do | do | 30 fluid ozs |
| 3rd to 6th month. | do. | - | 2 fluid ozs. | 1 dram. | do. | 1½ fluid ozs | 5 a.m. to 10.30 p.m. | 2½ hours | 32 fluid ozs |
| During 6th and 7th months. | do. | - | 3½ fluid ozs. | do. | do. | 2½ fluid ozs | 7 a.m. to 10.p.m. | 3 hours | 36 fluid ozs |

One is now in a position to indicate the qualities of an artificial food which render it an improper food:-

- (1) The food may be too rich or too poor in one or other of its constituents, or the proportions may be all wrong.
- (2) The food may be wrong in kind.
- (3) The manner of preserving, preparing, and administering the food may be at fault.

It is no uncommon occurrence to find parents who are anxious to rear a strong child, killing him by kindness. Probably as many children suffer from too much food as from too little. The milk, if not sufficiently dilute, contains more caseinogen than the infant can manage, and digestive troubles are apt to follow. Frequently milk is simply diluted with one or two parts of water. Such a milk may be right in proteids, but is sure to be deficient in lactose and fat. The deficiency in fat is a frequent cause of general malnutrition and of rickets. Simple as is the modification of milk, it is surprising how few mothers really take an intelligent interest in it. The milk is found not to agree and recourse is at once had to other substitutes. Among the working classes more especially, condensed milk is looked upon as "babies food". It is often, at first at least, surprisingly successful. This is specially apt to be the case in a baby who had failed to digest ordinary milk - because perhaps of too high a proteid. Condensed milk is poor both in proteid and fat. It contains abundance of carbohydrate, but this is usually in the form of cane sugar, and is on that account objectionable.

By and bye condensed milk fails - the child is not thriving, and a change is almost as a matter of course made to some one or other of the patent proprietary infant foods - too often supported by lying advertisements, "A perfect food for baby." Without specifying any particular food - and their name is legion - it may be safely said that not one of them is a proper food

for any infant under six months of age, however useful they may be if properly employed at later ages. They all contain an excess of carbohydrate in the form of starch or maltose, and are without exception deficient in fat, and mostly in proteid. The patent-food-fed baby is usually large, flabby, and rickety, and readily falls a victim to acute disease. Among older children - and sometimes among the very young - ignorant mothers pacify them by little tasty bits of anything that's going. Tea is early resorted to - almost as soon as the child can sip.

A want of cleanliness in the storage, preparation, and administration of food is responsible for many deaths. Milk is an excellent culture medium for nearly all pathogenic organisms, and so, if scrupulous cleanliness is not observed - and sometimes it is to be feared in spite of it - the child succumbs to diarrhoea. This evil is especially prominent in the long-tubed feeding bottle.

The long rubber tube of the ordinary and popular feeding bottle is well named the "baby killer". Its use has been made illegal in some of the States of America. It is supposed to be kept clean by the occasional passage of a tube brush, or by a soaking in borax and water. The more indifferent do not even make a pretence of precaution - the tube is allowed to remain in a state of putrefaction and only receives attention when it will not draw. But no reasonable amount of care can ensure the long tube being kept even sensibly clean, not to speak of a condition of asepsis.

The use of this senseless contrivance is responsible for much suffering among infants. At the least, it induces a septic condition of the entire digestive tract and produces chronic diarrhoea. In summer it is especially dangerous, and contributes very largely to illness and death from zymotic enteritis. The long tubed feeding bottle owes its favour to the force of custom, and the inertia of ignorance; while its special

recommendations to the lazy and indifferent is the ease with which bottles so fitted can be laid beside the child, which may then be left to feed itself.

One other circumstance connected with artificial feeding remains to be noted, and that is the rôle of the dummy teat. The dummy teat is mostly confined to artificially fed infants. The sucking of this teat is ignorantly regarded by many mothers as a panacea for all the fractious moods of infancy, and hence its name, "a comforter". Among the lesser evils of the "comforter" may be mentioned its action in deforming the mouth and nose. The constant sucking forms a vacuum in the back of the mouth leading to a high arching of the palate, a condition easily produced in the softened bones of the artificially fed. This in turn encroaches on the nasal cavities above, leading to respiratory troubles and disturbed sleep. But a more serious objection to the "Comforter" exists on the score of sepsis. It is seldom clean, always moist, frequently rolls upon the dirty floor and is forthwith replaced in the child's mouth without any cleansing, or at most, after a superficial rub on the nurse's dress or hands. By this means oral and intestinal sepsis is induced, leading to all sorts of digestive and diarrhoeal troubles. It is safe to say the "Comforter" must exact a heavy toll.

The question of properly feeding an infant is not always one of cost. It is certainly more expensive to feed a child on condensed milk - if taken at its calorie value - or on patent foods, than cow's milk. Wynter Blyth has recently examined most of the patent foods and condensed milks on the market and has calculated the energy value of each. He gives the following table showing the composition and energy value of a sample of condensed milk, three patent foods, and cow's milk as diluted for the use of infants, with which is compared human milk:- (1)

(1) From Newsholme's Report on the Health of Brighton 1904. p.78.

T A B L E 37.

| | Fat. | Proteids. | Starch. | Other carbohydrate. | Total energy. |
|---------------------|-------|-----------|---------|---------------------|---------------|
| Condensed milk. | 0.85. | 0.67. | - | 3.67. | 25.34. |
| Hunters Infant Food | 1.75. | 2.03. | 1.57. | 2.75. | 42.36. |
| King's do. | 0.46. | 0.89. | 0.40. | 2.83. | 21.21. |
| Neave's do. | 0.86. | 1.21. | 1.87. | 1.28. | 25.87. |
| *Cow's milk. | 1.75. | 1.70. | - | 2.37. | 32.90. |
| Human milk. | 2.1. | 1.5. | - | 4.75. | 53.51. |

* Diluted with equal quantity of water.

(4) The relation of artificial feeding to infantile mortality.

The subject of artificial feeding holds the first place in the consideration of the factors making for a high mortality among infants. A consideration of the subject cannot be divorced from that of parental ignorance, indifference, and neglect, for largely on these depend the baneful effects of artificial feeding. It requires no argument to prove that the only right and proper, as indeed the only natural, method of feeding an infant is by suckling at its mother's breast. The various causes of death through which, like a black thread, artificial feeding ^a ramifies, have already been sufficiently indicated. It remains only here to emphasise its importance. Any appeal to statistics is simply overwhelming in favour of natural versus artificial feeding. Infantile diarrhoea and kindred ailments are relatively more frequent in summer and autumn, than at other seasons of the year. The effect of artificial feeding would, therefore, be expected to be thrown into relief, so to speak, if the infantile deaths during the former seasons be analysed. This has been done by Hope of Liverpool(1). The investigation extended over a series of years and involved inquiries into the circumstances of upwards of one thousand deaths of infants. He found that amongst

(1) Hope: "Report on the Health of the City of Liverpool" 1903 p.166.

infants below three months of age, either wholly or partially fed during these seasons, on artificial foods, the deaths were 15 times as great as they were amongst an equal number of infants fed upon the breast alone. In other words, out of every 1,000 infants under three months of age, naturally fed upon breast milk alone, 20 died of autumnal choleraic disease; but of the same number of infants at the same age, artificially fed, then instead of 20 dying, as many as 300 deaths occurred. Similarly he found that amongst infants aged 3 to 6 months and 6 to 9 months, there was an immensely larger proportion of deaths amongst the artificially fed than amongst the breast fed, although the proportion diminished as the age increased.

Newsholme (1), from an enquiry at Brighton amongst 87 infants dying from epidemic diarrhoea, in 1903 and 1904, found that the deaths of suckled children were about an eighth of what ought to have occurred on the supposition of average distribution of diarrhoea; the deaths of those suckled, and also having farinaceous food were about one third; the deaths of those having only cow's milk were over four times; and the deaths of those having only condensed milk were 9 times as many as ought to have occurred on the same supposition of average distribution of diarrhoea among infants fed in different ways.

He believes, however, that there is reason to think that these figures understate the superiority of breast fed ^{eding} over artificially fed ^{eding of} infants. Even assuming that they are trustworthy, and that the Liverpool figures overstate the superiority of breast feeding, the broad fact remains that 10 hand fed infants succumb to summer diarrhoea for every 1 of the breast fed.

These are examples of the pronounced operation of artificial feeding, but there is no doubt that its influence on infantile mortality in general is prejudicial at other seasons, and in many other ways.

Howarth, in Derby, analysed the causes of death in three

(1) Newsholme: "Report on the Health of Brighton" 1904. p.47.

classes of infants, breast fed, mixed, and hand fed. The number of children on which the observations were made does not include those dying of premature birth, congenital defects, and malformations; nor were the observations limited to season. The following is an abridgement of his table (1) showing deaths per 1,000 on number observed.

T A B L E 38.

| | Breast fed. | Mixed. | Hand. |
|---------------------------------|-------------|--------|--------|
| Number of children. | 5,278. | 1,439. | 1,626. |
| <u> Disease. </u> | | | |
| Bronchitis & Pneumonia. | 14.4. | 12.6. | 26.5. |
| Diarrhoeal Diseases. | 10.0. | 25.1. | 57.9. |
| Marasmus, Atrophy, Debility. | 12.6. | 18.9. | 39.4. |
| Tuberculous Diseases. | 3.6. | 5.6. | 13.6. |
| Convulsions. | 15.0. | 20.9. | 25.9. |
| Dentition. | 1.4. | 4.9. | 4.4. |
| Zymotics (other than diarrhoea) | 5.4. | 7.7. | 13.0. |
| All other diseases. | 8.0. | 3.5. | 17.3. |
| <u> Totals. </u> | 69.8. | 98.7. | 197.5. |

368 deaths occurred amongst the breast fed, 142 amongst those having mixed food, and 831 amongst those entirely hand fed.

Newsholme (2) records, as showing the close connection between methods of feeding and infantile mortality, how that during the sufferings and starvation connected with the Seige of Paris in 1870 - 71, while the general mortality was doubled, that of infants is said to have been reduced by about 40 per cent; owing to mothers being obliged to suckle their infants. The same increase of adult and diminution of infant mortality was seen during the Lancashire cotton famine, when mothers were not at work in the mills.

If anything further were wanted to emphasise the relation

(1) Howarth. Lancet 1905. Vol. II. P.212.

(2) Newsholme: "Vital Statistics" 1899. p.128.

of artificial feeding to infantile mortality, it is to be found in the fact that the infantile mortality among Jews in England compares favourably with that of Gentiles living under no worse conditions of poverty, overcrowding, and adverse sanitary conditions generally. The writer is favoured by the following figures bearing on this specific point from Dr Niven of Manchester.

"The District of Cheetham", writes Dr Niven, "is largely Jewish, almost entirely so in its poorer portions, though the outer portion contains both well-to-do Jews and well-to-do Christians". (1)

T A B L E 39.

| District. | Deaths of infants under one year of age per 1,000 births. | | | | |
|------------------------|---|-------|-------|-------|-------|
| | 1899. | 1900. | 1901. | 1902. | 1903. |
| City of Manchester. | 205. | 189. | 198. | 151. | 169. |
| Cheetham Sub-district. | 104. | 114. | 124. | 97. | 108. |

The explanation of the marked difference in these infantile mortality rates lies in the broad fact that, as a rule, the Jewish mothers suckle their children at the breast, and generally bestow more care on their offspring, than do Gentiles in a corresponding sphere of life. It was stated by Sir Shirley Murphy (2), in his evidence before the Physical Deterioration Committee, that in parts of Stepney where alien immigration had largely occurred, there had been an actual falling in the rate of infantile mortality. This is but a way of showing that proper feeding in infancy, together with maternal solicitude, is sufficient to counteract in no small measure the influence of unhygienic surroundings.

From the foregoing consideration, it would appear that to attack the food problem in infancy would probably be one of the best means of dealing with many other factors contributing to high infantile mortality. Some means must therefore be sought to

(1) Letter to the writer from Dr Niven: March 1905.

(2) Minutes of Evidence Inter Departmental Committee Physical Deterioration. p.348.

equip mothers for the task of suckling their children, or if that be impossible, of providing a suitable substitute, to a much greater extent than prevails at present, before any substantial reduction of infantile mortality in England can be hoped for.

2. The remote factors.

(1) Sanitary condition as a factor in infantile mortality

The infantile mortality has been usually considered as specially deserving of attention, as an index of sanitary condition. The indications which it affords, however, are complex, and depend in no small degree on social conditions. Partly it is associated with maternal health and care, partly it is dependent on want of cleanliness in and about the house, and partly it shares in the general effects of bad housing. This is the opinion of Dr Niven of Manchester. (1).

Sir William Gairdner (2) would regard the rate of infantile mortality as even a more sensitive test of the sanitary condition of a district than the death rate at all ages.

Dr Vincent (3) in his evidence before the Physical Deterioration Committee pointed out that Hill of Birmingham has shown that "Sanitation has nothing to do with infantile mortality". Vincent (4) in his book, "The nutrition of the Infant", appears to quote Dr Hill's own conclusion, as the result of an analysis of the condition of houses in regard to sanitation, in relation to infantile mortality:- "Only one conclusion can be drawn from the above figures. It is that the sanitary conditions to which attention was directed could not be shown to have had any evident connection with the infantile mortality". This is a much more modified, and a much more understandable conclusion, than the definite statement, "Sanitation has nothing to do with infantile mortality." It can ~~readily~~^{readily} be understood how difficult it is from

the examination of any district or districts in which many factors

- (1) Niven: "Report on the Health of the City of Manchester" 1903 p.11.
(2) Gairdner: "British Med. Jour" 1902. Vol.11. p.642.
(3) Vincent: Minutes of Evidence Physical Deterioration Committee p.442.
(4) Vincent: "The Nutrition of the Infant". p.290.

affects great towns measured by one or another of these

-127- are operative, to come to an absolute conclusion regarding the exact extent to which any one of the factors concerned may act. This difficulty has been abundantly illustrated in discussing the relative influence of three factors - the industrial employment of women, overcrowding, and a high birth rate - upon infantile mortality. Taking either factor separately, it was shown that the case could be made out either for or against its influence in the causation of infantile mortality- but taken all together no such demonstration is possible.

What then is the evidence as showing that insanitation must be regarded as a factor in infantile mortality?

(1) The infantile mortality of rural England is lower than that of Urban England. While quite recognising that many places in rural England are less sanitary than many places in urban England, still on the whole ^{rural} England is much more sanitary than Urban England.

(2) Taking things as they are in England and Wales, it must be remembered that a considerable proportion of infants are hand fed. This opens up the way, so to speak, for the play of insanitary conditions through the influence of food. Fatal diarrhoea in hand fed children is on this account probably proportionate to the degree of insanitation to which the infant is exposed. Infantile diarrhoea is twice as fatal in towns as in the country.

(3) Measles is a very fatal disease amongst young infants; and it is especially so among those living under insanitary conditions. Deficient ventilation in particular tends to a fatal issue. It is much more fatal in towns than in the country. Whooping cough is less influenced by the same conditions, and hence its preponderance in towns is less marked.

(4) It can hardly be contended that an infant, brought up in the dark, damp, congested areas of slums, has not less resistant power than one brought up under more sanitary conditions. If it has less resistant power, it must more readily fall victim to disease.

(5) The influence of general insanitary conditions as it

affects great towns may be measured by one or another of three death rates, at all ages, and the corresponding infantile mortality may be studied. These rates are:-

1. The phthisis death rate.
2. The Diarrhoea death rate.
3. The "Fever" death rate.

The phthisis death rate, while a good test of the sanitary condition of any town, is yet liable to well-marked occupational incidence, and in so far is an unsuitable index for comparison with infantile mortality.

The Diarrhoea death rate is regarded as a very sensitive test of the salubriousness of any district. But the diarrhoea death rate is itself largely made up by infant deaths, and would therefore be unfair to use for comparative purposes.

The "Fever" death rate is one which does not to any appreciable degree affect infants. Under "Fever", the Registrar General includes deaths from typhoid, typhus, and simple continued fever. This is universally regarded as a good test of the sanitary condition of any district. Its rate has continuously fallen step by step with improved sanitation.

In the following table, (1) of the 33 large towns in England and Wales, the ten with the highest, and the ten with the lowest, average death rates from "Fever" at all ages in the decade 1893 - 02 are set out, with the corresponding average infantile mortality:-

T A B L E 40.

| Highest Fever rates. | | | Lowest fever rates. | | |
|----------------------|--------------------|-----------------|---------------------|-------------------|------------------|
| T O W N. | Fever. 1893-02. | I.M. 1893-02 | T O W N. | Fever 1893-02. | I.M. 1893-02. |
| Sunderland. | .50. | 175 | Newcastle | .15. | 173. |
| Salford. | .35. | 202 | Swansea. | .14. | 165. |
| Liverpool. | .33. | 189 | Oldham. | .14. | 160. |
| Preston. | .31. | 232 | Huddersfield. | .14. | 146. |
| Nottingham. | .30. | 185 | Bristol. | .12. | 144. |
| Wolverhampton. | .29. | 188 | Brighton. | .12. | 156. |
| Sheffield. | .29. | 182 | Cardiff. | .11. | 159. |
| Bolton. | .29. | 175 | Plymouth. | .10. | 172. |
| Birkenhead. | .29. | 172 | London. | .09. | 158. |
| West Ham. | .27. | 169 | Croydon. | .04. | 141. |
| Average. | .32 | 187 | Average. | .12. | 157. |

(1) Compiled from Registrar General's summary 1903. Table. 3.

had an average of 110, in 1897 - 01, 106, in 1902; and 84, in

1903. (1) It will be noted that the association of insanitation (as evidenced by the "fever" death rate) and high infantile mortality is very regular.

(5) The factor "overcrowding" includes many conditions which would rightly be described as insanitary. One need mention only the manifest pollution of air, soil, and water, which life under overcrowded conditions entails in one way or another. Overcrowding has been proved to a demonstration to conduce to a high rate of infantile mortality. Of all the conditions which make up "overcrowding" as a factor in infantile mortality, has it to be contended that those which are insanitary have no effect?

(6) If sanitation has nothing to do with infantile mortality, the infants of the slums, provided other factors could be eliminated, should compare at least equally with infants in the best parts of rural England. No such comparison however is possible; but the Jews offer some approach to it. It is well known that Jewish parents are very solicitous of their offspring. The poverty of the Jew is not allowed to affect the child. Jewish mothers do not work; and they suckle their children at the breast. In these respects, therefore, there is reason to believe that the Jewish infant compares favourably with the Gentile infant in the best parts of rural England. Dr Niven (1) found the infantile mortality in the district of Cheetham, which is largely Jewish, was in 1899, 104; in 1900, 114; in 1901, 124; in 1902, 97; and in 1903, 108. This is the strongest evidence the writer is aware of in support of the statement "Sanitation has nothing to do with infantile mortality." These are very small rates for infantile mortality as it goes in large cities, and they would almost suggest that insanitary surroundings have no share in its causation. Nevertheless, certain rural districts in England come out year after year with rates which compare favourably with these. Thus Wiltshire had an average infantile mortality of 101, in the quinquennium 1897 - 01; 98, in 1902; and 85, in 1903. Herefordshire

(1) Letter to the writer from Dr Niven. March 1905.

had an average of 110, in 1897 - 01; 108, in 1902; and 84, in 1903. (1) One may therefore conclude that the city ^{is} so much the worse for insanitary environment. The difference is very small ^{however} ~~and~~ ^{but it} emphasises what has already been indicated, that before insanitary surroundings can act in a pronounced manner there must be a predisposing cause, and this will usually be improper food.

Moreover, there is no reason to believe that these rates, small as they are, indicate the possible zero in infantile mortality, and the probability is that with improved sanitation, improvement is capable in each.

No one of these arguments alone, is perhaps enough to establish that insanitation is a factor in infantile mortality, but taken all together the writer believes they demonstrate it.

2. Meteorological influence on infantile mortality.

The meteorological conditions which have to do with infantile mortality were indicated when discussing diarrhoea as a cause of death. The principal conditions were shown to be Rainfall and Temperature.

(1) Rainfall. The following is an analysis (2) of the rainfall in the fifty years 1854 to 1903, in relation to infantile mortality. For comparative purposes the five years of greatest rainfall and the five of least rainfall have been selected.

TABLE 41.

Five years of greatest rainfall.

| Year. | Fall in inches. | Departure from average of 50 years. | Infantile Mortality. |
|----------|-----------------|-------------------------------------|----------------------|
| 1903. | 35.5. | 11.6. | 132. |
| 1860. | 32.0. | 8.1. | 148. |
| 1879. | 31.3. | 7.4. | 135. |
| 1866. | 30.7. | 6.8. | 160. |
| 1872. | 30.0. | 6.1. | 150. |
| Average. | 31.9. | 8.0. | 145. |

(1) Sixty fifth and sixty sixth ann. Rep. of the Registrar General.

(2) From data in sixty sixth annual report Registrar General.

T a b l e 41a.

Five years of least rainfall.

| Year. | Fall in inches. | Departure from average of 50 years. | Infantile Mortality. |
|----------|-----------------|-------------------------------------|----------------------|
| 1864. | 16.7. | - 7.2. | 153. |
| 1858. | 17.8. | - 6.1. | 158. |
| 1884. | 18.1. | - 5.8. | 147. |
| 1870. | 18.5. | - 5.4. | 160. |
| 1854. | 18.7. | - 5.2. | 157. |
| Average. | 18.0. | - 5.9. | 155. |

Infantile mortality is thus seen to bear an inverse relation to amount of rainfall.

(2) Temperature.

A high temperature causes a high death rate from infantile diarrhoea. It has already been shown that the infantile diarrhoeal death rate for the most part governs the infantile mortality figure for the year. The relation between temperature and infantile mortality will therefore be best brought out by an analysis of the mean temperature for the third quarter of any year - the quarter in which diarrhoea is highest. The following is such an analysis. (1) The five years with the highest temperatures and the five with the lowest have been selected (1854 to 1903).

T A B L E 42

Five highest.

| Year. | Average temperature for quarter ending last day Sept. | Departure from average of 50 years. | Infantile mortality. |
|----------|---|-------------------------------------|----------------------|
| 1868. | 63.9. | + 3.5. | 155. |
| 1857. | 63.3. | + 2.9. | 156. |
| 1899. | 63.0. | + 2.6. | 163. |
| 1859. | 62.8. | + 2.4. | 153. |
| 1898. | 62.7. | + 2.3. | 160. |
| Average. | 63.1. | + 2.7. | 157. |

(1) From data in sixty sixth annual report Registrar General.

T A B L E 42b.

Five lowest.

| Year. | Average temperate quarter ending last day Septr. | Departure from average of 50 years. | Infantile mortality. |
|----------|--|-------------------------------------|----------------------|
| 1860. | 56.2. | - 4.2. | 148. |
| 1888. | 57.6. | - 2.8. | 136. |
| 1879. | 58.1. | - 2.3. | 135. |
| 1882. | 58.1. | - 2.3. | 141. |
| 1890. | 58.4. | - 2.0. | 151. |
| Average. | 57.6. | - 2.7. | 142. |

Infantile mortality has therefore direct relation to the average temperature in the third quarter of the year.

Conclusions.

In a former part of this paper (page 28), the presumption was established that the infantile death rate ought to have improved under those same sanitary measures, and measures of preventive medicine, as had apparently benefited other age periods. It has now been shown that sanitation has an effect on infantile mortality. Yet infantile mortality does not improve with advance in sanitation and preventive medicine, comensurate with the improvement in other age groups. Tatham has shown by comparing the opening and closing quinquennia of the last quarter of a century that while the rate for rural England has slightly decreased for both sexes, that for urban England has actually increased.(1)

T A B L E 43.

| | 1873 - 77. | | 1898 - 1902. | |
|----------------|------------|----------|--------------|----------|
| | Males. | Females. | Males. | Females. |
| Rural counties | 139.9. | 112.5. | 138.8. | 111.0. |
| Urban counties | 175.9. | 145.5. | 180.0. | 149.2. |

This further supports the hypothesis with which this paper opened namely (2) "that the reason why infantile mortality has

(1) Tatham. Appendix. V.A. Physical Deterioration Committee p.132

(2) Page 30 of this paper.

not fallen must be looked for in the more pronounced operation of other conditions (that is other than sanitary) which are especially inimical to infant life; "and these conditions were for the moment regarded as "Urban conditions". That is to say the explanation of a stationary (or rising) infantile mortality rate, coincident with advances in sanitary science and preventive medicine, has to be found in the increasing action of agencies especially inimical to infant life. It remains only to touch on one other point before disclosing what these agencies may be. And that is, it is well known that during at least the last three decades, there has been an increasing urbanization of the people. There are now, both absolutely and relatively, more infants living under urban conditions of life than, say, 30 years ago. It has been shown that the urban rate of infantile mortality is (normally as it were) higher than the rural rate. The urbanization of the people, therefore, would tend to raise infantile mortality quite apart from any question of sanitation.

The writer would advance the following in explanation of the continued high infantile mortality in England and Wales, coincident with advances made in sanitary science, and preventive medicine:-

- (1) The manner of the decline in the birth rate. (page 104)
- (2) Decline in breast feeding. (page 112.)
- (3) Increase in artificial feeding.
- (4) Increased urbanization of the people.

All of these conditions may be regarded as more operative in towns than in the country; and for this reason the rate of infantile mortality in rural England has, as Tatham has shown, actually improved, co-incident with improved sanitation. For the same reason the infantile mortality rate of urban England, because of the increasing action of these inimical agencies, has increased in the face of improving sanitation.

Prevention of Infantile Mortality.

Prevention of Infantile Mortality.

Knowledge, and the children's health...

1. General considerations.

- (1) Moral, Educational, and Social.
- (2) Legislative.
- (3) Philanthropic.

2. Measures more or less intimately connected with

Public Health Administration.

- (1) Leaflets of Instruction.
- (2) Lady Health Visitors.
- (3) Municipal Milk Depots.
- (4) Municipal Crèches.
- (5) Teaching of Girls in School and Evening Continuation classes.

1. General considerations.

Class 1. Infantile mortality due to

... This class is represented by ... diseases of the respiratory system ... It was shown that ... their connection with the ... bacterial septicæmia, ...

Class 2. Deaths due chiefly to improper food and want of
Prevention of Infantile Mortality.

It has been said that the people perish for lack of knowledge; and it may be further said that only too frequently the children perish through lack of conscience.

By whatever means it is proposed to combat the lamentable waste of infant life which goes on year after year, none can be expected to succeed permanently which leaves out of account the value of education in the laws of health by every possible agency, and (of) the necessity of creating a healthy public conscience on this subject.

The discussion of prevention has therefore to do with the consideration of many moral, educational, social, and industrial problems, which can only remotely be said to touch on the realm of Medicine. Many of them are rather problems for the Economist and Politician. Nevertheless, infantile mortality to-day is one of the most pressing and vital questions to which the Hygienist can address himself; and an attempt will therefore be made, chiefly from the point of view of Public Health, to indicate what measures it would appear desirable to advance, in order to make an appreciable effect upon this black spot in the records of sanitary and hygienic achievements.

Many of the measures proposed, and instanced, must be regarded largely, not as in themselves ultimate, but rather as a means to an end.

1. General considerations.

In analysing the separate causes of death it was shown that the deaths might be roughly divided into three classes.

Class 1. Deaths due chiefly to inherent weakness in the infant. This class is represented for the most part by the wasting diseases of the Registrar General and by congenital syphilis. It was shown that the chief factors concerned in their causation were the health conditions of the parents - parental syphilis, tuberculosis, and alcoholism more particularly.

Class 2. Deaths due chiefly to improper food and want of care. This is a large class, amounting in 1903 to no less than 37 per cent. of the total infant deaths.

Class 3. Deaths due to "other causes." Many deaths included in this class would no doubt be more properly included in Class 2, and to a lesser extent in Class 1; but on the other hand, this is probably pretty nearly compensated for by the inclusion in these latter of deaths which ought to be included in this one.

As affecting the infant at birth most of the deaths in Class 1 must be regarded as inevitable - ~~that~~ is, non-preventable; deaths in Class 2 must be regarded as strictly preventable; and those in class 3 as doubtfully preventable.

It is manifest, therefore, that in order to reduce the deaths ascribed to Class 1, the methods of prevention must have regard primarily to the parental circumstances which make these deaths possible - that is, preventive measures must be directed to reduce the possibility of infants being born inherently weak. This is the least hopeful aspect of infantile mortality so far as prevention is concerned. Nevertheless, much may be done by a continual crusade against the moral, *and* social conditions concerned in the causation of syphilis, tuberculosis, and alcoholism. Some check on the marriage of unsuitable people has been suggested, securing the greatest good for the greatest number, and, in Dr. Farr's words, rendering "growth more perfect, decay less rapid, life more vigorous, and death more remote" (1). More energetic still is the proposal of Dr. Rentoul (2) that certain mental and physical degenerates be sterilised. It is however safe to say that public opinion is not yet ripe for such drastic measures. The recommendation of the Inter-Departmental Committee on Physical Deterioration as regards syphilis

(1) Newsholme: "Vital statistics" 1899. p.126.

(2) Rentoul: "The proposed sterilization of certain mental and physical degenerates".

is more feasible (1). It is recommended that a Commission be appointed to enquire into its prevalence and effects, having special regard to the possibility of making the disease notifiable, and to the adequacy of hospital accommodation for its treatment. There is no doubt whatever that proper control (if that be possible) of this dreadful scourge of civilization would result in a material reduction of infantile mortality, and produce a distinct advance in Public Health, but the difficulties attending such control would be of much magnitude.

Tuberculosis has engaged the earnest attention of sanitarians for many years and with splendid results. The campaign against overcrowding, and ^{against} insanitary conditions generally, must be prosecuted if possible with renewed vigour.

As regards alcoholism, this has to be looked upon both as a social and as a physical disease. Its effect does not end in the class now considered, and any measures tending to reduce alcoholism in either parent can only have a beneficial effect from whatever point it is viewed. It is discouraging to observe that there is well-founded reason for believing that alcoholism among women is on the increase. Alcoholism is ^{so} inextricably mixed up with other social factors - such as poverty, overcrowding, vice, disease, and crime, - that it is manifest its prevention can only be accomplished by a great social regeneration of the people. Much may be hoped for from education, and from the creation of a healthy public conscience on this social disease. The general medical practitioner, as a minister of health, can contribute to this by preaching abstinence. He can show that alcohol is useless in health, and of very limited service in disease.

It has been shown that closely connected with, and due to the same causes as, deaths in this class, was another aspect of the question, which though strictly unconnected with a consideration of the prevention of infantile mortality, may be mentioned here. And that is what may be called the ante-natal deaths-

(1) Report of the Inter Departmental Committee on Physical Deterioration p.92.

abortions and still births. The same measures which would prevent the one would also prevent the other, and thus tend to diminish the infantile mortality rate, whilst improving the birth rate.

It has been said that the deaths included in Class 1 represent what may be regarded as an index of the children born to inevitable early death. This, of course, whilst a good working hypothesis, is not absolutely true. It is quite possible that improved environment might reduce the deaths in this category. For example one from time to time hears of even the premature infant surviving. Jardine (1) reports the survival of a premature child weighing 2 pounds, and born at a period of gestation not more than six and a half months. Among the class of the community, however, in which infantile mortality is highest, the chances of the premature child surviving may be regarded as negligible. The chance in any case is of course one of degree, depending largely on the health of the mother. Ballantyne (2) for example states that a 7 months' child of a strong healthy woman, may be better equipped than say a full-time syphilitic. The same writer regards the problem of the premature infant, in view of the falling birth rate, as an urgent one. It may not, he says, be possible exactly to define the value of the premature child to the State and the community, but manifestly it is greater now than when the birth rate of England and Wales was 35 per 1,000. Maternity charities, perhaps subsidised by the local health authority, might be established in all large towns, and especially in those where much female labour is employed. Women should be received some months before expected confinement, and no distinction should be made between those who are married and those who are not. By this means, rest to both body and mind would be secured, and a reduction of premature and inherently weak infants hoped for. The pre-maternity hospital has a recognised place on the continent as an aid to puericulture. The writer

(1) Jardine: Brit. Med. Jour. 1901. I. 767.

(2) Ballantyne: Brit. Med. Jour. 1902. I. 1196.

believes that in Dundee there is a maternity charity hospital which expressly excludes distinction between mothers married and unmarried. Such hospitals would surely be a great means of reducing infantile mortality in English towns such as Blackburn, Burnley, and Preston, where many women are engaged in occupation.

As has been indicated, however, the reduction of the deaths in this class has to be hoped for by social evolution rather than by measures of practical preventive medicine.

There can be no doubt that universal suckling on the part of mothers, and direct personal care of their infants in an intelligent manner, would practically banish the deaths falling in Class 2. How this has to be done presents many problems which can only be touched upon here. The influence of the general practitioner might do much. It is to be feared that the importance of suckling is only insisted upon by the profession in a kind of half-hearted way. The force of circumstances and custom has so associated the baby and the feeding bottle, that it excites no comment, and is largely taken both by the profession and the laity as a matter of course.

When one considers the enormous number of infants who for one reason or another must be hand fed, the importance of a pure milk supply as one means of reducing infantile mortality cannot be over-estimated. It is a matter of common knowledge that the milk supply of the country generally is far from satisfactory. Not only may it be poor in quality, but during the warm months of the year it has to be looked upon as a direct menace to infant life. Milk is an excellent culture medium for all kinds of micro-organisms and is liable to bacterial and other contaminations at all points from the cow to the consumer. The more important micro-organisms rendering milk dangerous were mentioned when discussing diarrhoea as a cause of death. The danger of milk being contaminated in the home by dust and the domestic fly must here again be insisted upon. Two remedies would therefore

suggest themselves:-

(1) More strict enforcement of the Regulations under the Dairies, Cowsheds, and Milk Shops Orders, and of The Sale of Food and Drugs Act.

(2) The removal of the ignorance which prevails of how milk should be stored and of the conditions under which it is fit for use.

For the further protection of the hand fed child the use of the long tubed feeding bottle should be made illegal;

it should be an offence to feed a child under 7 months of age on farinaceous food; advertisements of patent infant foods in terms which are not true in fact should be made illegal.

The industrial employment of married women too often implies not only improper food, but also the placing of the child in the custody of young or incompetent persons. More stringent regulations are required for those taking infants to nurse, or as lodgers.

The Infant Life Protection Act might be amended to apply to one child irrespective of circumstance. The risk of accident to infants has been shown to be very great. Against such carelessness as results in suffocation consequent upon parental intemperance, little would appear to be possible.

The provision of separate cots for infants as a remedy has been proposed; but the class of persons among whom this accident is most likely to happen are just the very ones least likely to make such provision.

One must again come back to the conviction, that the removal of ignorance, and the stimulation of public conscience, are after all the only remedies. This consummation would be hastened if every case of suffocation, or other accident, that occurs were rigorously enquired into, and a real effort made to bring home parental neglect and severe punishment meted out when found. Similar enquiry should be held into all uncertified infant deaths. Too often such matters, even when enquired into, end only in a censure by the Coroner.

There is a strong suspicion in the minds of

many well able to judge that the practice of infant life insurance, is not free from danger to infant life. It appears that the practice might well be restricted to cover only the actual cost of burial. / The writer would suggest that infant insurance be worked on such lines that the event of death under one year would only ensure the return of premiums paid. What the attitude of the general practitioner should be when he is convinced an infant death is due purely and simply to improper food, or ^{to} criminal neglect, is too ethical a question to enter into here. The writer however is strongly of opinion that a more frequent appeal to the Coroner could not but have beneficial effects.

The factory and Workshops Act 1901, provides that an occupier, may not knowingly employ any woman or girl in any factory or workshop within four weeks after she has given birth to a child. This period is manifestly too short so far as the interest of the infant is concerned. There are unfortunately many circumstances, however, which need not be mentioned here, which render it undesirable to interfere with the provision of this Act. But there is reason to believe that even this moderate requirement is frequently evaded. The Inter Departmental Committee on Physical Deterioration make the following recommendation on this point:- (1) "The Committee do not think that the period during which employment after confinement is prohibited could be extended without counterbalancing disadvantages. But the law should certainly be strengthened, so as to place upon the employer the burden of proof that the required period has elapsed since the confinement of the woman he employs; or, in the alternative, so as to prohibit future employment in the absence of (1) a medical certificate that it will not be prejudicial to their physical wellbeing, and (2) proof that reasonable provision is made for the care of their infants. This might take the form of a crèche, or be secured by the recognition for the purpose of a duly licensed body of women".

(1) Report of the Inter Departmental Committee on Physical Deterioration p.88.

entirely. The prevention of infantile mortality offers ample scope for the exercise of philanthropy, and as this should be guided largely by medical opinion, it may be briefly noticed here.

Perhaps of all philanthropic movements connected with the prevention of infantile mortality, none has such a long and creditable history as that known as the Manchester and Salford Ladies Public Health Society which has been in existence for over a quarter of a century. The special object of the society is to bring within the knowledge of the mothers among the poor such information as will enable them to do duty by their children.

Dr Niven (1) commenting on the work of this society, and also that of the Ladies Society for visiting the Jewish poor, says:-

"The work performed by those Societies for a number of years in teaching personal and household cleanliness, in the poorer districts of the City, has had a marked effect in these districts, and an improvement on former conditions can now generally be discerned". Again, "I attach also very great importance to the work which the Health Visitors are doing in the instruction of mothers in the procedures which they must adopt when artificially feeding their children." Similar societies in all large towns, co-ordinated by the Local Health Authority, would undoubtedly do much good. The direct appointment of Lady Health Visitors by the Public Health Authority will be considered presently.

In large towns where Childrens' Hospitals exist, it would be a good plan to set aside one or two wards for the special treatment of infantile diseases of malnutrition. The medical student would thus have an early opportunity of coming to close quarters with a class of case which bulks largely in private practice. He would also have the opportunity of observing the remedial effect of correct dietetic treatment. Leaflets of instruction on infant feeding and hygiene might usefully be distributed by such hospitals.

More ambitious still is the establishment of a hospital

(1) Niven. "Report on the Health of the City of Manchester" 1903. p.227.

entirely for infants. Such a hospital, which the writer believes is the only one of its kind in this country, has been quite recently established, and is known as "The Infants' Hospital," in Hampstead, London. The hospital is under the patronage of a philanthropic movement - the Infants' Health Society - and is entirely dependent upon voluntary contributions. The objects of the Hospital are:- (1)

- (1) To place the management of Infants on a basis of scientific hygiene.
- (2) To place the treatment of disorders and diseases of nutrition occurring in infants upon a system in harmony with modern investigations.
- (3) To investigate and demonstrate the means by which the present disease and mortality in infants may be prevented.

The study of infantile nutrition is carried out with great exactitude. The precise composition of the food of each infant is shown in one chart; in another the condition and progress of the infant are detailed. Medical practitioners and students are freely permitted to accompany the Physician when treating the cases, so that they may have every opportunity of studying the subject. The training of nurses for infants is a special feature of the hospital. The probationers work under constant supervision of the Matron and Sisters, and, before their period of probation is completed, they have had actual experience in the care and management of at least one hundred infants.

It is too early yet to speak definitely of results - the hospital having only been in existence since the beginning of 1903 - but the report for the year 1904 is distinctly encouraging. It is not improbable that the Infants' Hospital will at no distant date have a recognised place in all large cities of the Kingdom.

Another example of what philanthropy may do is found in a recent private scheme of the Mayor of Huddersfield (Alderman B. Broadbent), who takes an intense interest in infant life. It takes the form of a promissory note, printed on a neat card, surmounted by the coat of arms of the Borough. The following is a copy of both sides of the card and is self-explanatory.

The front of the card is as follows:-

Date..... No.....

For the Baby.

Longwood District of the County Borough of Huddersfield.

Name of the Baby..... Date of Birth.....

Name and address of Parents.....

The Golden Rule,

for the Life and Health of the Baby.

"Feed with the Mother's milk:

The Mothers Milk is the natural food AND THE BEST!

Twelve months after date I promise to pay to the Parents or Guardians of the above-named child the sum of One pound on production of proof that the said child has reached the age of Twelve months.

Signed.....

Mayor of Huddersfield.

For every baby fed on its Mother's Milk who dies before the age of three months, fifteen babies die who have been fed by other means.

The back of the card has some wholesome rules in plain language:-

Rules for the Welfare of the Baby.

When the Mother cannot suckle the child it should be fed on New Milk and Water mixed in certain proportions according to age. At first half milk and half water, with a teaspoonful of

cream and a little sugar. Then as the child grows older less water to be added. When cream cannot be obtained a small piece of suet may be shredded into the milk.

WHAT TO DO.

ALWAYS feed baby at regular intervals every three hours.

ALWAYS keep the baby very clean.

ALWAYS bathe (or sponge all over) the baby once a day in warm water.

ALWAYS let the baby sleep in a cradle or cot; a wicker basket makes a good cot (or even an empty packing case).

ALWAYS use Fuller's earth to powder the baby, not starch or flour.

ALWAYS attend to the baby when it cries. The baby cries for one of 3 reasons.

- (1) The baby is hungry;
- or (2) The baby is uncomfortable or something hurts;
- or (3) The baby is ill.

WHAT NOT TO DO

NEVER give the baby soothing syrups, fever powders, or anything of that sort.

NEVER give the baby bread or sops, or any other food except milk till it is more than seven months old.

NEVER give the baby skimmed milk, or milk that is not perfectly fresh and good.

NEVER use a feeding bottle with a long tube. Nobody can keep the inside of the tube clean.

NEVER carry baby "sitting up" until it is 5 months old.

NEVER neglect to send for a Doctor if the baby is ill. Babies are soon overcome and easily die.

Such a scheme of the Mayor of Huddersfield is worthy

of emulation by the wealthy in other great towns, were it for no other reasons than those of arousing interest in, and for directing public attention to, the importance of preventing infantile mortality. The scheme is frankly an experiment - an object lesson - and nothing can be said of its result, as its year of trial has not yet expired. It should be stated that the Mayor himself visits, and takes an interest in, every infant on whose behalf a card is issued.

(5) Infantile mortality in general will be reduced by all measures which tend to the moral, intellectual, and social advancement of the people. As the measure of vice, intemperance, ignorance, poverty, and overcrowding diminishes, so will infantile mortality improve. There is work here for the minister of religion, no less than ^{for} the minister of health; for the apostle of the people, no less than ^{for} the people themselves.

(5) Teaching of Girls in School and Evening Conventions
and Classes.

2. Measures more or less intimately connected with Public Health Administration.

(1) Teaching of Girls in School and Evening Conventions and Classes.

It is now proposed briefly to indicate some measures more or less intimately connected with Public Health administration, which may be hoped to produce a reduction in infantile mortality. It must here again be insisted upon that the value of any measure has to be judged not merely by its immediate result, but for the most part by its influence as an educational agency, and by the extent to which it is calculated to engage the attention - the sympathetic attention - of the people. Unless the masses are reached, little good is to be expected from any measures. Nor must the object be to lessen parental responsibility, but rather to be a means of fixing it.

The prime objects to be attained in preventing infantile mortality may be summed up as follows:-

- (1) Promoting breast feeding to the greatest possible

extent; and, where for any reason breast feeding cannot be carried on, directing efforts to dispel the large amount of ignorance which prevails among mothers and guardians respecting the subject of artificial feeding.

- (2) Promoting instruction on the general care of infants.
- (3) Making provision where necessary for a supply of suitably modified pure milk.
- (4) Making provision for the care of infants whose mothers are obliged to work.
- (5) Education of the future mothers.

These objects may be attained by the following agencies:-

- (1) Leaflets of Instruction.
- (2) Lady Health Visitors.
- (3) Municipal Milk Depots.
- (4) Municipal Crèches.
- (5) Teaching of Girls in School and Evening Continuation Classes.

(1) Leaflets of Instruction.

The leaflet by itself is not likely to do much good, but a great deal may be expected by its judicious distribution, in conjunction with home visitation by Lady Health Visitors. In many places leaflets are distributed by the Registrar at the registration of birth. This to the writer's mind is too promiscuous. Moreover, registration is not required under six weeks of age, and a great deal of harm may already be done before that time. This suggests the importance of having early information of a birth. The Corporation of Huddersfield have recently decided to offer inducements to parents and other giving information of a birth within 48 hours of its occurrence. A fee of one shilling has to be awarded to the first person giving such information to the Health Authority. This will in many cases secure its object; and the idea seems to the writer to be worthy

of the consideration of other Authorities. Registered Mid-wives might be required to give immediate notice to the Health Authorities of all births occurring in their practice. Moreover it is suggested that midwives themselves might be made an instrument of the greatest utility for the dissemination among mothers of proper knowledge and practical advice (1). The only other ways of securing early information would be through the agency of sanitary inspectors, and lady health visitors, in the course of their ordinary duties; or by direct and immediate communication between the Registrar and the Health Authority. ^{Any} Either of ^{these} which means, however, would imply a certain amount of delay. What is wanted is earlier registration.

As regards the leaflet itself, it should be short, written in plain language, and printed in large type on a single page. The leaflet above all things must be distributed judiciously. The recipient requires to be impressed with the fact that it is a special effort with a very special object in view. It will not seldom be necessary to have it read and explained.

Every leaflet, no matter what other things it may deal with, should give prominence to the importance of breast feeding. To this there should be no exception.

There should be a general leaflet, somewhat after the same style as those recommended by the Physical Deterioration Committee, (2) "Advise on the feeding and rearing of infants", and "How to rear a healthy baby". These leaflets the writer has abstracted and placed in the appendix to this paper. If any criticism might be directed to them it is that they err in being too long. Besides this general leaflet there should be special ones for distribution under special circumstances. Thus diarrhoea should be dealt with in a special leaflet which should be distributed before the advent of summer diarrhoea; leaflets dealing with

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- (1) Report of the Inter Departmental Committee on Physical Deterioration p.89
 - (2) Appendix (XVIII) to the Report. Physical Deterioration Committee.

ities should hold certificates from the Sanitary Institute in measles and whooping cough, at times of epidemic; because these which case it would appear desirable that they should have the special leaflets will be more likely to succeed in their object if specially distributed when the special circumstances arise.

Dissemination of such information should be the minimum duty of every authority having to do with the prevention of infantile mortality.

(2) Lady Health Visitors.

More good ^{may} (has to) be expected when the leaflet is reinforced by lady health visitors. Many authorities in England, such as London, Preston, Burnley, Blackburn, Leeds, and other places now regard such appointments as a normal requirement of Public Health administration. Their special duties, so far as the prevention of infantile mortality is concerned, are usually as follows:-

teaching of the

- (1) Visiting homes (especially among the poor), where births have occurred, immediately on receiving information of the same.
- (2) Distributing and explaining leaflets and giving personal advice on the rearing and nurture on infants, and generally doing everything possible to reduce domestic unhygiene.
- (3) Making enquiries into infant deaths.

In order to do these duties well - and everything depends on how they are done - qualifications of no mean order are required. The ordinary mother of the poorer classes has small respect for anyone she does not conceive is much better than herself, and she is quick to appreciate the subtle something which makes all the difference. For this reason, the first essential of the Lady Health Visitor is that she should be a lady. She should have practical and assured acquaintance with the principles of correct management, rearing, and feeding of infants. If she has some real knowledge of the diseases to which infants are specially liable, so much the better. Above all, she must be endowed naturally with insight sympathy and tact. It is usual to require that lady health visitors appointed by sanitary author-

ities should hold certificates from the Sanitary Institute; in which case it would appear desirable that they should have the same power of action as sanitary inspectors, which so far the writer believes they have not.

Whenever these lady health visitors have been appointed, it is believed that good results have followed. It may not always be possible to demonstrate just how much good they may do, and after all it must be remembered that more has to be hoped for from what may be regarded as their indirect influence. It is conceivable that years of steady patient work may be required before the gross figure of infantile mortality will tell in their favour.

Preston, as is well known, has long had an ^Winenviable position as regards infantile mortality. During the last 2 years (1903 and 1904) two lady health visitors have been employed.

The following figures (1) are suggestive in their connection:-

Deaths from Diarrhoea in Preston.

| Week ending. | 1897 Ground Temp. July. 18. 56° Aug. 6. 59° | 1899 Ground Temp. July 15. 56° Aug. 21. 59° | 1904 Ground Temp. July 14 56° Aug. 6 59° |
|--------------|--|--|---|
| July 10. | 3. | - | - |
| 17. | 3. | - | 1. |
| 24. | 4. | 2. | 3. |
| 31. | 6. | 3. | 1. |
| Aug. 7. | 12. | 4. | 3. |
| 14. | 24. | 24. | 7. |
| 21. | 34. | 23. | 12. |
| 28. | 40. | 37. | 4. |
| Total. | 126. | 93. | 31. |

It should be noted that the year 1904 was not one especially favourable for infantile diarrhoea in the country generally; and the marked improvement in the Preston figures must

(1) Times Sept. 22nd 1904.

be taken as an index, in part at least, of the beneficent influence of the lady health visitor.

Altogether the employment of lady health visitors promises well both as a direct and an indirect means of reducing infantile mortality.

There is no doubt that by means of leaflets and lady health visitors, if universally employed throughout the country, an immense saving of infant life would be effected, and much unnecessary suffering avoided. In many cases no further direct municipal action would be required, especially in places where the philanthropic spirit has already evolved some kind of an organisation directed to this end. The Inter Departmental Committee, reviewing the evidence in favour of instruction by this system of leaflet and lady health visitor, expressed themselves as follows:- (1)

"The Committee believe that enough has been said of the value of the system, and the testimony paid to its success by competent judges, to justify them in urging upon every locality the adoption of similar methods. The system has the advantage of linking individual and philanthropic effort with municipal responsibility in a way that regularises the one while energising the other, and appears to give to each its proper influence in dealing with social wrongs, at the same time tending to check the overlapping and misdirections so often characteristic of purely charitable impulse.

Other agencies to the same end, such as lectures and mothers meetings are not excluded; indeed, they can very well be worked into the system and be utilised to expand and develop its scope. There is no step in short, towards training mothers in personal, domestic and infant hygiene, with which it cannot be associated and towards the effect of which it cannot be made to contribute.

The Committee desire to press these considerations with

all the earnestness at their command upon the most serious attention of the community, and they would further suggest to the Local Government Board the desirability of issuing to local authorities a circular explaining the objects to be sought and the means by which they can best be attained".

It is to be hoped, then, that it will soon be the exception to find any considerable town in which systematic instruction by leaflet and lady health visitor has not its recognised place in the prevention of infantile mortality.

(3) Municipal Milk Depots.

In recent years the municipal milk depôt has risen to quite an important place as a special means of preventing infantile mortality. The milk depôt has long had a place in France and some other countries, but in England it may still be said to be upon its trial. Much criticism has been directed against the municipal milk depôt as organised in this country, and some of this will be noted presently.

The function of the depot is to supply at reasonable cost a modified pure milk for the use of infants with the special object of preventing infantile mortality. The milk is modified by the addition of water, cream, and sugar, suitable to the age of the infant. It is supplied sterilised, in specially designed bottles - each bottle containing only one ^(meal) feed - sufficient for one day's supply. Thus an infant of three months has its day's supply in say 9 bottles, each bottle for one feed containing about 3 ozs. of modified milk.

The justification for the municipal milk depôt can only too easily be found in the infantile death rate of great towns; in the state of the milk trade of this country generally; and on account of the ignorance which prevails regarding the proper manner of modifying cow's milk as a food for infants.

The first municipal depot established in this country

was that at St Helens in 1899. This was followed by one at Liverpool two years later, and by Battersea in 1902. Other milk depots have been established at Leith, Dundee, Glasgow, Bradford, Burnley, and Ashton. A milk depot as a charitable organisation exists at York, and another, under medical supervision, at Finsbury. Leeds, the writer is informed, has decided to establish a municipal depot in the near future.

The Liverpool depot is the largest in this country, and the following particulars, which the writer believes are more or less common to all municipal depots, are taken mainly from Dr Hope's report for 1903 (1).

The first object is to obtain a milk supply as pure as possible. The milk is supplied by contract from town and country dairies, and samples of it are taken on delivery from time to time for chemical and bacteriological analysis. When it arrives at the depot, as a routine practice, a sample is taken for the purpose of estimating the amount of fat by Garber's test; a sample is also examined in the cream tube. Next a mixture is prepared consisting of cows' milk, water, cream, salt, and sugar, in such quantities as to make the liquid practically the same as human milk; a sufficient amount for one feed for an infant of stated age is put into each bottle, and the bottle and contents are then sterilised, rapidly cooled, and the milk is then ready for distribution. When a mother or other person brings an infant it is weighed. If the child is not brought, milk is only supplied on the condition that it be brought to be weighed at the earliest opportunity. The mother or guardian is told how to feed the child, and the card of instructions is explained. It is especially impressed upon all mothers that the milk is but a poor substitute for the breast. From time to time, visits

(1) Report on the Health of the City of Liverpool 1903.

*Garbers test consists in well mixing 10.c.c. of sulphuric acid, 1.c.c. of amyl alcohol and 11.c.c. of milk in a special tube with a graduated neck, and then centrifuging. The fat separates and is measured in the graduated neck. T.D.

are paid by female inspectors to the homes of the infants, to ascertain if the milk is being used intelligently and in a proper manner. Every effort is made to induce the mothers to bring their children to be weighed at least once a fortnight. In cases where the mother says the child does not like the milk, or does not appear to be thriving on it, the female inspectors have instructions to pay a visit, and if a doctor is not in attendance, the mother is advised to call one in.

Such is the general routine at the milk depot in Liverpool, and it appears to be as comprehensive as any municipal undertaking may well be. A copy of the regulations which control the sale of the milk is included in the appendix to this paper.

As regards the results of milk depots, any statistical examination is beset by many sources of fallacy, and at best can only be received with much caution. The following figures for Liverpool, however, taken with the foregoing reservation are valuable as indicating that a properly organised milk depot exercises a beneficial effect on infantile mortality.

Hope found that of 4,453 infants fed on the milk since operations were started to December 31st 1903, and whose approximate average age was $3\frac{1}{2}$ months, 350 infants died. Among these 350 infant deaths were 228 infants ill at the time of commencing the milk; 18 were irregularly supplied; 49 had less than one week's supply; and of the total number only 55 were healthy to begin with, and subsequently properly fed.

Dr Hope's comments are as follows:-

"Without attempting to draw too close deductions, the fact stands out, that out of 4,453 infants coming very promiscuously to the depots, at varied ages and in conditions of health below the average, the mortality was 78 per 1,000; as against 159 per 1,000 for the whole City; and 88 to 118 for the best districts, and 212 to 215 for the worst".

This calculation for the milk depot infants is of course open to the objection that the rate of mortality is on a selected

number - for the depot must needs be selective, whether to its advantage or disadvantage is another question - which have probably passed a not inconsiderable portion of the period of infant life, when infant mortality is highest. Such an objection could be only partially met by a very complete life table of the first twelve months. To some extent this objection is modified by the further remarks of Dr Hope:-

"But it must be remembered that in that 159 for the whole City, and 88 to 118 for the best districts, and 212 to 215 for the worst districts, are included also breast fed infants; clearly if breast fed infants were excluded, and artificially fed infants only taken into account, the rate of mortality amongst them would be enormously higher, and would show even more forcibly the advantages of the sterilised food, which, of course, is an artificial food, over other methods of artificial feeding."

Such then is the evidence so far as statistics can go for Liverpool. The experience of Battersea is much on a par with that of Liverpool.

The following table (1) is the statistical evidence in favour of the milk depot at St Helens:-

| Year. | No. of children on books. | Death rate per 1,000 among children at Depot. | Infantile Death rate of the Borough. |
|-------|---------------------------|---|--------------------------------------|
| 1899. | 232. | 103. | 157. |
| 1900. | 332. | 102. | 188. |
| 1901. | 282. | 106. | 175. |
| 1902. | 200. | 82. | 167. |
| 1903. | 183. | 54. | 137. |

These results are satisfactory so far as they go, but they must be accepted with the caution already indicated.

At Rochester, New York, a municipal milk supply was introduced seven years ago. The mortality in infants under one year had fallen 65 per cent., and that of children between 1 and

(1) Annual Report on the Health of St. Helens 1903.

5 years 58 per cent.(1) The writer believes that at Rochester the supply of milk from the cow to the consumer is throughout under direct municipal control, the object being to obtain a pure milk which does not require sterilisation.

But the strongest evidence in favour of the milk depot is not to be found in figures solely. There is the evidence (as has been demonstrated by Mussen at Liverpool (2)) of satisfactory increase in body weight and in quality of nutrition; the evidence of parents, of medical men, and of others well qualified to judge, that to the use of sterilised milk has been attributed the saving of many a child's life.

With the exception of Burnley, the reports of the English municipal milk depots are fairly satisfactory. Dr Deane (3) of Burnley writes:- "Two years ago they (the Health Committee) tried supplying parents and nurses with sterilised milk, but the demand for it gradually ceased because it was too much trouble to fetch it". Against such apathy as this municipal enterprise is vain. At St Helens (4), the number of children on the books of the depot was only 183 in 1903, against a previous maximum of 332 in 1900. The use made of the depot in St Helens would therefore appear to be disappointing.

The advantages of a well conducted milk depot would appear to be:-

- (1) A probable reduction of infantile mortality.
- (2) Securing a pure milk supply, suitably modified for the infant's age.
- (3) The means of maintaining a more or less close supervision over a certain number of infants.
- (4) Impressing upon the people the importance of care in handling milk; and of regularity in feeding, both as regards time and quantity.

(1) Still: "Some recent work in diseases of children" Practitioner, Vol., LXXIV., No.2., p.217.
(2) Mussen: Journal of State Medicine, Vol.XI., No.10., p.599.
(3) Report on the Health of Burnley 1903.
(4) Annual Report on the Health of St. Helens 1903.

The educational benefits which may be expected to follow a well-managed milk depot are therefore of no small moment.

The principal disadvantages of the milk depot are:-

- (1) The danger of encouraging artificial feeding in place of breast feeding.
- (2) The sterilisation of milk alters its qualities, and destroys the antiscorbutic principle; and prolonged feeding on sterilised milk has been followed by scurvy.
- (3) The milk may not be sterile.
- (4) The milk is supplied without due medical supervision.

These alleged disadvantages are sufficiently serious to demand some comment.

- (1) The danger of encouraging artificial feeding in place of breast feeding.

The statistics already given as to the extent to which breast feeding is carried on, show, that, whatever may be the danger of the milk depot in encouraging artificial feeding in place of breast feeding, a condition of affairs already exists in England which warrants an attempt to make artificial feeding as safe as possible. There is no evidence, however, so far as the writer is aware, which would lend colour to the contention that this danger exists. The experience of Burnley, and in a lesser degree that of St Helens, would rather suggest that the difficulty will be to ensure due use being made of the facilities afforded. It would be satisfactory if one could think that the failure of Burnley, and the reduction of the number of infants on the books at St. Helens depot, is due to an increase in breast feeding in these places. No such conclusion however is warranted.

No matter what efforts a municipality may make, for example, by leaflets or health visitors, a large proportion of infants will continue to be artificially fed, and it is for these that the milk depot is solely intended. In every milk depot in England persistent prominence is given to the fact - both

by leaflet and otherwise - that the depot milk is but a poor substitute for the mother's milk. This objection therefore can hardly be considered a valid one.

(2) The sterilisation of milk alters its qualities, and destroys the antiscorbutic principle; and prolonged feeding on sterilised milk has been followed by scurvy.

These are more serious objections and demand very careful consideration.

Vincent (1) in his evidence before the Inter-Departmental Committee on Physical Deterioration vigorously condemned the Municipal Milk Depot. He attaches great importance to the necessity of providing a vital living fluid. In particular, milk should never be heated above 160°F; his own practice limits the heating to 150°F. Milk heated above 160°F, while it may have most of its contained micro-organisms destroyed, also has its vital principal destroyed, and such a food produces Scorbutus. He recounted the chief physical and chemical changes occurring in milk as the result of sterilisation as tabulated by Judson and Gittings:- "Lecithin and Nuclein are decomposed, organic phosphorus is diminished, while the inorganic phosphorus is increased. The phosphates become insoluble and precipitation of the calcium and magnesium salts occurs. Normal lactic acid fermentation is inhibited. The fat emulsion is injured or destroyed. The lactalbumen is coagulated, and caseinogen is only partially or not at all coagulated by rennin, this latter change being related to precipitation of the calcium salts. Digestion of the caseinogen is delayed. After prolonged sterilisation albuminoid toxins may be produced."

In spite of successes in Paris and elsewhere, Vincent regards the attempts of Liverpool and Battersea to provide a sterilised milk supply for infants as fraught with danger of producing disease. He thinks it a serious thing for any Corporation to give its endorsement to. He cited, in support of his contention, Dr Ashby's case of infantile scurvy arising from taking

(1) Minutes of Evidence; Physical Deterioration Committee p.442.

municipal humanised sterilised milk.(1). He would absolutely condemn sterilised milk as a food for infants.

Wynter Blyth (2) believes that the practice of sterilisation as conducted by municipal milk depots is not to be recommended. He thinks the disadvantages of sterilised milk may be got over by the use of "pasteurised milk", the majority of micro-organisms being killed, and the milk being altered in qualitative composition not at all, or at most very slightly.

That sterilisation in some measure is a real objection, probably the most enthusiastic supporters of the municipal milk depot will admit, though one may be excused from taking the extreme view of Vincent. The remedy to the writer's mind seems to be found, either in a radical change in the milk trade of this country, or in the complete municipal control of the depot milk from the cow to the consumer. This opens up economic questions which cannot be discussed here. But if this could be done it ought to be possible to produce a milk which could be modified without sterilisation, or at any rate that sterilisation need only be practised during the warm months of the year.

The writer is informed by Dr Cameron, the Medical Officer of Health for Leeds, that this is the ideal which his authority has set itself. It is proposed to have a milk supply for the depot as pure as possible. The herd will be examined as to general healthiness and freedom from tuberculosis. Bacterial multiplication will be reduced to a minimum by refrigeration of the milk immediately after milking to 40°F. Some recent experiments in Leeds would seem to show that the problem of securing a reasonably pure milk supply is not insuperable; and it is hoped to do away with the necessity for sterilisation altogether. All the micro-organisms found in milk are not necessarily all pathogenic; nor do they all elaborate poisonous ptomaines.

(1) Brit. Med. Jour. Feb. 27th 1904.

(2) Annual Report Health of Brighton 1903. p.77.

The milk is supplied without any medical supervision.

The writer believes, however, that when everything is said against sterilisation that can be said, the fact remains that it is a great advance upon the present milk of commerce. Moreover, the danger of zymotic enteritis during the warm months of the year so overshadows the danger of scurvy, that sterilisation then stands justified. Hueppe (1), criticising some observations of Behring on the changes which cow's milk undergoes in the process of sterilisation, remarks that the preservation of the active proteids of the milk of cows is practically not so important as Behring believes. "The milk of cows", he continues, "is for children in every case a heterogeneous nutrition", with and without active proteids. A child is not a calf, and its natural nutrition is human milk. If we must in place of this use a substitute, we must certainly guard against infection and poison, and this can only be done cheaply through sterilisation by heat".

The pasteurisation proposed by Blyth (by which the writer takes him to mean heating to 150°F. for fifteen minutes) might be practised on other occasions. The occasional administration of fruit juices would also diminish the risk of scurvy.

3. The milk may not be sterile.

Robertson and Mair (2) have recently made some important observations on the so-called "sterilised milk" supplied from an Infants Milk Depot by the Leith Corporation. They found that only 15 per cent. of the bottles examined failed to yield some growth of bacteria. This only emphasises the necessity of care in the process of sterilisation, if it is necessary to sterilise at all. It is a well known laboratory fact that for the perfect sterilisation of such a fluid as milk, heating on three successive days is necessary. But such an academic ideal of sterilisation cannot be applied in the milk depot. Moreover the milk used by the depot should be fresh, and it is not intended to be consumed two or three days after sterilisation.

(1) Hueppe: Jour. State Med., Vol. Xll., No. 10., p. 593.

(2) Brit. Med. Jour. May. 14. 1904.

4. The milk is supplied without due medical supervision.

Carpenter (1) has criticised the municipal supply of milk for infant feeding as at present conducted in this country. He points out that even healthy infants have digestive peculiarities, and that to supply stock milk mixtures, according to the age or size of the infant, is not the correct solution of the dietetic problem. He believes that municipalities are no more qualified to preside over infantile dietetics and infantile bowel complaints, which cannot be dissociated, than are the proprietary food vendors.

To this it may be replied that the milk depot is not regarded as a final solution of the problem of infantile dietetics. The primary object of the municipal milk depot is to reduce infantile mortality. Whatever may be said of the milk depot stock mixtures, they are at least a marked advance upon the happy-go-lucky modifications which obtain in the homes of the poor. If the milk depot does no more than impress upon the minds of the people that some thought and care is necessary in the modification of milk, it will not have existed in vain. The refinements of the milk laboratory, and the percentage feeding advocated by Rotch, are all very well for the wealthy, and as an instrument of dietetic therapeutics; but these means fail to touch the class which has most need of help. If anything of the sort becomes general in England, it must be looked for at the hands of the philanthropist. There is no doubt scope for the milk laboratory, which might be a kind of extern Infants Hospital, where milk could be prescribed and dispensed. This is the kind of organisation which exists in the "Goutte de lait," and the "consultation de nourrissons," on the Continent; the latter being in connection with maternity hospitals. It is from the "Goutte de lait" indeed, that the English milk depot has sprung. But the writer believes, from his own observations that the vast majority of poor children - and, after all, these are the ones a

(1) Brit. Jour. Children. Dis. April 1904.

municipality has most concern with - do not require the niceties Carpenter would suggest.

To compare the efforts of a municipality to reduce infantile mortality by providing a reasonably suitably modified milk, as on a par with the frank commercialism of the proprietary food vendors is manifestly absurd.

On the whole, therefore, it may be reasonably concluded that, for the present at least, the milk depot has a distinct place among the municipal measures which may be taken for the prevention of infantile mortality. It has not to be looked upon as by any means a final solution of the problem of infant feeding, and improvements will no doubt be evolved in the near future. These are foreshadowed by the following recommendation of the Inter Departmental Committee on Physical Deterioration (1). "It is of great importance that the milk supply should pass through as few hands as possible, and that milk vendors should not be general dealers whose sale of milk is confined to a few quarts. In order to effect these objects, milk depots should be formed in every town obtaining their supply direct from the farms. The Committee believe this could be done without recourse to direct municipal action, but they think that in all Improvement Bills promoted by Local Authorities, the insertion of provisions dealing with the milk supply within their area should be insisted on".

4. Municipal Crèches.

It has already been shown that under urban conditions of life a vast number of mothers are engaged in employment, which necessitates their absence from home for many hours at a time. What provision should be made for the care of those infants whose mothers are thus obliged to work, is a very serious and difficult problem in connection with the prevention of infantile mortality. Until some adequate provision is made in this respect, in such towns as Blackburn, Burnley, Preston, and

(1) Report. Inter Departmental Committee on Physical Deterioration. p.89.

other places where many married women are employed, a high figure for infantile mortality has to be looked for. The Crèche as constituted on the continent is not looked upon with favour in England, and yet it would appear the only solution short of restricting female labour. So far as the writer is aware, there is not a municipal crèche in this country, although quite a number of what are known as Day Nurseries are in existence. There are several of these in London, two in Birmingham, and one each in Bradford, Bristol, and Salford. These are, for the most part, charitable institutions. Moreover they have little remedial effect upon infantile mortality because they are mostly used for older children, and are in no wise used as educational agencies. The working mother with an infant prefers, as a rule, to leave it in the care of an irresponsible old woman; or in that of an elder child. If some well organised municipal undertaking with the special object of having care of infants, could be evolved, this condition of affairs would be altered. Hunt, who had made great efforts to induce the urban district of Acton, in which district a large number of married women are engaged in laundries, to establish a Municipal Crèche, has attempted to justify such a step, and the writer agrees with him. "It has been proved over and over again" writes Mr Hunt (1) "what are the causes of a high infantile mortality, and if these be removed, as they would be in the Crèche, the inevitable result is a decrease in the death rate. Municipalities must remember that until 25 years ago we had a fear of overpopulation and no fear of depopulation. But with the continuous decline in the birth rate at home, and of the English or British abroad, the people must begin to appreciate that the danger is not over-production of children, but under-production, and they will be willing to give infant life the protection it needs".

The case for the crèche, where many women are employed, seems to be strong enough. That it might be made an educational

(1) Letter to the writer. March 05.

means is apparent from the following recommendation of the Inter-Departmental Committee on Physical Degeneration (1):-

"Whenever it was thought desirable, owing to the employment of married women in factories or for other reasons, to establish municipal crèches, girls over fourteen might be made to attend occasionally, and the teaching of infant management to such girls should be eligible for aid from the grant for public education".

Used in this ^{manner} (matter), the crèche would appear to be one of the most hopeful means of removing the large mass of ignorance which prevails on infant dietetics and hygiene, and on which so much of infantile mortality depends.

5. Teaching of Girls in School and in Evening Continuation Classes.

This the writer regards as the most hopeful means of all of permanently reducing infantile mortality. It has been repeatedly insisted upon in this paper that on education and on the formation of a healthy conscience the crux of this problem must hang. And he believes that both of these things are possible and practicable if gone about in the right way. The effect will not be immediately evident, but has rather to be looked for in the future. "Cast thy bread upon the waters; for thou shalt find it after many days". As the twig is bent, so will the branch incline.

Both boys and girls alike, should be given at school plain instruction in the elements of physiology, personal and domestic hygiene, and in the evils of intemperance. They must be taught that the preservation of health is largely a personal matter; and ^{that it} is a duty to one's self, and to the community. The writer believes that in Scotland, school instruction in this respect compares favourably with England.

Herbert Spencer long ago might have been writing on this aspect of the prevention of infantile mortality when he

(1) Report Inter Departmental Committee on Physical Deterioration p.91.

Yet these girls, he says, are the mothers of the next generation, penned the following words. (1) "That parents should begin the and nothing which they learn at school or at the factory, thereby difficult task of rearing children without ever having given a so valuable to them and so necessary to the nation, as the knowledge of the principles - physical, moral, or intellectual - which ought to guide them, excites neither surprise at the actors nor pity for their victims". And again, "knowledge which subserves direct self preservation by preventing loss of health is of elements of a rational education. Physical Education is of primary importance. We do not contend that possession of such filed to by quite a number of people. It is clear that in our present phase of civilisation men's necessities often Physical Education is compulsory as the subject of instruction in these days of transgression. And it is further clear that, even compulsory as the subject in the absence of such compulsion, their inclinations would frequently lead them, spite of their convictions, to sacrifice future good to present gratification. But we do ~~not~~ contend that the under proper conditions, are trained, and that it is possible to make an essential part of a rational education. such knowledge must precede a more rational living - come when that may. We infer that a vigorous health and its accompanying of every subject of high spirits are larger elements of happiness than any other regard to the things whatever, the teaching how to maintain them is a teaching forming a part of that which yields in moment to no other whatever. And therefore we is imperative that such a course of physiology as is needful for the both in general and in detail than the comprehension of its general truths, and their bearings on daily Dr Niven of Manchester has outlined a course of instruction for girls, with which the writer is in agreement. tion for girls, with which the writer is in agreement. It is as follows:

That there is urgent need for special additional instruction in the case of girls in England the writer is convinced. He has often been painfully struck with the utter ignorance of the ordinary girl of 14 or 15 years of age, on anything and everything pertaining to the laws of health, and of the values of foods, not to speak of the care and nurture of infants. Dr Niven of Manchester, than whom few men have better means of judging, is of opinion that there is little doubt that the girl of to-day knows much less on the average about domestic economy and the management of children than did the average girl 50 years ago.

(1) Spencer: "Education: Intellectual, Moral, & Physical."

(2) Niven: Report on the Health of Manchester 1903. p.26.

Yet these girls, he says, are the mothers of the next generation, and nothing which they learn at school or at the factory is nearly so valuable to them and so necessary for the lives dependent on them, as the housewife knowledge which has become disused.

The advantages to be derived from a systematic teaching of girls in schools and in evening continuation classes, the elements of cookery, hygiene, and domestic economy, were testified to by quite a number of witnesses before the Committee on Physical Deterioration. The Committee (1) recommend that "instruction in these matters should, as far as possible, be made compulsory on the elder girls at school, and care should be taken that it is placed in the hands of properly qualified teachers, to which end it is expedient that some State aid should be given under proper conditions to Schools of cookery at which teachers are trained, and that hygiene in its various branches should be made an essential element in the course of training for all teachers."

The writer further believes that it should be the duty of every Education Authority in the country to have primary regard to the fact that the girls whose minds and habits they are forming are the future mothers of the race. In order to do so, it is imperative that more attention should be given to this subject, both in general and in detail, than has been the case in the past.

Dr Niven (2) has outlined a commonsense scheme of instruction for girls, with which the writer is in entire agreement.

It is as follows:-

- (1) Cooking.
- (2) Sewing, mending and washing.
- (3) How a house should be cleaned, and in what cleanliness essentially consists.
- (4) Practical instruction in the requisites of feeding, clothing, and tending infants; in the food and clothing of children.
- (5) Instruction in food values, and the economic arrangement of diets.

(1) Report. Inter. Depart. Comm. Physical Deterioration p.90.

(2) Niven. Op. Cit.

(6) On the way to keep foods.

Dr Niven writes, "I would express the opinion that the education now advocated is vital to the welfare of men, women, and children".

This special course should be concentrated in the last six or twelve months of school life, or by compulsory continuation classes for girls beyond school age. It is very essential that such instruction should be given by capable teachers; made interesting; and, as far as possible, free from school tedium. It should be of the nature of demonstration and drill, rather than mere class work.

The machinery whereby the practical instruction in the requisites of feeding, clothing, and tending infants, could best be accomplished, ought not to be beyond the ability of the combined action of the Education and Health Authorities. The co-operation of the lady health visitor, for example, would find a natural place. The establishment of municipal crèches would simplify matters by providing real live material for actual demonstration and practice; or where day nurseries already exist, it ought to be possible to use these for this purpose. In any case, such a scheme of instruction can alone supply what is wanted; and to the writer's mind the need is sufficiently urgent to justify whatever innovations might be necessary in practice. This is not urged merely as a counsel of perfection, but in the firm conviction that it is practical; that it is the best form of *ped*iculture as applied to England; and that this way lies the surest solution of the problem of infantile mortality.

Thomas D'aine.

27 September 1905.

Chart 1.
Comparison of Birth Rate and Infantile Mortality
A P P E N D I X.

- (1) Chart 1. Showing Birth Rate and Infantile Mortality in England and Wales, 1854 - 1903.
 - (2) Chart II Showing General Death Rate, Child Mortality and Infantile Mortality in England and Wales, 1854 - 1903.
 - (3) Chart III Showing the influence of Rainfall upon Infantile Mortality, 1854 - 1903.
 - (4) Chart IV Showing the influence of Temperature upon Infantile Mortality, 1854 - 1903.
 - (5) Chart V Showing the influence of Rainfall and Temperature upon the Infantile Death Rate from Diarrhoeal Diseases, 1894 - 1903.
 - (6) Leaflets recommended by the Inter-Departmental Committee on Physical Deterioration:-
 - (a) Advice on the feeding and rearing of infants.
 - (b) How to rear a Healthy Baby.
 - (7) Leaflet issued by the Corporation of Brighton:

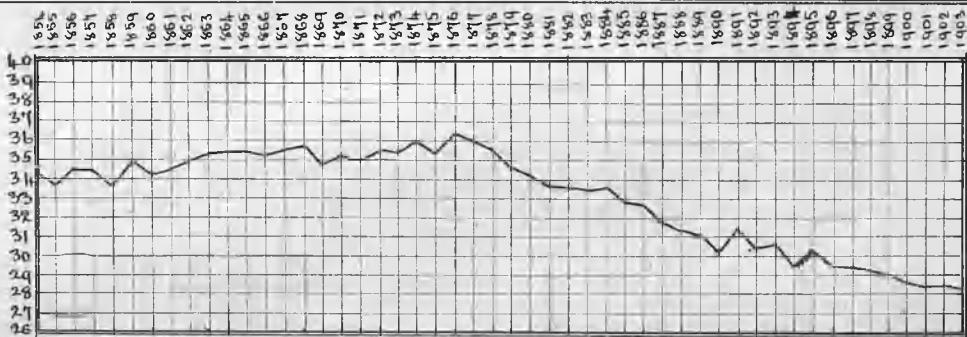
How to prevent diarrhoea.
 - (8) Regulations which control the sale of milk in the Liverpool Municipal Milk Depots.
 - (9) Sterilized Milk Enquiries (Liverpool),
-

Chart 1.

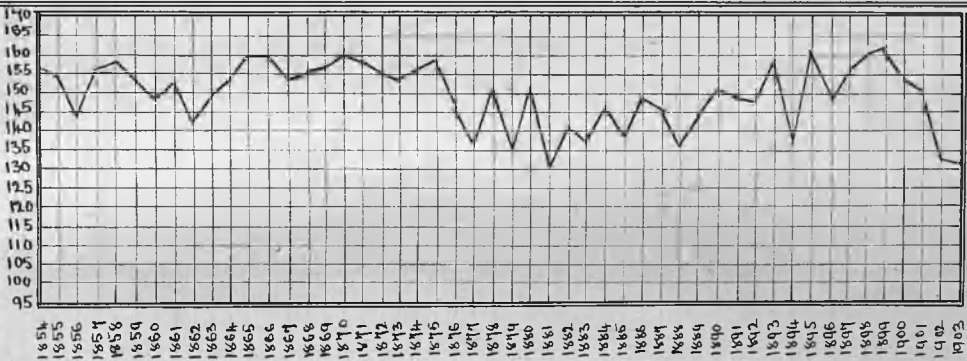
— Comparison of Birth Rate and Infantile Mortality. —

— England and Wales —

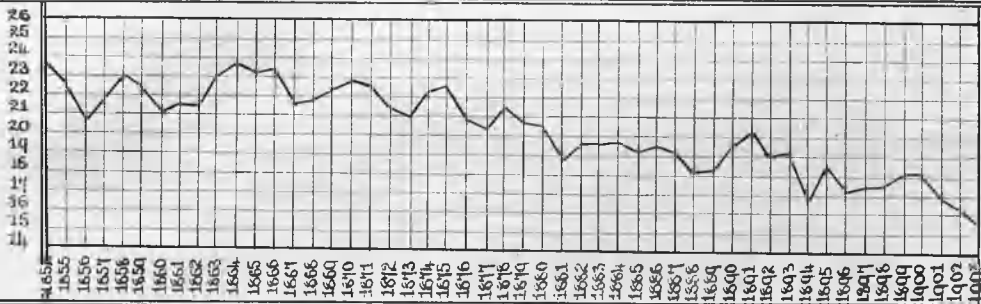
— Birth Rate. —



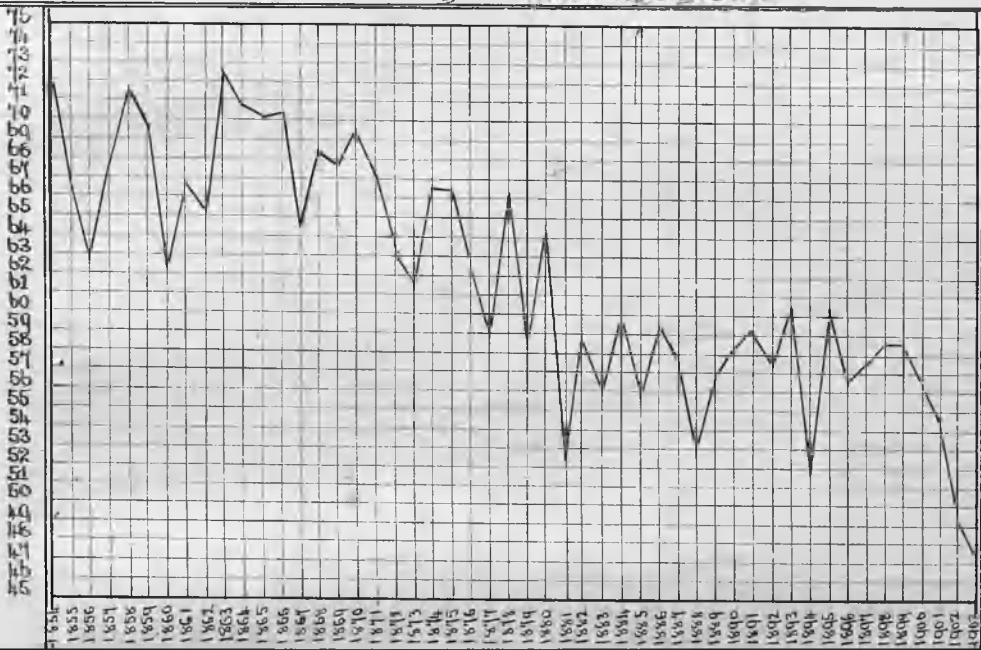
— Infantile Mortality. —



— Death Rate. —
— Per 1000 living at all ages —



— Child Mortality. —
— Deaths of children under 5 years of age —
— Per 1000 living at that age group. —



— Infantile Mortality. —
— Deaths of infants under one year per 1000 births —

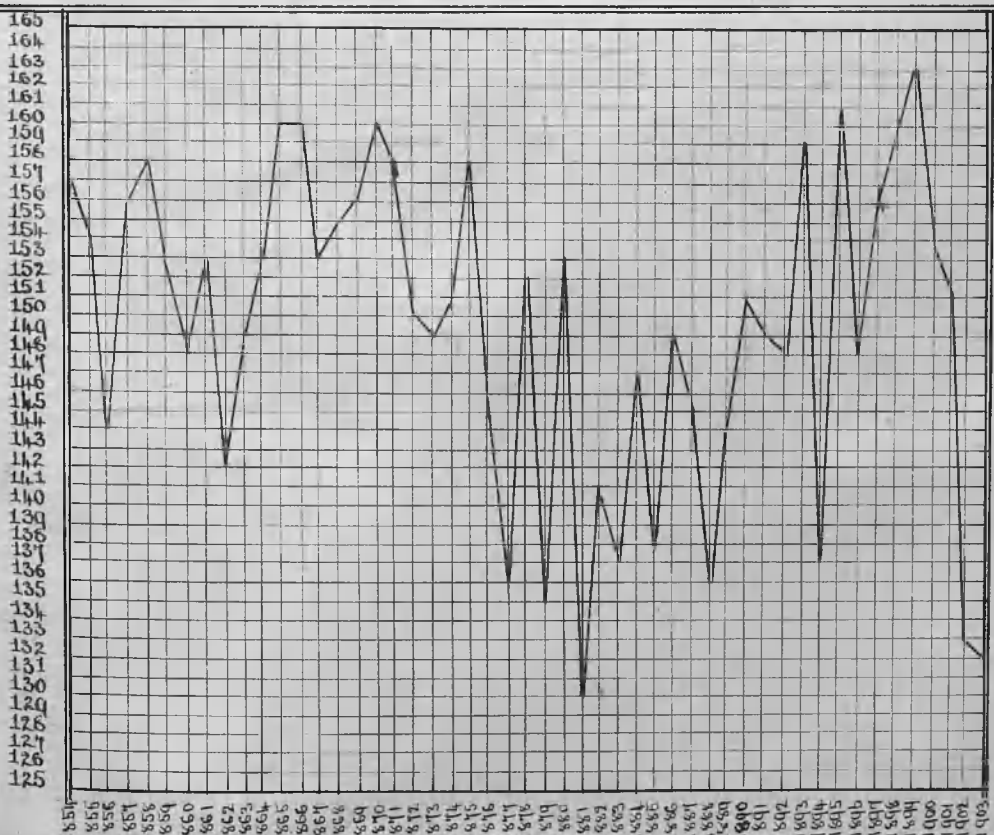
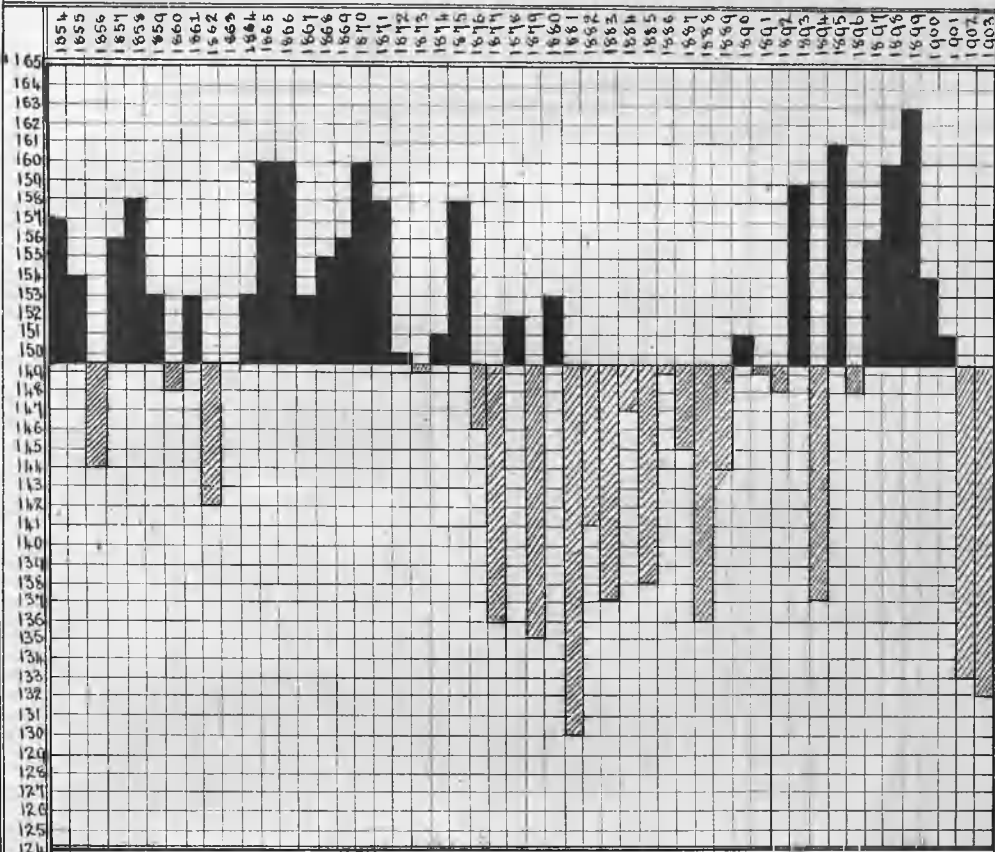
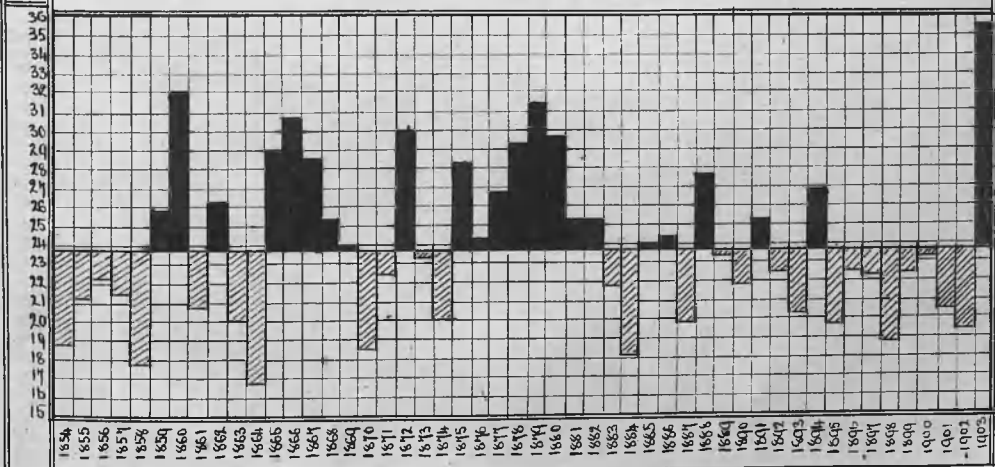


Chart III.

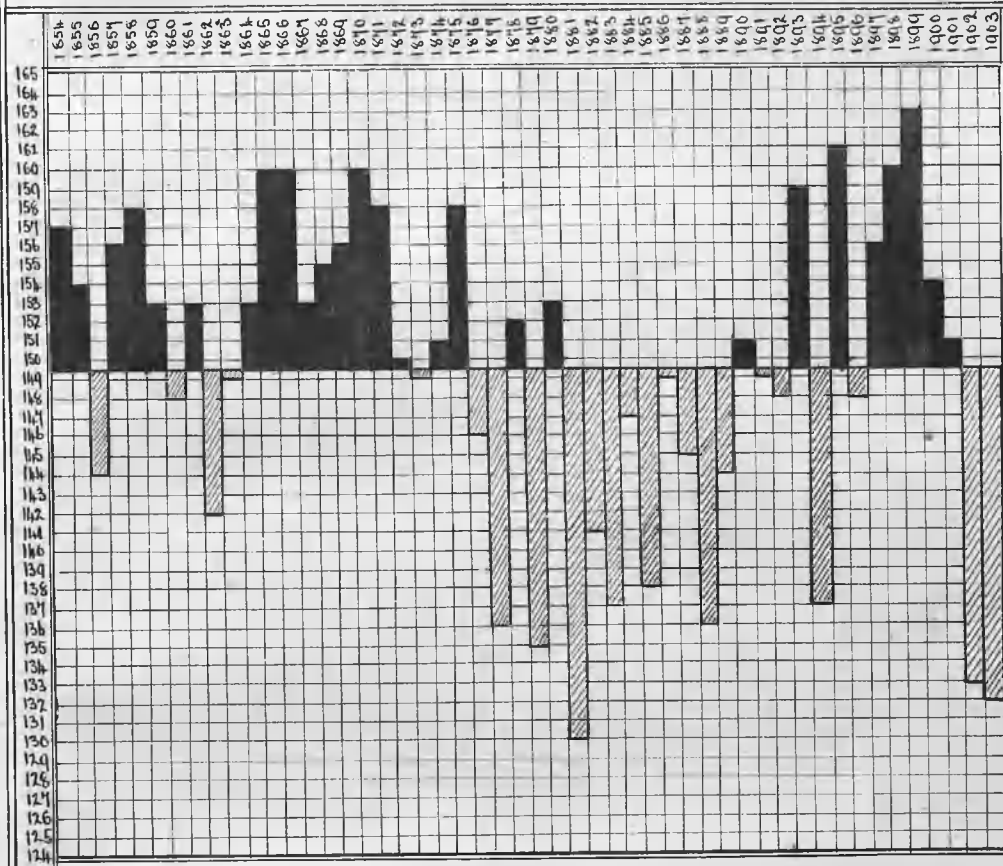
— Infantile Mortality. —



— Rainfall. —
— Total annual fall in inches. —

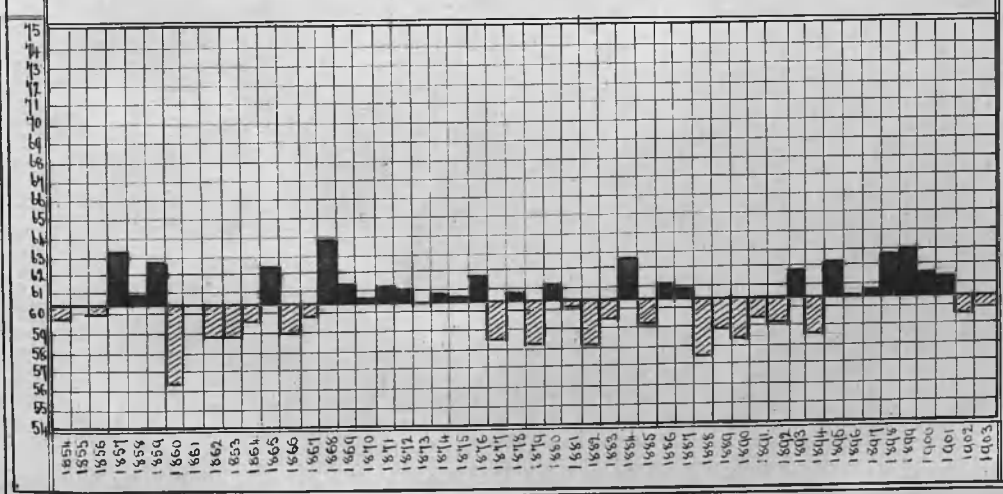


— Infantile Mortality. —



mean time = 1874.

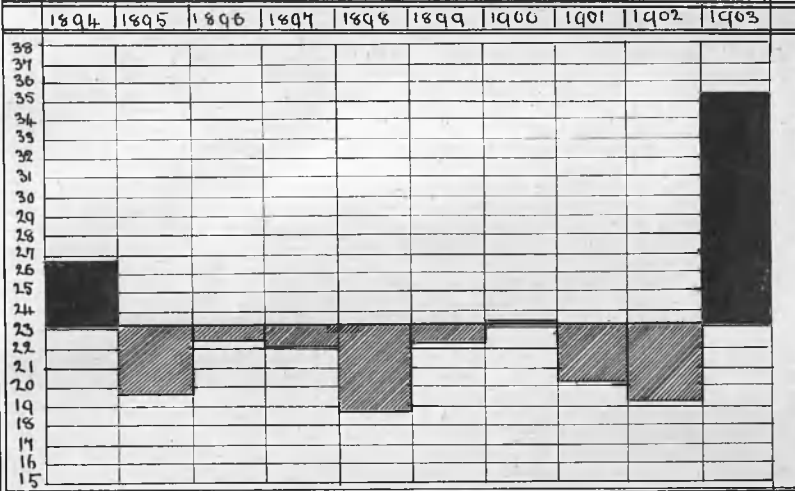
— Mean Temperature of the Air. —
 — 3rd quarter of each year. —



mean time = 60.4° F.

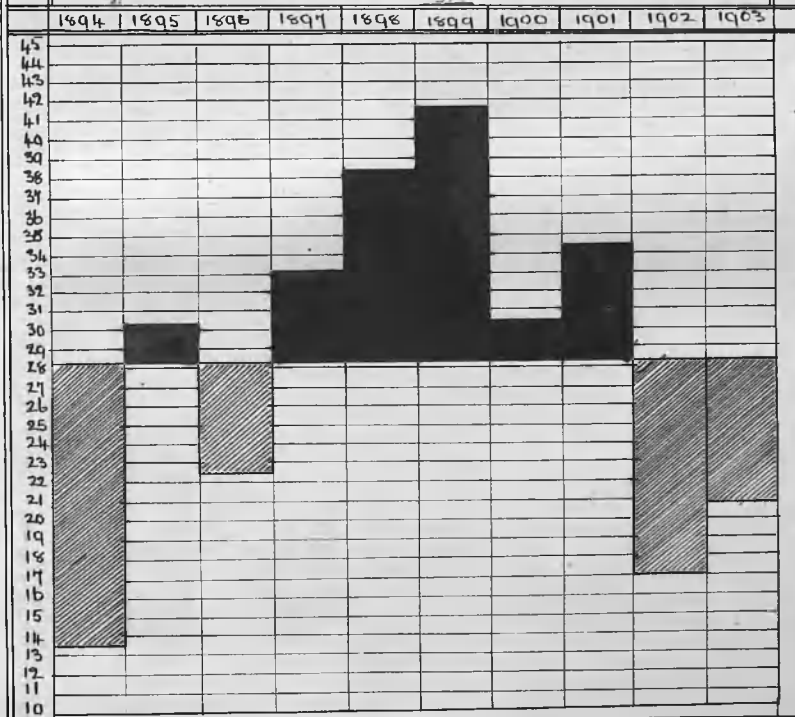
Chart v.

— Rainfall. —



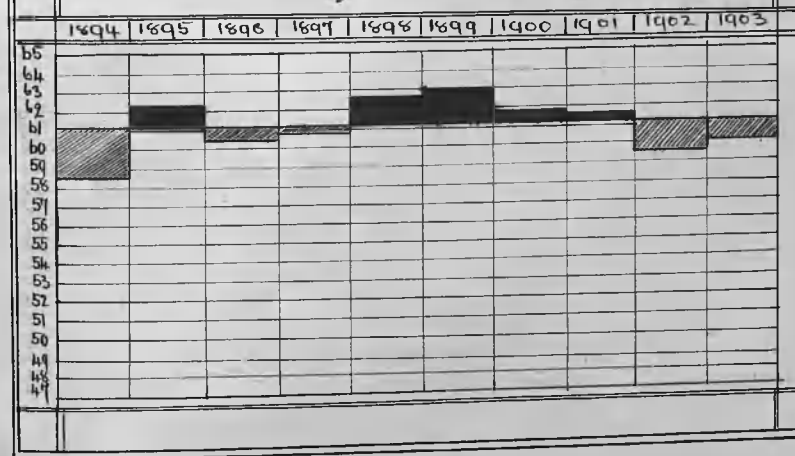
Mean line = 23.1 in.

— Diarrhoea. —



Mean line = 28.3 deaths per 1000 births.

— Temperature. —



Mean line = 61.1° F.

Leaflets recommended by Inter-Departmental Committee on Physical Deterioration.

(From the Appendix to the Report of the Committee)

(a) Leaflet issued by the Health Department of Sheffield.

"Advice on the feeding and rearing of Infants"

Issued by the Health Department, and intended to be followed in all cases except where a Doctor is in attendance and gives special instruction.

1. Infants should have no food but Milk for the first six or seven months of their life.
2. They should, if possible, be fed at the breast, because breast-fed infants are much healthier than bottle-fed infants. They should have the breast every two hours during the day, and every four hours during the night for about ten minutes, and as they grow older, less frequently. Irregular feeding upsets the infant's digestion. The infant must ^{not} be allowed to go to sleep at the breast. In order that her milk may be wholesome, the mother should lead a healthy life, eat only plain and wholesome food, and not take intoxicating drinks, such as spirits and beer. If her nipples are sore, she should wash them with warm water before and after the child is fed and apply glycerine to them.
3. If from want of milk or other absolutely unavoidable cause the mother cannot suckle her infant, it will be necessary to feed it on fresh cow's milk. For a newly born infant the cow's milk should be mixed with an equal quantity of water, and should be sweetened and boiled before use. If the milk curdles on the child's stomach, barley water may be used in its preparation instead of plain water, or one or two tablespoonfuls of lime-water may be added to each pint of milk and water. As the infant gets older, the amount of water should be lessened, until at the end of six months about one and a half pints of pure milk without

any water are given. Infants are often starved by being given too much water with their milk. The newly-born infant should be fed every two hours during the day, and every four hours during the night. As the infant grows older its meals should be less frequent. Irregular feeding upsets the infant's digestion.

Bottles should not have long tubes, because it is impossible to clean a long tube. The best kind of bottle has a rubber teat, which can be turned inside out and properly cleaned. Only sufficient milk for one meal should be put in the bottle at a time, and both bottle and teat should be thoroughly cleaned with water and soda after each time of using, and boiled once a day. If any old milk is left in the bottle or its fittings it will sour the next meal, and give the infant diarrhoea or a disordered stomach.

4. Diet from six months to twelve months old.

First meal, 7.a.m. A suitable quantity of some infant food, such as Mellin's, Ridge's, Frame, Benger's, Neave's, etc. prepared accordingly to the directions, with twelve tablespoonfuls of milk.

Second meal, 11.a.m. Twelve tablespoonfuls of pure milk which has been brought to the boil.

Third meal., 1.30.p.m. Same as first.

Fourth meal, 5.30.p.m. Same as second.

Fifth meal, 10.p.m. Same as first.

Diet from Twelve to eighteen months old.

First meal, 7.a.m. Bread boiled in milk, or oatmeal porridge, with plenty of milk.

Second meal. 11.a.m. Twelve tablespoonfuls of milk.

Third meal. 1.30.p.m. Bread crumbs and gravy, or a lightly-boiled egg and bread and butter, or a milk pudding.

Fourth meal., 5.30.p.m. Bread and milk.

Fifth meal. Milk to drink.

5. Infants should on no account be given all sorts of things to suck, such as carrots, turnips, raw potatoes or unripe fruit, neither should they be given bits from their mother's or father's

plate to get them used to it.

6. Infants should be given a warm bath every day, and soap should be used to every part of the body, including the head. The whole of the body should be carefully and thoroughly dried, and dusted with fuller's earth or boracic powder, especially the folds of the skin. Infants should not be allowed to lie in wet or soiled napkins; the part covered by the napkin should be bathed and powdered each time the napkin is changed.

7. Flannel and wool are the best materials for a baby's clothes. They should be warmly clothed, but not with many clothes. Their clothing should not fit tightly about the body, but loosely, so as to give free play to the lungs. The limbs should be covered equally with the body.

8. Infants should not be placed on the floor, as they are thus exposed to draughts and infectious dirt.

9. Great care should be taken of the infant's eyes. Bathing the eyes with warm water containing a little boracic powder will prevent them becoming sore.

10. Mothers are strongly warned against giving their children teething powders or soothing medicines to send them to sleep.

11. When an infant continues to suffer from indigestion or diarrhoea, in spite of every care in feeding, the mother should consult a doctor, who will advise her how to act. It is a good plan to have an infant weighed from time to time. A thriving infant should gain weight steadily.

12. The air of the room occupied by the infant should be kept fresh by opening the window. The bedroom window should always be left open all night. Night air is not harmful either for infants or children, or grown-up people.

13 It cannot be too strongly impressed upon mothers that young infants can be much more easily protected from disease by careful feeding and management than they can be cured when disease

actually occurs. An enormous number of children die every year in Sheffield from diarrhoea, more especially in the months of August and September, and it is quite certain that if they were fed and reared according to the directions given above, and were not given sour milk and other quite unsuitable food, and at the same time, they, their clothes and their homes were kept clean, the majority of these infants would not die.

(b) Leaflet issued by the Wakefield and District Sanitary Aid Society

"How to rear a Healthy Baby"

Food. If the mother's milk is good and plentiful, the child should have no other food whatever until seven months old. If the mother has not enough milk, cow's milk should be given in addition to it, but not in place of it: the two milks will not disagree. While suckling, the mother should take plain and wholesome food: stimulants are not necessary, and spirits are distinctly harmful.

Times of feeding. For the first month the baby should be fed regularly every two hours by day and every four hours by night. In the second month, feed every two and a half hours by day: in the third month, every three hours by day and twice during the night. Gradually increase the interval between the feeds, so that at seven months old the child is fed once every four hours by day and once in the night, if awake.

On no account must a baby be put to the breast every time it cries: it may be crying for some other reason than hunger. Look at the clock, and, if it is not feeding time, do not feed it: a teaspoonful or two of clean cold water will often comfort it. Fretfulness, stomach-ache and sickness are caused if an infant is fed irregularly or too frequently.

Bottle feeding. If there is not enough mother's milk, the diet must be supplemented by fresh unskimmed cow's milk. A bottle prepared as follows should then take the place of one or more feeds at the breast.

All milk used for children should be well scalded by placing in a clean jar and keeping on the fire in a saucepan of boiling water for twenty minutes. Do this as soon as the milk comes to the house. Then put the jar in a cool place, and keep it covered.

The following are the proper amounts for each feed:-

For an infant a week old use one tablespoonful of this milk, two tablespoonfuls of water or barley water, and a small lump of sugar.

Gradually increase the quantities, so that by the fourth week each feed consists of two tablespoonfuls of milk to three or three and a half of water, with a lump of sugar. By the third month use three tablespoonfuls of milk and three of water. From three to six months old the child should have eight to twelve tablespoonfuls in each bottle, of which not more than two or three are water. From eight months onwards the child should be able to digest pure milk, scalded and sweetened, and should have one and a half pints a day.

If the infant is having no mother's milk, the cow's milk should be enriched, if possible, by adding a teaspoonful of fresh dairy cream to the milk for each bottle before scalding. Do not use the cream sold in jars, as it may have chemicals added to make it keep, which would be hurtful to a baby.

When the right quantity of milk, water, cream, and sugar has been mixed, the food should be warmed and placed in a perfectly clean bottle. Use an old fashioned "boat bottle" with a teat that can be turned inside out for cleaning. Tube bottles are dangerous. Directly after each food cleanse the bottle and teat thoroughly, and place them in clean cold water till wanted again.

If a child does not take all the food, what is left should not be kept. Never give milk that is not quite fresh to any child.

Weaning. As a rule a child should be gradually weaned at the eighth month. Suckling beyond this time is most injurious to mother and child, and it is untrue that the mother will not become pregnant while she is suckling. Take care that the baby has plenty of cow's milk after weaning; a healthy weaned child of nine months old needs at least one and a half pints of good scalded milk a day.

By the time the child has 4 teeth, it may have its milk thickened with baked flour, rusks, toasted bread, or the prepared infant's food. On no account give any sort of bread food before the teeth are through, as the infant cannot digest it, and convulsions may be caused. Watch over the child's feeding carefully. Do not give it "just what we have ourselves". Do not let the other children give it "little bits."

When a child is 10 months old, it may have milk pudding, bread and milk, porridge, egg, or a little broth, but still give it plenty of milk. Train it to regular meal times, and to eat and drink slowly.

Never give the baby tea or coffee. Children would be much sturdier if given warm milk instead of tea or coffee till four years old.

The following things are also harmful for little children: Beer, spirits, wine, new bread, currants, unripe fruit, soothing syrups, or teething powders. The use of the two last undermine the health of many children. No medicine should be given except by doctor's advice.

A baby's clothing should be clean and warm, but not tight about the body.

A baby should be washed all over every day with warm water and soap. Also, night and morning, fix a piece of clean rag firmly round the finger, dip into clean water, and thoroughly wash the gums and roof of the child's mouth. Burn the rag. You are strongly advised not to use a comforter. It is often the cause of thrush and other troubles.

A baby should be taken out whenever possible if the weather is fine. Babies need pure fresh air - indoors and outdoors- even

more than grown people: those who have the most of it will be the least liable to bronchitis, and will sleep the best. An infant should have a separate cot, and not stay in the mother's bed during the night.

A healthy baby should gain four to six ounces in weight every week. If it suffers from diarrhoea or indigestion, in spite of every care, take it to a doctor without delay.

During the summer a considerable number of infants die in England from Diarrhoea. Babies who are fed entirely from the breast rarely always escape. It is evident, therefore, that in the prevention of this very fatal summer disease, precautions as to food are most important.

Attention to the following points would save many infants' lives:-

1. Do not wear your infant during the hot months of July, August and September. To begin artificial feeding during hot weather is very dangerous. If the breast-milk is insufficient, it is better to give this alternately with cows' or condensed milk than the latter alone.

2. If feeding by hand is absolutely necessary, carefully follow these directions:-

A. - If cow's milk is employed.

(a) The milk should be boiled or killed when it comes into the house, and kept in the coolest place, protected from flies and dust.

(b) The infant's feet must be wrapped first each time.

(c) All cups or other vessels used for giving milk must be scalded out and kept absolutely clean. They should be covered, to prevent access of flies or dust.

(d) The feeding-bottle must be thoroughly washed after each meal. It is best to use alternately two pint-sized bottles washed after, and the nipples of these should be

The following is a copy of card issued by the Corporation of Brighton for the prevention of diarrhoea.

(From Dr Newsholme's report 1904)

HOW TO PREVENT DIARRHOEA

During each summer a considerable number of infants die in Brighton from Diarrhoea. Babies who are fed entirely from the breast nearly always escape. It is evident, therefore, that in the prevention of this very fatal summer disease, precautions as to food are most important.

Attention to the following points would save many infants' lives:-

1. Do not wean your infant during the hot months of July, August and September. To begin artificial feeding during hot weather is very dangerous. If the breast-milk is insufficient, it is better to give this alternately with cows' or condensed milk than the latter alone.

2. If feeding by hand is absolutely necessary, carefully follow these directions:-

A. - If Cows Milk is employed.

(a) The milk should be scalded or boiled when it comes into the house, and kept in the coolest place, protected from flies and dust.

(b) The infants' food must be prepared fresh each time.

(c) All jugs or other utensils used for storing milk must be scalded out and kept absolutely clean. They should be covered, to prevent access of flies or dust.

(d) The feeding bottle must be thoroughly washed after each meal. It is best to use alternately two boat-shaped bottles without tubes, and the nipples of these should be

form is dangerous to health, and for removing it wet cleaning is preferable to dry. Thus washing and scrubbing are dangerous. If the bottle smells sour, something is safer means of cleansing floors, etc., than sweeping. not clean, and the infant will suffer.

B. Report to the Sanitary Officer, Town Hall, any smells

or stated B.- If condensed Milk is employed. Flies appear

to be (a) Carefully read the label on the tin before purchasing, and never purchase machine-skimmed or separated milk.

The most suitable brands for babies are those certified to contain unsweetened unskimmed condensed milk.

(b) The tin should not be kept more than two days after being opened, and should be carefully protected from flies and dust.

(c) The condensed milk should be mixed with water in accordance with the directions on the can for infants; the necessary dilution varying with age from 1 in 20 to 1 in 8. Condensed milk is usually given too concentrated. Don't use sweetened condensed milk. Nearly half this consists of sugar, which means that either the baby has to take too much sugar or gets too little of the milk.

The feeding bottle must be cleansed in the same way, whether condensed or fresh milk is used.

3. Decomposing refuse, such as decaying vegetables, bones, fishheads, &c. is a fertile source of diarrhoea. It should be burnt, and not placed in the dustbin. Flies are bred in manure heaps and other decomposing refuse. They carry contaminating material about with them, and should not be allowed to have access to sugar or other foods. Fly-papers should be employed.

4. Scrupulous cleanliness of the house, especially of the rooms where food is stored, is most important. Dust in every

form is dangerous to health, and for removing it wet cleansing is preferable to dry. Thus washing and scrubbing are safer means of cleansing floors, &c., than sweeping.

5. Report to the Sanitary Office, Town Hall, any smells or choked closet or drain. If any excess of flies appears to be caused by a neighbouring manure heap, complain at the Town Hall.

1. The milk is supplied in baskets of nine, seven or six bottles, each bottle containing sufficient milk for one feed, according to the age of the child.
2. When all the milk in one bottle is not used, the remainder must not be warmed up again for the infant, but a fresh bottle opened for its next meal.
3. The person using the milk must guarantee to continue its use regularly during the needs of the child, and to send for it at the stated hours.
4. Should the milk not be agreeing with the child, the matter should be reported at once.
5. Every person using the milk will be supplied with two teats, which must be kept clean, and brought to the Depot for inspection at least once a week. Extra teats will be charged for at the rate of 3d each.
6. Just before using, each bottle should be placed submerged in a jug of plain or hot water, and warmed to the proper temperature. The bottle should then be cooled and the teat inserted. It is recommended that at first the infant should be fed every two hours during the day, and every four hours during the night, and after four months of age the intervals of feeding should be gradually lengthened.
7. After using, the bottle should be thoroughly rinsed in cold water.
8. If children are sent for the milk, they must be warned not

to tamper with the stoppers of the bottles.

9. All bottles, stoppers, washers and rubber rings not returned to the Depot, will be charged full value.

Regulations which control the sale of milk from
the Liverpool Municipal Milk Depots.

The following is the form adopted in making inquiries

1. The milk is supplied in baskets of nine, seven or six bottles, each bottle containing sufficient milk for one feed, according to the age of the child.
2. When all the milk in one bottle is not used, the remainder must not be warmed up again for the infant, but a fresh bottle opened for its next meal.
3. The person using the milk must guarantee to continue its use regularly during the needs of the child, and to send for it at the stated hours.
4. Should the milk not be agreeing with the child, the matter should be reported at once.
5. Every person using the milk will be supplied with two teats, which must be kept clean, and brought to the Depot for inspection at least once a week. Extra teats will be charged for at the rate of 3d each.
6. Just before using, each bottle should be placed unopened in a jug or basin of hot water, and warmed to the proper temperature. The bottle should then be opened and the teat inserted. It is recommended that at first the infant should be fed every two hours during the day, and every four hours during the night; and after four months of age the intervals of feeding should be gradually lengthened.
7. After using, the bottle should be thoroughly rinsed in cold water.
8. If children are sent for the milk, they must be warned not

to tamper with the stoppers of the bottles.

9. All bottles, stoppers, baskets and rubber rings not returned to the Depot, will be charged full value.

The following is the form adopted in making inquiries in cases in which infants using the milk have died:-

STERILIZED MILK ENQUIRIES.

1. Date of Death.....
2. Name.....
Address.....
3. Age.....
4. Cause of Death.....
5. Previous feeding and health.....
6. Date or age at which Sterilized Milk was first given, and where obtained:
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7. Length of time on Milk.....
8. Was it given regularly, or with any addition?.....
9. Did Milk suit the Child? If not, in what way did it disagree?.....
10. When was it discontinued?.....
11. Duration of fatal illness.....
12. Any complaints as to Milk.....
13. Condition of House, &c.....

Remarks:-

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