

FURTHER OBSERVATIONS ON THE RELATION
OF THE DECLINE IN THE NUMBER OF HORSE-
DRAWN VEHICLES TO THE FALL IN THE SUMMER
DIARRHOEA DEATH-RATE

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(With 1 Chart)

TEN years ago the writer (Graham-Smith, 1929) called attention to the relation of the decline in the number of horse-drawn vehicles, and consequently of the urban breeding grounds of flies, to the fall in the death-rate from summer diarrhoea in children under one year of age.

In that paper reasons were given for thinking that the fluctuations in the death-rate were not directly dependent on the rise of the air temperature in the third quarter of the year, and that the house-fly, *Musca domestica*, was an important, but not the sole vector, of the disease.

It was pointed out that "previous to the outbreak of the Great War in 1914 comparatively little attention was paid to the possibility of the dissemination of disease by the agency of flies, and great fluctuations in the diarrhoea death-rate occurred, usually associated with seasons either suitable or unsuitable for flies. Soon after the declaration of war large numbers of horses were requisitioned for army purposes, and various measures were adopted to limit the breeding of flies in camps. As the war progressed the potentiality of the fly as a vector of disease became widely recognized, and in the war zones extensive measures were taken against flies in all stages of their life history. The publicity given to these measures influenced the civil population to take a more active interest in the insect, and no doubt some of the recent diminution in the diarrhoea death-rate is due to more cleanly habits, including the protection of food from flies and attempts to eliminate their breeding places near dwellings."

It was suggested that "since the returns on which the death-rate is calculated undoubtedly include some deaths from diseases other than summer diarrhoea, and since other means of distribution exist, the eradication of flies would not be likely to reduce the rate to zero, but might bring it down to a very low level". Also the statement was made that "the next hot summer [after 1926] will undoubtedly cause a rise in the death-rate, but it is unlikely that it will again reach the high level of 1911".

Fortunately, the first prediction, that the eradication of flies would reduce

the death-rate to a low level, has been fulfilled, and the second, that hot summers would cause rises in the death-rate, has not.

The period, 1901–37, covers a time of great change in the methods of road transport, namely, from almost the beginning of the introduction of motor vehicles to the almost complete elimination of horse-drawn vehicles in towns. At the beginning of the period horse manure was accumulated and stored, often for weeks, in the neighbourhood of urban stables, and flies were regarded as inevitable nuisances; at the end the owners were compelled to remove all accumulations of horse manure and refuse within a few days, and flies were regarded as preventable dangers to health.

The present chart is based on the one published in 1929, to which have been added the departure of the mean air temperature in the third quarter of each year above and below the average for 50 years (1861–1910) from 1901 to 1937, the number of horse-drawn vehicles licensed in Great Britain during the last 10 years, and the diarrhoea death-rate for children under 1 year of age per 1000 live births in England and Wales from 1901 to 1905 and during the last 10 years.

The chart shows that in the first part of the period, 1901–22, very great fluctuation in the death-rate occurred, in most years the rises (1901, 1904, 1906, 1908, 1911, 1914, 1921) and falls (1902, 1903, 1907, 1909, 1910, 1912, 1916, 1918, 1919, 1920, 1922) corresponding to the rises and falls in the mean air temperatures of the third quarters. The 4 years in which the fluctuations in the two curves did not correspond were peculiar; in 1905 and 1917, though the mean air temperatures were high, the third quarters were very wet and therefore unsuitable for fly-breeding and fly-activity and the death-rates were low, while in 1908 and 1913, though the mean air temperatures were low, the third quarters were very dry and therefore suitable for fly-breeding and fly-activity and the death-rates were high.

During the first 5 years, 1901–5, the average death-rate was 25·4, in the second, 1906–10, it was 18, in the third, 1911–15, it was 19, mainly owing to the very high rate in 1911, and in the last, 1916–20, when public interest in the possibility of the conveyance of infection by flies had been aroused, it was 9·6, about one-third of the average death-rate in the first 5 years.

In the period 1906–22, the number of horse-drawn vehicles licensed in Great Britain fell by nearly one-half (411,334 to 237,342), probably resulting in accumulations of horse manure, suitable as breeding grounds for flies (*Musca domestica*), being reduced by more than one-half in urban areas. On the other hand, the number of motor vehicles licensed rose from 67,115 to 979,000. During these 17 years, if the very exceptional year 1911 be omitted, the decline in the death-rate corresponded to the decline in the number of horse-drawn vehicles.

For the period 1922–37 the chart presents a different appearance. Great

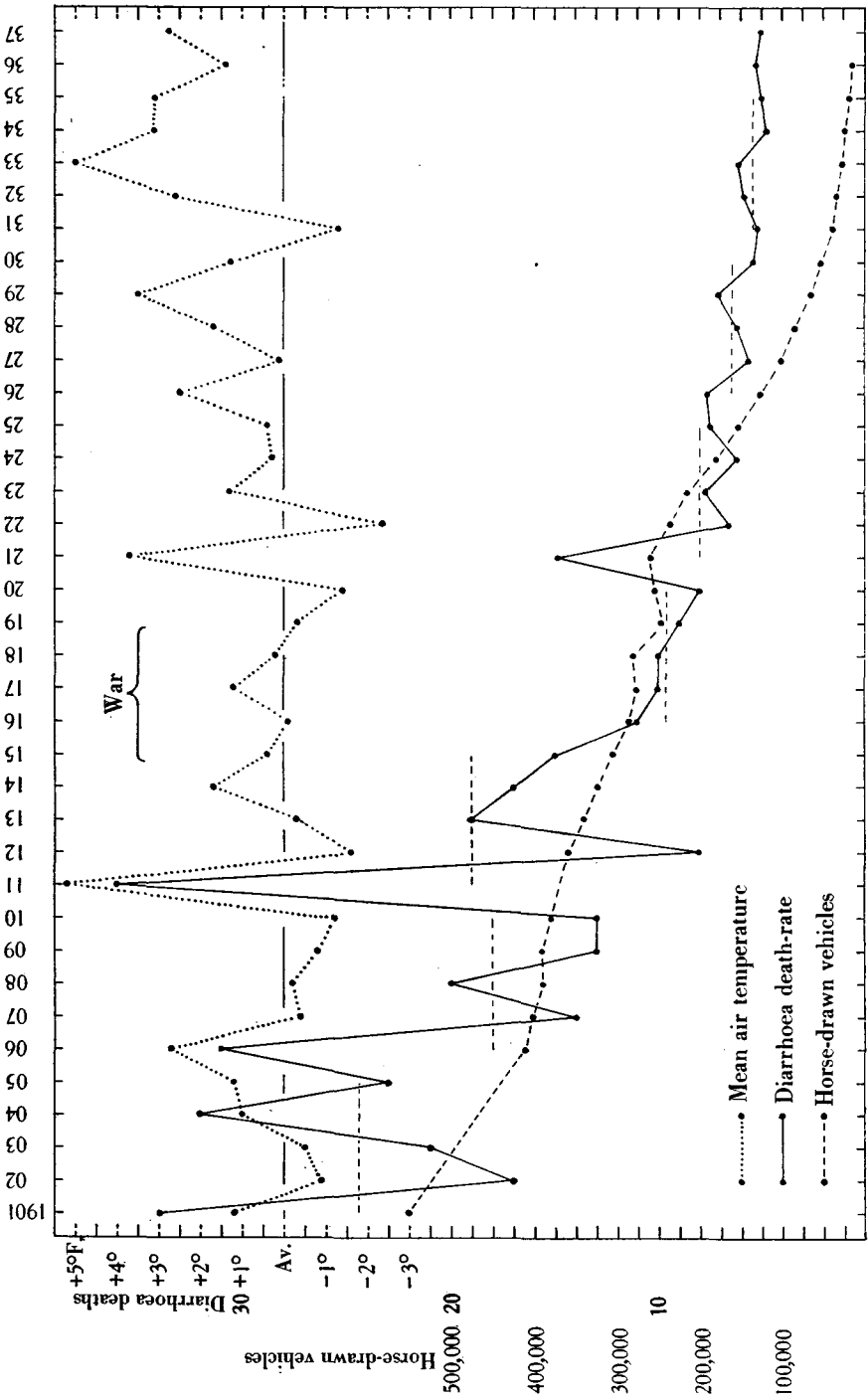


Chart 1

fluctuations occurred in the mean air temperatures of the third quarters; they were very low in 1922 and 1931, high in 1923, 1928, 1930 and 1936, and very high in 1926, 1929, 1932, 1933, 1934, 1935 and 1937. According to previous experience there should have been considerable epidemics in the 7 years last mentioned, but the fluctuations in the death-rate were slight, and no epidemics occurred. In fact, the average death-rate in the consecutive 5-year periods, 1921-5, 1926-30 and 1931-6 fell steadily, being 8.0, 6.45 and 5.43.

It is of interest to note that in the period 1901-22 the average of mean temperatures of the air in the third quarters was 0.4° above, whereas in the period 1923-37 it was 1.8° above the average of 50 years (1861-1910).

During the period 1922-36 the number of horse-drawn vehicles licensed fell from 237,342 to 14,195, the fall being much more rapid than that of the death-rate. The number of motor vehicles licensed increased from 979,000 to 2,706,555.

The chart suggests that owing to the lack of breeding facilities the urban fly population had reached such a low level by 1925 that, even in the consecutive very hot summers of 1932-5, it no longer had any serious influence on the dissemination of the disease. The chart also suggests that a high air temperature in the third quarter is not, as Mellanby (1916) thought, itself a cause of the disease.

CONCLUSIONS

During the last 37 years the summer diarrhoea death-rate in children under 1 year of age per 1000 live births in England and Wales has declined from an average of 25.4 in the first 5 years (1901-5) to an average of 5.3 in the last 5 years (1933-7).

In the first 21 years the death-rate showed great fluctuations, the rises usually occurring in hot summers, but during the last 16 years it has, in spite of many hot summers, shown only slight fluctuations, suggesting that a high air temperature in the third quarter of the year is not itself a cause of the disease.

Legend to Chart 1

Chart 1. Showing the mean air temperature in the third quarter of the year, the summer diarrhoea death-rate and the number of horse-drawn vehicles licensed in each year from 1901 to 1937. The dotted line shows the departure of the "mean temperature of the air" in the third quarter of each year above or below "the average of 50 years (1861-1910)", and the solid line the diarrhoea and enteritis deaths of children under 1 year per 1000 live births in England and Wales. Both these sets of figures are taken from the Reports of the Registrar-General. The broken line represents the total number of horse-drawn vehicles licensed every year in Great Britain from 1906 to 1936, as shown up to 1920 in the Reports of the Commissioners of Customs and Excise and from 1921 in the Reports on the Administration of the Road Fund. Comparable figures for the first 5 years do not seem to be available, but in 1901, 574,224 vehicles, horse-drawn and motor, were licensed, of which probably about 555,000 were horse-drawn. The thin horizontal line across the chart represents the average air temperature in the third quarter from 1861 to 1910, and the thin broken horizontal lines, crossing the death-rate line, the average death-rates for 5-year periods.

During the last 30 years the number of horses kept in the larger towns has decreased, probably to less than one-thirtieth, and regulations prohibiting the accumulation of horse manure and of refuse have been passed. In consequence of the almost complete eradication of places suitable for breeding, the fly (*Musca domestica*) population in towns has been greatly reduced, and during the last 16 years, although in at least seven of them the conditions have been very favourable for fly-activity, it seems to have had little influence on the spread of summer diarrhoea.

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