

## AN OUTBREAK OF FOOD POISONING DUE TO *SALMONELLA TYPHI-MURIUM* WITH OBSERVATIONS ON THE DURATION OF INFECTION

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(With 1 Figure in the Text)

### THE OUTBREAK

In a school with 250 pupils all under the age of 10, sixty-four suffered from diarrhoea and abdominal pain. The victims sickened on 5 and 6 February, but it was not until 12 February that the first cases (bacteriologically confirmed) were notified to the Health Authority. All the notified cases were between the ages of 6 and 9 years and attended the same school. Older children, who attended other schools, were not affected.

The only common article of food was school milk, and the school concerned was the only one to receive its supply from a farm which supplied only three households apart from the school. The milk (T.T. unpasteurized) was bottled at the farm. The farmer, his wife and two children were found to be excreting *Salmonella typhi-murium* in their faeces yet none of them gave a history of recent illness.

A sewer swab (Moore, 1948), taken from the drain of the byre in the farm, yielded a culture of *Salm. typhi-murium* of the same phage type as those isolated from the farmer's family and the pupils of the school. Samples of faeces from the cows were examined but found negative.

It appeared established beyond all reasonable doubt that the milk had been infected at the farm before it was bottled. It might have been infected by the farmer or from some other source of infection in the byre. The latter alternative would imply that the farmer and his family were infected from the milk.

Arrangements were made to collect specimens of faeces from the sixty-four children who had suffered from diarrhoea. The specimens were examined on 18 February (the school had been closed for a short vacation from 12 to 17 February) and fifty-six out of the sixty-four were found positive. Arrangements were made to collect specimens of faeces from the remaining 191 children who had no symptoms, and twenty-four were found positive. These specimens were examined on 24 February.

One schoolmistress out of a staff of ten was positive, and she was the only member of the staff who drank the suspected milk.

In the households of the affected children were twenty-eight secondary cases which were not included in the following analysis of the duration of infection.

## DURATION OF INFECTION

There are many articles describing the duration of infection in infectious diseases, and George, Harvey & Thomson (1953) have emphasized the importance, if errors are to be avoided, of assembling the population to be studied early in the illness. Cases diagnosed later cannot be admitted to the population without compensating adjustments, as each case diagnosed late represents more than one case that fell ill. This would appear to be particularly important in food poisoning by *Salm. typhimurium*, as the clearance rate is said to be between 40 and 50 % per week (Kwantes, 1952; Mosher, Wheeler, Chant & Hardy, 1941). It is equally important not to reject cases for which laboratory records may be incomplete. It often happens that many patients refuse to co-operate, and after a series of positive results are never shown negative by laboratory tests. These cases must be kept in the population for as long as they are known to be positive. To reject them for all the calculations has the effect of increasing the clearance rates. The errors that may arise by assembling the population slowly on the one hand, and jettisoning cases on the other hand, can be avoided if the clearance rates are calculated only on the cases known to be positive at the unit of time under consideration. If the clearance rates are calculated in this way, and the results finally expressed in the form of a declining population beginning with 100 % at week 1, the procedure is the same as that used to compile a life table.

The outbreak reported here, however, presented very favourable conditions for an analysis of the duration of infection for four reasons:

- (1) All those who had fallen ill were known.
- (2) The total population at risk was known.
- (3) It was possible to follow all those found positive and none were jettisoned from the survey.
- (4) Only a handful of the cases had been given chloramphenicol or any other chemotherapeutic drug.

The pupils who fell ill recovered quickly, and few had symptoms lasting more than a day or two. On 18 February, at the end of the 2nd week after the onset of illness, fifty-six out of the sixty-four who sickened were still excreting *Salm. typhimurium*. Thus, even although the eight found negative at this time had indeed suffered from salmonella food poisoning, it was already established that the clearance rate was much lower than that recorded by previous workers. It was decided to accept the eight found negative as cases which had cleared themselves of infection between 5 and 18 February. There was thus a population of sixty-four positive at the beginning of the 1st week after onset of illness of whom fifty-six remained positive at the end of the 2nd week. The population still positive at the beginning of the second week was not known precisely but lay between fifty-six and sixty-four.

Arrangements were made to collect samples of faeces twice a week from every child found positive until a series of negative results showed them to be free from infection. As these specimens were most faithfully collected the analyses were not complicated by adjustments necessary when there is an interval between the last

recorded positive and the first of a series of negatives. Of the sixty-four who fell ill the numbers remaining positive at successive periods of half a week were 64, (56-64), (56-64), 56, 55, 50, 35, 27, 20, 11, 8, 5, 3, 2, 2, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0.

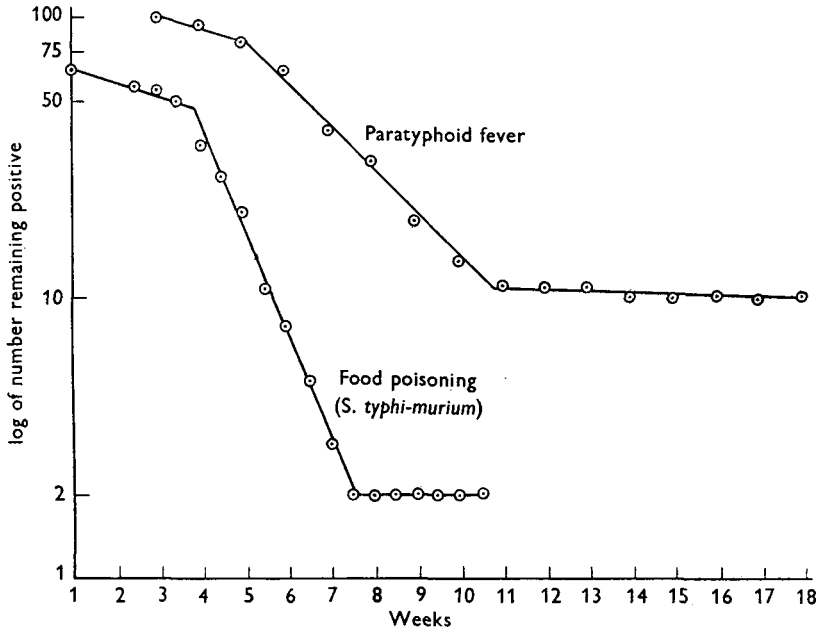


Fig. 1.

For 3 weeks the population of excretors fell slowly. It then declined rapidly and logarithmically until at the beginning of the 7th week only two remained. These two eventually became negative, one in the 10th week and the other in the 18th week. The result is shown graphically in Fig. 1, where the logarithms of the numbers remaining positive are plotted against time. The curve is of the same kind as that found by George *et al.* (1953) for paratyphoid fever, and the curve for the latter is reproduced in Fig. 1. The curve for paratyphoid fever is shown from the 3rd week only for reasons given in the original paper.

Although a curve with a very definite shape could be drawn through the plotted points it would be unwise in our opinion to draw too precise conclusions. We believe it is sufficient to conclude that the rate of clearance is low for a period; it then increases and is remarkably constant until there remain only the few patients who remain positive for a comparatively long time.

There were twenty-four children who had no symptoms yet were found positive on 24 February, i.e. at the end of the 3rd week after the onset of the outbreak. Specimens from these children were not collected regularly enough to justify an analysis at half-weekly intervals, but the numbers remaining positive at successive weeks were (beginning with a population of twenty-four at the end of the 3rd week) 24, 13, 5, 5, 2, 1, 1, 1, 1, 1, 0.

From the time the identified symptomless excretors were brought into the

population (end of 3rd week) they cleared at the same rate as did those who sickened. There was no initial lag in the clearance rate, but had the symptomless excreters been identified earlier there might have been. This, however, is conjecture, and it shows the errors which may arise when the decline of the population remaining positive is considered without regard to the time which has already elapsed between infection and identification.

#### CONCLUSIONS

1. Unpasteurized T.T. milk was the vehicle of infection of an outbreak of food-poisoning (*Salm. typhi-murium*) in a school.
2. The rate of clearance from infection was comparatively low for 3 weeks. Thereafter it greatly increased and was remarkably constant until there remained only two patients who excreted *Salm. typhi-murium* for a comparatively long time.

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The phage type of the strain of *Salm. typhi-murium* was determined by the Central Enteric Reference Laboratory of the Public Health Laboratory Service.

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