

PARATYPHOID FEVER AND *AERTRYCKE* ENTERITIS IN ABERDEEN—A CONTRAST.

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(With 4 Charts.)

IN the *Medical Research Council's Special Reports*, Nos. 91 and 92, and in the *Journal of Hygiene*, vol. XIV. No. 1, July, 1925, W. G. Savage and P. Bruce White stress the desirability of restricting the term "*B. paratyphosus* B" to the organism of paratyphoid fever and nothing else, and of designating the organism that most commonly causes food-poisoning outbreaks as *B. aertrycke*, and not as *B. paratyphosus* B (type *aertrycke*). In view of the fact that the features of a paratyphoid fever outbreak due to infected ice-cream, and of an *aertrycke* enteritis due to infected pork as occurring in Aberdeen in 1925 emphasise the distinction between paratyphoid fever and *aertrycke* enteritis, it has seemed well to record these two outbreaks in some detail for the purpose of contrasting them the one with the other and with the milk-borne Gaertner enteritis which is recorded in the preceding paper.

OUTBREAK OF PARATYPHOID FEVER DUE TO INFECTED ICE-CREAM.

An outbreak of paratyphoid fever due to *B. paratyphosus* B originated in the Woodside district of Aberdeen during the first week of August, 1925. Subsequent investigation revealed the fact that a total of 21 Aberdeen cases was associated with this outbreak. It was further ascertained that two girls from Glasgow, who had been on holiday in the Woodside district of Aberdeen from July 17th to 30th, had sickened of paratyphoid fever in Glasgow on August 2nd and 5th respectively, coincident with the appearance of the Aberdeen cases. In all, therefore, 23 cases connected with the Woodside district of the City had sickened on or about August 4th, and had apparently a common source of infection. Five were males, and 18 females, the cases being confined to 20 families. The ages of the sufferers varied from 5 to 75 years; 11 were in the 5-15 year age-period; 9, 15-25; 2, 25-45; and one above 65 years.

Symptoms. The onset in all the cases was characteristically insidious, marked by progressive lassitude and malaise which continued during the first week of illness. Headache was a prominent feature, slight at first, but increasing to great severity in some cases, mostly frontal, but also occipital in position. In the worst cases the pain was situated low down on the forehead and behind

the eyes, and one patient was unable to tolerate ordinary daylight. Giddiness was present in a few cases, and noises in the ears in others. Loss of appetite was an early symptom, with dry mouth and tongue, considerable thirst, and a feeling of nausea. Vomiting was not a common feature, and, when present, was slight. Pains were experienced in the back and legs, and occasionally in the arms. Quite a large proportion of the cases complained of chilliness and shivering. Abdominal discomfort or pains, with no constant localisation, were common to all—in the majority more or less continuous, and in a few spasmodic in nature. Pain in the region of the spleen, occurring towards the end of the first week of illness, was present in a few cases. If anything, constipation was the rule; some cases had mild diarrhoea, while in others there was no disturbance of the bowel. The urine was dark coloured and concentrated. Epistaxis occurred in three cases, and slight deafness, beginning about 4 days from the onset and lasting 3 to 4 days, in two cases. Progressive drowsiness was present in a few, one patient being admitted to hospital as a case of encephalitis lethargica. Nearly all complained of a mild degree of bronchitis lasting a few days. Pain in the throat was a prominent symptom in some of the cases, one patient being sent to hospital as a case of diphtheria. This was apart from another case admitted to the diphtheria ward, in which the diagnosis of diphtheria was confirmed bacteriologically, but which patient was also found, both clinically and serologically, to be suffering from infection with *B. paratyphosus* B. The condition of the patients when admitted to hospital varied from those in whom the disease was still advancing and who were really ill, to those in whom the symptoms had been slight and who were on the point of recovery.

The following may be taken as an example of the gravely ill type of case. The patient, a female, aged 26 years, was admitted on the ninth day of illness. The facial expression was heavy, somewhat anxious, with a slight flush on the cheeks. There was complaint of headache and thirst. The lips were dry and inclined to crack, the tongue thickly furred, brown down the centre merging into white at the edges and with a red triangular area at the tip, the apex of the triangle being directed backwards. The fauces were moderately congested. Slight cough was present, but nothing gross was found in the lungs. The skin was hot and dry. The abdomen was moderately distended. Rose spots were present in considerable number, not only on the abdomen but also on the chest and flanks. Some of them were surmounted by a minute vesicle. There was slight tenderness and gurgling in the right iliac fossa, and some tenderness under the right costal margin. A certain amount of muscular resistance to palpation was present on the whole of the right side of the abdomen, more so than on the left. The spleen was enlarged, and its edge clearly felt about one and a half inches below the ribs, and was slightly tender. Diarrhoea was very troublesome, the stools being of a light brown colour, not typically pea-soup in appearance. The abdominal reflexes were absent. The temperature on admission was 103° F., and was of the continuous type, never

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varying beyond the limits of 103 and 103·6° F. The pulse was full and rather soft, not dicrotic, and varied from 120 to 128. For a week after admission the temperature remained practically level at 103° F. The pulse became dicrotic, the heart enfeebled, but the bases of the lungs remained clear. The lips were dry and cracked, and the tongue dry and glazed. Slight epistaxis occurred once. The abdomen was not greatly distended but was somewhat tender, especially in the right iliac fossa. Diarrhoea continued and was frequent, and the patient became extremely exhausted and very miserable. She perspired freely, had a tendency to drowsiness, and had incontinence of faeces. There was no delirium. On the sixteenth day the temperature dropped to 102° F., and the pulse to 112 beats per minute. On the eighteenth day, the pulse increased to 120, and the patient had a moderate haemorrhage, followed by a drop of temperature to 98·4° F. Next day it rose to 103° F. and fell by lysis to normal in 6 days. This was the most severely ill of all the cases, and was the only one in which haemorrhage occurred.

The temperature in the other more severe cases was of the remittent type, with a swing of three or more degrees, the high temperature being mainly in the evening. Two typical Temperature Charts (I and II), one of which appertains to the gravely ill type case described, are appended (see p. 447). Charts I and II record the temperature of paratyphoid fever patients from the ninth day of illness onwards, and are in marked contrast with the temperature charts of patients suffering from either Gaertner enteritis or *aertrycke* enteritis.

In the other more severe cases the pulse varied from 90 to 120, was full and rather easily compressed, and was without dicrotism. The tongue appearances were as above recorded, and were practically constant. Rose spots were present in most cases, but not all were typical. Moderate distension of the abdomen was frequent, and tenderness most marked in the right iliac region, but also in the gall bladder and splenic areas. Enlargement of the spleen, recognised clinically, was the exception, being present only in three cases. Diarrhoea was not marked. The urine was inclined to be scanty and high coloured. Vomiting was absent. The mild cases exhibited very little beyond the initial symptoms described as occurring during the stage of onset. Perhaps the most constant signs were the appearance of the tongue, rose spots, and slight abdominal tenderness. Abdominal reflexes were absent in about 50 per cent. of the cases. Moderate pyrexia and increased pulse rate for a few days after admission were the main features. A characteristic was the degree of hunger experienced by practically all patients, even those with high temperature, and a liberal light diet was consumed without any untoward effects. A moderate amount of anaemia was present in most cases. Pyuria occurred in four cases and retention of urine in one case. Defervescence took place in 4 to 7 days by lysis, the morning temperature usually falling more than the evening, while the temperature of convalescence was inclined to be subnormal. The tongue cleaned and appetite increased. Persistence of some tenderness in the region of the caecum was observed.

Source of Infection. Previous to 1924, paratyphoid B fever, confirmed bacteriologically, had been absent from Aberdeen for four years, but on May 7th, 1925, a case of paratyphoid fever, confirmed bacteriologically,



Chart I. Paratyphoid B fever due to infected ice-cream, 1925.
Case—G. T. (female).

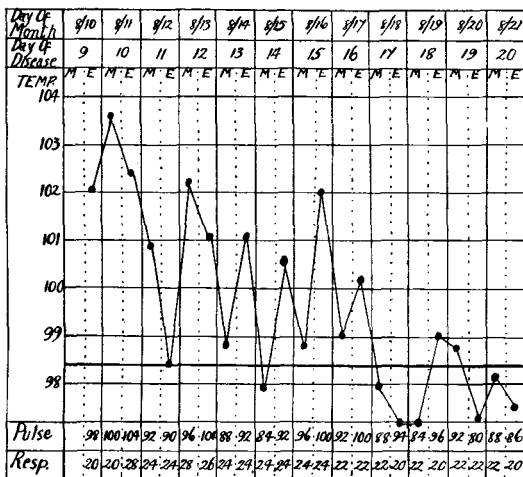


Chart II. Paratyphoid B fever due to infected ice-cream, 1925.
Case—W. L. (female).

occurred in Hutcheon Street; on June 20th a case occurred in Louisville Avenue; on July 10th a case occurred in Leadsid Road; on August 5th a case occurred in Upper Denburn; and on August 9th a case occurred in Bright Street. These cases, so far as could be determined, were separate and distinct

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from the 23 cases of paratyphoid fever associated with the Woodside outbreak; and it has not been possible to trace the source of infection in any of these five cases, or to trace any relationship between them.

In endeavouring to ascertain the source of infection in the 23 cases associated with the Woodside outbreak, the milk supply could be excluded, thirteen separate dairies being concerned in supplying the cases.

After full inquiry concerning every food substance in the diet of these 23 patients, it was ascertained that the one common article of food consumed was ice-cream, obtained from a particular shop in Great Northern Road, Woodside, the ice-cream in every case having been obtained on July 20th; and since the cases sickened on or about August 4th, the incubation period of the disease is put at 15 days.

Some of the cases occurred in districts of the City other than Woodside, but all of them had obtained ice-cream at the shop in Great Northern Road on July 20th; and the same was true of the two cases that sickened in Glasgow, it being revealed in a communication from the Medical Officer of Health of Glasgow that the two Glasgow cases had obtained ice-cream daily from July 17th to the 30th at the suspected shop.

It was not possible to ascertain how the ice-cream became infected. In the shop in question, about 6 gallons of milk were daily converted into ice-cream, the milk being brought to the boil, corn-flour, etc., added, and the mixture being again brought to the boil. This custard, when cold, was introduced into the refrigerator, which had a capacity of about three gallons, and in the freezing process the custard was stirred with a wooden stirrer having a steel scraper at the end. In serving the ice-cream, a wooden spoon was always used, and was kept for that purpose only. In regard to the number of people served daily with ice-cream from the suspected shop, it was estimated that on the average a gallon of ice-cream would be distributed to 60 consumers, so that 6 gallons of ice-cream would supply some 360 consumers.

There is no reason to believe that the milk from which the ice-cream was made was infective. This milk was obtained from one of the largest milk retailers in the City, and there was no evidence of infection of this milk supply.

Similarly, full bacteriological investigation of the workers engaged in preparing and selling the ice-cream had a negative result, as will be shown later. It is true that the shopkeeper had agglutinins in her blood to *B. typhosus* in dilution of 1 in 60, but there were no agglutinins to *B. paratyphosus* B, and there was a history of this individual having had typhoid fever in childhood. Her mother, similarly, had agglutinins in dilution 1 in 30 to *B. typhosus*, but she also had previously suffered from typhoid fever at the same time as her daughter. So, also, the shopkeeper's son, who worked in the premises, had agglutinins both to *B. typhosus* and *B. paratyphosus* B in dilutions 1 in 60, but while this person had no history of previous illness, he was inoculated against typhoid and paratyphoid fevers in the army in 1917.

It is difficult to explain why only 23 cases of paratyphoid fever occurred,

if anything from 2 to 6 gallons of ice-cream, distributed to, say, 120 to 360 people, was infective. Again, it is to be noted that ice-cream is of more or less solid consistency, and that the refrigerator temperature would not permit of multiplication of paratyphoid bacilli. Impossible as it has been, however, to ascertain the source and the method of infection of the ice-cream with paratyphoid bacilli, it can, nevertheless, be accepted that the ice-cream consumed on July 20th was infected and caused the 23 cases of paratyphoid fever. This ice-cream obtained on July 20th was the only food consumed in common by all the 23 patients, who sickened 15 days after consuming it. The natural reticence of a shopkeeper when his goods are suspected of being the source of a food infection, and the time that had elapsed since the food was infective, made it impossible to obtain further information as to how the ice-cream had been handled and disposed of on the day in question.

Bacteriological Investigation. As regards the 21 City cases, an organism giving the cultural and agglutination reactions of *B. paratyphosus* B was isolated from the blood in three cases, from the faeces in eight cases, and from the urine in two cases. Paratyphoid B agglutinins were found in the bloods of all the cases, varying in dilution from 1 in 60 to 1 in 960, according to the stage and nature of the illness. Later an agglutinating serum was prepared against one strain, and reciprocal absorption tests with the new serum and stock *B. paratyphosus* B strain, and the stock paratyphoid B serum and the causative strain showed that the causative organism was undoubtedly *B. paratyphosus* B.

There were 96 contacts in the infected households, and 88 specimens of faeces and 90 specimens of urine from these contacts were examined for *B. paratyphosus* B with negative results.

Of all the contacts, 3 workers engaged in the public distribution of food and 17 children were kept from work and from school respectively, for a period of three days, until negative bacteriological findings sanctioned their liberation.

As regards the source of infection at the shop supplying the ice-cream, reference has already been made to the bacteriological findings among the workers employed in the shop. Typhoid agglutinins in dilutions 1 in 60 and 1 in 30 were found in the shopkeeper and her mother respectively, and typhoid and paratyphoid B agglutinins in dilutions 1 in 60 were found in the blood of the son, who was also employed in the shop. Samples of blood from the other three employees contained no agglutinins, and the specimens of faeces and urine from all the employees were negative.

Three weeks had elapsed from the time the ice-cream was infective before these investigations were begun. As already stated, the source of infection of the ice-cream has not been determined. It is assumed that a paratyphoid B carrier either directly or indirectly contaminated the ice-cream, and it may be that this undetermined carrier and the other five cases of paratyphoid fever which occurred throughout the City during the preceding three months, and which had no relation to the Woodside outbreak, had a common source

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of infection; but, as already stated, no epidemiological evidence has been obtained of such relationship between any of these cases.

OUTBREAK OF *AERTRYCKE* ENTERITIS DUE TO INFECTED PORK.

An outbreak of meat poisoning, confined, so far as is known, to two households, occurred towards the end of October, 1925. In the first household, which consisted of six members, including a maidservant, the infected pork, purchased on October 26th, was consumed within 24 hours, by four members of the household, who sickened during the night of October 27th-28th. The incubation period in these four patients averaged 24 hours. In the other household only a maidservant consumed the infected pork, which also had been purchased on October 26th, and which was consumed on the same day. This maidservant sickened on Thursday, October 29th, no other member of the household being affected, and in this case the incubation period was 60 hours.

Symptoms. In practically all the cases the onset of illness was ushered in by sickness, vomiting, diarrhoea, rise of temperature to 102-103° F., severe headache, photophobia (and in one case diplopia), abdominal pain, and pain in the neck and loins.

Temperature Charts III and IV are typical.

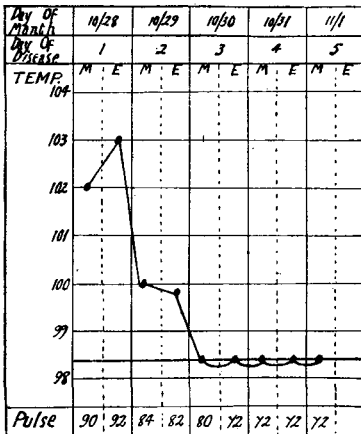


Chart III. Meat poisoning due to *Bacillus aertrycke*, 1925.

Case—J. C. (female).

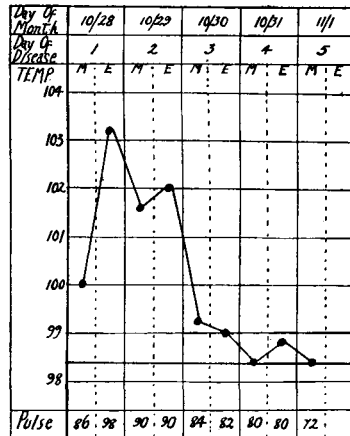


Chart IV. Meat poisoning due to *Bacillus aertrycke*, 1925.

Case—C. McR. (female).

In all cases the abdomen was somewhat distended, and there was tenderness on palpation in both iliac fossae. The pulse was rapid but regular, the expression anxious, and there was a degree of restlessness, which in one of the cases went on to mild delirium. Diarrhoea of a distressing nature continued for 3 days, after which recovery took place rapidly.

Source of the Poisoning. On investigation, it was ascertained that in the household where four out of the six members had suffered from the enteritis,

all the members of the household had partaken of the same food with the exception of the cooked pork which had been consumed only by the four persons affected.

The pork which caused the enteritis in both households was purchased on Monday, October 26th, and was obtained from a large retail grocery establishment in the City, the pork being cut from a cooked pork roll. It was ascertained that some four or five of these cooked pork rolls, weighing from 5 to 6 lbs. each, are retailed weekly from the shop in question—the pork being cooked in a factory in Glasgow. On Monday, October 26th, when the pork was apparently infectious, only one roll was sold to the public.

The physician in attendance on the family where the four cases of enteritis developed first notified these cases of food poisoning to the Health Department, and it was this medical practitioner also who directed attention to the case of food-poisoning in the maidservant of the other household. Only half a pound of cooked pork was purchased by each of the households, and it is interesting to note that no further cases of enteritis were put on record, even although it be assumed that the infection was confined to one pork roll weighing 6 lbs.

In the first household, what was left of the pork was given to the cat, and this cat developed severe sickness and diarrhoea of one day's duration some 48 hours later.

The maidservant in the second household consumed about $\frac{1}{4}$ lb. of the pork, and the remaining $\frac{1}{4}$ lb. was available for laboratory examination. This $\frac{1}{4}$ lb. of pork was of good appearance, and showed no signs of undercooking, being of a medium grey colour, and other rolls of pork similarly cooked have, on examination, shown no appearance of undercooking.

In the retail grocery establishment from which the pork was purchased, there are six employees, only two of whom had access to the pork in question, and all of these employees appeared well and gave no history of illness.

The infected pork as retailed in Aberdeen had been cooked in a factory in Glasgow, and on communicating with the Medical Officer of Health of Glasgow it was ascertained that the pork roll in question was one of six, packed in one case, purchased in Glasgow Meat Market, but that no information could be obtained concerning the pig from which the pork was derived, as the cases were shipped from America. The only possible handling of the pork in Glasgow occurred immediately prior or subsequent to the heating in the oven, as the pork rolls were then wrapped in grease-proof paper. Only four employees in the Glasgow factory were liable to have contaminated the pork; and specimens of faeces were obtained from these individuals and examined for the presence of *B. aertrycke*—all with negative results.

Bacteriological Investigation. Non-lactose fermenting colonies were obtained from a specimen of faeces from one of the group of four cases. The biochemical reactions of two cultures were tested and after an incubation period of 10 days these organisms were found to produce acid and gas in glucose, mannite,

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dulcite, sorbite, trehalose, rhamnose, maltose, xylose and inosite, while neither acid nor gas were produced in media containing lactose, salicin, saccharose and raffinose. The organisms produced rapid blackening of lead acetate agar but no indole was formed in peptone water.

Non-lactose fermenting colonies were also obtained from the specimen of pork and two strains gave biochemical reactions similar in every way to those produced by the cultures obtained from the faeces.

All the organisms agglutinated to the full titre of a mono-specific *aertrycke* agglutinating serum. Further an agglutinating serum was prepared against one of the strains isolated from the faeces and reciprocal absorption tests between the stock strain of *B. aertrycke* and the new serum, and the isolated strains and the stock serum showed that all strains were of the *B. aertrycke* type.

A specimen of faeces and a specimen of blood were also obtained from the maidservant. No pathogenic organisms were obtained from the faeces, but the serum agglutinated *B. aertrycke* in a dilution of 1 in 120.

Finally, specimens of blood and faeces obtained from each of the six employees engaged in the retail grocery shop were examined with negative results.

CONCLUSION.

The clinical and bacteriological findings in an outbreak of paratyphoid fever due to infected ice-cream as contrasted with the findings in an outbreak of *aertrycke* enteritis due to infected pork, and as contrasted with the findings in an outbreak of Gaertner enteritis due to infected milk and recorded in the preceding paper afford support to the contention of Savage and Bruce White that paratyphoid fever is a definite disease caused by *B. paratyphosus* B, *B. paratyphosus* A, and possibly by *B. paratyphosus* C, and that it is never caused by the types of the Salmonella group, such as *B. Aertrycke* or *B. enteritidis*, which are responsible for the great majority of food-poisoning outbreaks.

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