A LOCALIZED OUTBREAK OF *SALMONELLA* FOOD POISONING APPARENTLY TRANSMITTED BY A HEN'S EGG

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This account of an outbreak of food poisoning may prove interesting, as its origin is attributed to a somewhat unusual source.

INITIAL FEATURES

The outbreak was notified to the Public Health Department of Dublin on 8 July 1944. The position on that morning was as follows:

Two households, occupied by two families, with a total of eighteen members, had been suddenly attacked by an illness, the nature of which was manifestly similar in each case.

Family A consisted of ten members. The first sickened at 2.30 p.m. on 6 July and before midnight of that day seven others were affected.

Family B consisted of eight members, most of whom sickened on the following day, 7 July. Mr B had not complained at this time.

The onset had been of a typically 'explosive' nature, with vomiting, diarrhoea, headache and abdominal pains as predominant features. These symptoms varied in intensity but, on the whole, were severe and protracted. Vomiting and diarrhoea remained so profuse that, even during the period I spent in the A household on the morning of 8 July, several containers which I brought were filled with specimens of faeces and vomit.

INVESTIGATION AND COURSE

The history suggested food poisoning due to some substance consumed in both houses. Stew had been consumed in each house on 6 July, a few hours before the dramatic onset in family A. Moreover, the meat for this had been purchased in bulk that morning by one of the children and subsequently apportioned between the households. Although two indisposed members declared they had not eaten the stew, suspicion at first centred on this item. Remnants of it, as well as specimens of faeces, vomit and blood, were collected for bacteriological examination.

Inquiries at the butcher's shop revealed that the meat for the stew had been purchased as 'pieces', i.e. scraps from different parts of one carcass. As inquiries revealed that other customers had eaten the flesh of this animal, a heifer, without ill effects, it was assumed that the beast was healthy prior to slaughter and that its flesh was unlikely to have been at fault.

The following day, 9 July, two fresh cases were notified, Mr B and Miss C having developed acute gastro-enteritis the previous evening. On the afternoon of 7 July the latter had gone to help her aunt, Mrs A, eight members of whose family were at this time confined to bed. While there Miss C had a meal of bread, butter, jam and tea, and attention was now directed to one of these articles as being the vector.

It was now learned that a method for extending butter rations had been in vogue in the locality for some time. The process entailed making a suspension of cornflour and milk, bringing this to the boil, next adding a quantity of butter and then a raw egg and finally whipping the ingredients together.

On 5 July, Mrs A, employing this technique, made a supply for the use of her family. After finishing she did the same for her niece, Mrs B, who, however, brought her own ration of butter, milk and cornflour and an egg. The two mixtures were made, one after the other, in the same bowl and 'whipped' with the same fork. When completed, Mrs B took her portion home and the mixtures were consumed in both households that evening and the following days. It was asserted that hens' eggs were used in making the 'butter', the possibility of the first being a duck's egg being definitely refuted.

The position then on 9 July was that seventeen persons had developed acute gastro-enteritis, i.e. eight members of family A, the eight members of family B and Miss C. Each one was affected 1–2 days after eating a hand-manipulated foodstuff, a specimen of which was obtained for examination from the B household.

During the next few days this 'butter' was more definitely inculpated, as four additional persons, each of whom had partaken of it, were found to have experienced diarrhoea and vomiting shortly afterwards. Three of these had a meal in the A household on 5 July; the fourth, Miss T, while at work on 6 July ate a bread, butter and jam sandwich received from Miss A.

In all, twenty-seven persons consumed the 'butter'

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mixture, and, of these, twenty-three showed evidence of infection.

T.D. was the last to be affected. This boy first complained on 12 July, i.e. nearly a week after the beginning of the outbreak. His serum was negative on the 15th but became positive, 1 in 250, by the 18th. His faeces contained *B. aertrycke*, on 16 July.

While this boy did not eat the 'butter', and therefore cannot be directly connected with the apparent source of infection, his mother was one of the two people at risk who nevertheless showed no trace of infection in blood or faeces. However, Burt (1944), while dealing with an outbreak in a mental hospital, came across three males whose faeces contained *B. aertrycke* for a few days only but whose sera showed no agglutinating properties. It is, of course, possible that Mrs D excreted bacilli for a few days in the course of which she infected her son.

BACTERIOLOGICAL AND SEROLOGICAL INVESTIGATIONS

An organism was grown from the specimen of 'butter' which, besides giving characteristic cultural evidence, was agglutinated to a titre of 1 in 200 by 'H' specific, and 1 in 250 by 'O', anti-*aertrycke* sera, the maximum titre of which was 1 in 250. Moreover, it was agglutinated to a titre of 1 in 400 by the serum of one of the convalescing patients, the same level to which this serum also reacted with a standard suspension. These findings were regarded as sufficient to classify this organism as *B. aertrycke*.

B. aertrycke was also found in the faeces of six patients. It was not detected in the vomits, but these were obtained on the third day of an illness, up to which time vomiting had been continuous. Samples of jam, cornflour, and stew gave negative results.

Sera from twenty-one of the twenty-seven people who consumed the butter mixture agglutinated *B. aertrycke* at titres of 1 in 100 to 1 in 250. No blood was taken from two small children, members of affected families, both presenting typical signs and symptoms of gastro-enteritis. Two persons gave no clinical, bacteriological or serological evidence of involvement, while the remaining two apparently did not sicken, but would not submit to examination. Sera from sixteen of the eighteen members of families A and B were negative when taken on the third day of the outbreak, but later specimens, taken within a week, agglutinated *B. aertrycke* in the titres indicated above. Included in this group are Mrs A and the tenth member of her family, neither of whom, despite the change in their serological reactions from negative to positive, complained of any sickness.

ORIGIN OF THE OUTBREAK

While the cause of the outbreak and the vehicle of spread are satisfactorily established, its origin has not been ascertained.

It is known that *B. aertrycke* was present in the 'butter'. It might have reached this vehicle from:

(1) *A human carrier*. The existence of the carrier-state, however, except during, and for a few weeks after, illness seems unlikely (Bruce White, 1929; Savage, 1942).

Burt (1944), however, mentions a woman who continued to excrete *B. aertrycke* in her stools for 4 years. At the end of this time cholycystectomy was performed and the bacillus grown from a gall-stone and gall-bladder mucous membrane. During the 7 months that elapsed since this operation *B. aertrycke* was not found in her excreta.

The superiority of Wilson and Blair's medium over that of McConkey in demonstrating the persistent carrier-state of this woman was strikingly illustrated, and it is very probable that the use of modern selective media may show that carriers are more prevalent than was at one time supposed.

In this particular outbreak the most likely person to have filled the role of carrier was Mrs A, who actually prepared the food. However, as is suggested by the change in her serological reaction from negative at an early stage to positive at a later period, she may have been infected at the same time as the others. Indeed, a similar change in serological reaction seemed to eliminate the probability of a carrier among the other members of this household.

(2) *Animal reservoir*. No domestic animals were kept in the house, nor was there any evidence of infestation by rodents.

(3) *One of the ingredients*. Illness was confined to those who consumed one of two butter mixtures each consisting of milk, butter, cornflour and an egg. Other portions of the first three were sold over the counter and consumed without ill effects by members of the public. Suspicion therefore points to the egg used in making the first 'butter' mixture.

Mrs A made the two mixtures. The first, presumably contaminated heavily by the infected egg, produced symptoms within 24 hr.; the second, made with different components, was presumably infected by the use of the same dish and 'whipping' fork. Initially its infection was therefore much smaller, and it did not cause symptoms for 2 days.

On the assumption then that the egg used in making the first mixture was *aertrycke*-infected, and in no other way, that I can envisage, can the sequence of events be explained.

Unfortunately, this egg was used in its entirety and therefore its direct incrimination, by finding the specific organism in an unused portion,

was not possible. Unfortunately, it was also impossible to trace the farm from which the egg originated.

Nevertheless, I consider the field observations together with the result of the laboratory findings sufficient to incriminate the egg used in the first mixture as the cause of the trouble.

I am particularly fortunate to have obtained Sir William Savage's comment on this conclusion. He writes: 'I think your suggestion of one infected egg, with secondary infection of the other butter mixture, fits the facts very well. Hens' eggs as a source of *Salmonella* must be extremely rare, but I do not think they can be excluded.'

DISCUSSION

Although Lecoq, in a monograph published in Paris in 1906, mentions the possibility of transmission of infection through the medium of eggs, it is only comparatively recently that this view has attracted attention.

Scott (1930) described three and mentioned seven instances of *B. aertrycke* infection in which he considered the circumstantial evidence sufficiently strong to incriminate ducks' eggs. He also showed that culture of this organism, if applied experimentally, could penetrate the intact shell and could be recovered from the yolk.

Scott (1932), two years later, was able to show clearly the role of the egg in transmitting disease. Three patients, unconnected in any way, were concerned. On each occasion suspicion centred on ducks' eggs, and he was able to trace the particular flock from which these originated. *B. aertrycke*-infected ducks, laying eggs in which these bacilli were found, were discovered in each flock.

Since then evidence has continued to accumulate against the duck, particularly the Khaki Campbell strain, of which the following three accounts are briefly cited as illustrations:

Miessner & Kofer (1934) described an outbreak involving fifty guests at a wedding. A pudding which contained, among other things, forty eggs, was blamed, and, although none of this remained, *B. aertrycke* was isolated from an unused duck's egg which remained over from this batch.

Kathe & Lerche (1936) described an outbreak on a farm, involving three persons. In this case the eggs originated from a particular duck from whose excreta, and later from whose ovarian follicles, *B. aertrycke* was isolated. Here, examinations of her freshly laid eggs were negative, but after 6 days' incubation *B. aertrycke* was isolated from her eggs.

Brown, Coombs & Wright (1940) described an outbreak which occurred in an orphanage in Kansas involving fifty-two persons. The vehicle was a rice-custard pudding which contained, among other things, four ducks' and two hens' eggs. There were twenty-one ducks on the orphanage property. Three of these, whose blood agglutinated the organism isolated from pudding and patients, were killed; *B. aertrycke* was found in the oviducts of two.

Contact with stagnant pools and liability to lay eggs in damp places probably accounts for the relative frequency with which ducks are associated with *Salmonella* infection. In this connexion, the work of Beller & Reinhard (1934) and Lerche (1936) is of interest. The former examined 1500 ducks' eggs obtained on a farm in Germany, of which fifteen contained *Salmonella* organisms. Lerche examined 330 ducks' eggs bought in Berlin, of which nineteen proved to be infected with *B. aertrycke*. This organism was found sixteen times on the shell, once in the white and twice in white and yolk.

An egg may be infected in a specifically infected bird during its formation in the oviduct or by contact with bedding, etc., contaminated by bacteria contained in the dejecta of affected birds. Lerche showed experimentally that eggs, the shells of which were smeared with infected faeces, became infected despite the fact that the albumen exercised a bacteriostatic action.

B. aertrycke infection has also been reported in canaries and parrots (Beaudette, 1926), geese (Baars, 1931) and pigeons (Schutt, 1931), but meanwhile the reputation of the hen has remained unsullied. Thus, Savage (1941) considers 'there is very little evidence against the egg of the hen', while the *British Medical Journal* (Editorial, 1944) states 'the egg of the hen has a much cleaner record. There have been at the most only one or two food poisoning outbreaks which might be associated with infected eggs.' The good record enjoyed by the hen is perhaps explained by the fact that it is a relatively clean feeder and nests to a great extent in the shelter of the hen-house.

At the same time, *B. aertrycke* has, on a number of occasions, been isolated from chicks (Doyle, 1927; Edwards, 1929; Jungherr & Clancy, 1939), and this raises the possibility of adult fowls acting as carriers. Actually, *B. aertrycke* has been found by McCaughey (1932) in the liver and spleen of a hen, and Ruys (1936) mentions an *aertrycke* outbreak following the consumption of chicken broth. In the latter case, bacteriological investigation resulted in the isolation of this organism from the interior of the chicken's leg. It would appear perfectly feasible, therefore, for a hen's egg to harbour *B. aertrycke* either as the result of infection within the body of the hen or by contact with soiled bedding, etc.

The danger from surface organisms can be counteracted by boiling, but, as has been shown by

Sieke (1943), to deal adequately with a centrally infected yolk, this would require to be continued for 8 min. However, while lightly boiled eggs may cause individual cases of gastro-enteritis, and indeed on these occasions the possibility of alimentary infection is often discounted because the patient apparently consumed only food shared with impunity by others, the real danger exists when these are used in an undercooked state in puddings, custard, mayonnaise, etc.

In this particular outbreak, it will be recalled that Mrs A asserts it was a hen's egg which she used in making the artificial butter, and as this is a most unusual source, it may be contended that she mistook it for a duck's egg. However, it seems unlikely that a housewife, accustomed to purchase and cook for a family of ten, would be mistaken in a matter such as this and, having bought and actually mixed it in the uncooked state with the other ingredients, she was in an excellent position to form an opinion.

CONCLUSION

An outbreak of *aertrycke* food poisoning, the vehicle for which was artificial butter and the source an infected egg, is described. It was characterized by a dramatic text-book onset and an almost familial localization. Twenty-three out of the twenty-seven persons at risk were affected and, although the symptoms in some cases were very severe, all the patients eventually recovered.

Although somewhat unusual, *aertrycke* disease in human beings has, on a number of occasions, been caused by ducks' eggs. This particular outbreak is, however, of special interest, as there is evidence to suggest that it was caused by a hen's egg, a source which, as far as I have been able to ascertain, has not been previously described.

The investigation of this outbreak was carried out under the guidance of Dr Russell, City M.O.H., to whom I express my thanks for permission to publish an account of it. I also wish to thank Dr Elcock, Resident Medical Superintendent, Vergemount Fever Hospital, in which institution the patients were treated, and Dr Stritch, City Bacteriologist, for their help. In particular, I would like to place on record my indebtedness to Sir William Savage for giving me the benefit of his opinion of the outbreak.

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