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# *Salmonella aberdeen* infection in cattle associated with human sewage

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SUMMARY

*Salmonella aberdeen* was established as the cause of illness in 30 out of a herd of 90 milking cows. The illness was only moderately severe, and all animals responded to treatment.

The source of infection was considered to be human sewage effluent overflowing onto grazing land. There was no report of human infection in the area from which the effluent came.

## INTRODUCTION

There is an extensive literature on the transmission of salmonella infections from animal sources to man, and in the interests of public health, one would expect the subject to be well documented. The fact that transmission can occur from human sources to animals is also of importance, particularly from an epidemiological aspect, but receives scant attention in the literature. Only a few of the many reviews on salmonellosis, in particular one by Gibson (1965), discuss this possibility in any detail. As far as cattle are concerned, the source of infection is usually human sewage, after irrigation of pasture (Bederke & Lundt, 1954; Messerli, 1962); accidental contamination of drinking water (Hoflund, 1961); or accidental contamination of pasture (Piening, 1955). In some cases a method of spread cannot be definitely established, although a link exists between human and animal infection. Morten (1962) described an outbreak of *Salmonella typhimurium* infection in a dairy herd, where human infection with the same phage type had occurred in the same area, before the cattle outbreak. Lenk, Rasch & Bulling (1960), Hensel & Frerking (1964) and J. F. Harbourne (personal communication) all recorded cases of *Salmonella paratyphi* B infection in cattle, where there was strong evidence that the infection was derived from human sources.

This paper describes a herd outbreak of *Salmonella aberdeen* infection and its association with an overflow of human sewage onto pasture.

## THE OUTBREAK

### *Description of herd and farm premises*

The herd consisted of 90 dairy cows and approximately 70 young stock; dairy replacements were reared on the farm, but a few additional animals were purchased each year. In the winter the cows were housed in a covered yard and fed on hay and silage; during the rest of the year they were kept on a conventional

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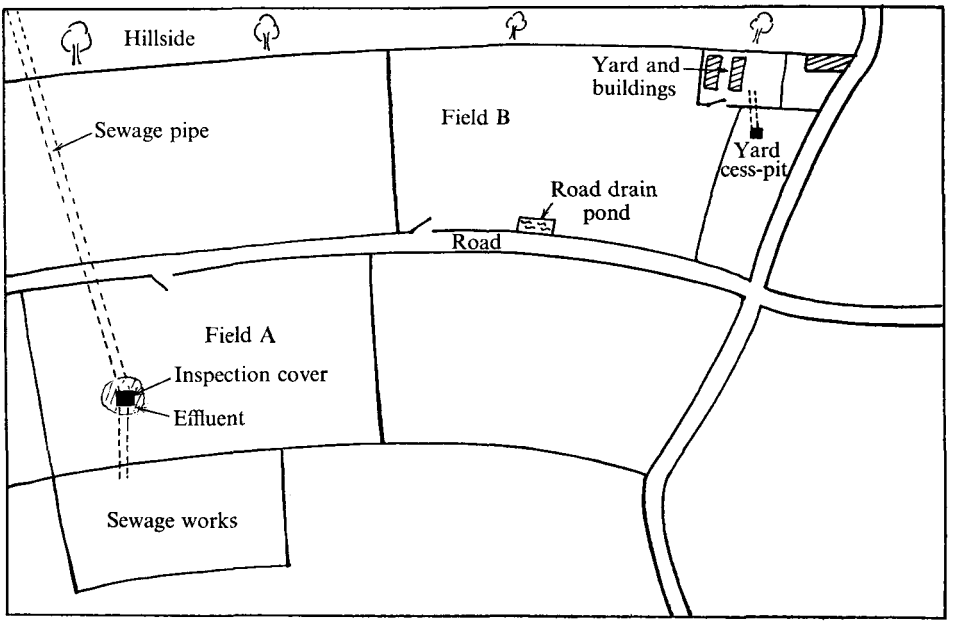


Fig. 1. Diagram of farm premises.

grazing system. Concentrates were fed all the year round, according to milk production.

The farm was situated on the slope of a hill and was made up largely of well-drained pasture land. The buildings, including the milking parlour, were in one corner of the farm, which was also separated into two parts by a road. Drinking water for the cows was from the main supply piped to troughs in the fields; the only other source of water accessible to the cows was a road drainage pond in a field adjoining the buildings. Immediately adjacent to the lower part of the farm was a sewage works, which dealt with material from a housing estate at the top of the hill; the main sewage pipe traversed the farm and was fitted with an inspection cover in one of the fields.

The essential details of the farm are shown in diagrammatic form in Fig. 1.

### *History*

At the beginning of March 1970 the cows were turned out by day to graze a crop of rye in field A (Fig. 1). To reach this field they crossed field B, and walked along the road, returning by the same route for the afternoon milking. On at least one occasion during the month it was noted by the farmer that material had overflowed from the sewage pipe inspection cover into the rye, and this fact was reported to the local authority.

During April 1970 14 milking cows became ill, in batches of four or five at one time, over a 2-week period. The clinical signs included inappetance, moderate diarrhoea, pyrexia and marked drop in milk yield. Suspecting that this might be a salmonella infection, the owner's veterinary surgeon prescribed a 5-day course of

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oral furazolidone (Neftin: Smith, Kline and French Laboratories Ltd) for each cow, at a dosage rate of 5 g. daily for 5 days; there was a good clinical response in every case. At this stage the possibility of infection arising from the overflowing sewage effluent was considered, and the cows were kept out of field A and allowed to graze only in field B (Fig. 1).

In late May 1970, whilst still grazing in field B, a further 16 cows became ill, nine being affected on one day. The signs included inappetance, slight diarrhoea, pyrexia, drop in milk yield and in approximately half the number, a severe mastitis. Once again oral furazolidone treatment was given and a good clinical response obtained. After this second period of illness the possibility of the road-drain pond having become a source of infection was considered, and it was fenced off. No further clinical cases occurred after this time.

## METHOD OF INVESTIGATION

### *Inspection of the farm*

A visit was made to the farm in early June, at the request of the farmer's veterinary surgeon. There were no seriously ill cows at this time, although the last group affected were still giving very little milk. Field A had been ploughed up and resown with barley, but the area of the inspection cover had been left undisturbed; it was covered to a depth of several inches with dried, matted effluent over an area approximately 6 ft. in diameter. The cover was found with difficulty, and removed; there was only a moderate flow of sewage material, but effluent similar to that above ground was heaped up on the benching. The road drain pond was fenced off; it contained only a small amount of water and was bordered on both sides by soft mud which showed many hoof imprints. The farm buildings were reasonably clean, but the adjoining yards were extremely dirty. Liquid material from this area drained into a cess-pit, which was overflowing.

### *The sewage effluent*

Details of the effluent overflow in field A and the operations of the sewage works were obtained from the farmer; the information was later confirmed and amplified by the local medical officer of health. The works had been built during the war to deal with sewage from an American camp and closed shortly after the end of the war. It had been re-opened in January 1970 as a temporary measure to deal with sewage mainly from a new housing estate. Effluent was seen to overflow from the inspection cover on at least two occasions during March and April. Enquiries established that sewage material from cess-pit tankers was being pumped into the pipe at the top of the hill. The slope of the pipe and the fact that it changed direction at the inspection point, was sufficient to cause an overflow.

### *Public health aspects*

At the end of June, investigations by the medical officer of health amongst the human population on the farm showed only the farmer to be a faecal excretor of *S. aberdeen*. The farmer's son and the dairyman had experienced bouts of diar-

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rhoea at the time the cows were ill but both were negative at the time of sampling. No other cases of human *S. aberdeen* infection were reported from the rural district, including the area from which the cess-pit material came, during the whole of 1970.

*Bacteriological examinations*

Samples collected from the farm in June included rectal swabs from 80 cows; portions of the dried effluent; material from the sewage pipe benching, immediately beneath the inspection cover; mud and water samples from the road drainage pond; faeces from the farm-yards and material from the farm-yard cess-pit. At the end of August, approximately 4½ months after the first outbreak of infection, and 3 months after the first sampling, a second batch of rectal swabs was collected.

The rectal swabs and samples of effluent, pond mud, and faeces were incubated in selenite broth (Oxoid) at 37° C for 24 hr. and then plated cut on deoxycholate citrate agar plates. After a further 24 hr. incubation non-lactose fermenting colonies were inoculated into Kohn Two-Tube medium (Oxoid) and incubated again. After 24 hr., cultures with the normal salmonella biochemical reactions were tested by means of salmonella agglutinating sera (Wellcome Reagents).

## RESULTS OF BACTERIOLOGICAL EXAMINATIONS

A salmonella subsequently identified by the Salmonella Reference Labaratory, Colindale, and by the Central Veterinary Laboratory, Weybridge, as *S. aberdeen*, was isolated from 22 cows; from the sewage effluent; from material inside the sewage pipe; from two samples of pond mud; from the farm-yard cess-pit and from dung in the farm-yard.

## DISCUSSION

Since *S. aberdeen* was isolated in June from 22 cows, all of which had been ill during April or May, and no other cause of disease was found, there can be little doubt that this organism was directly responsible for the illness.

The main methods of introduction of salmonellas into a dairy herd are by purchase of infected stock; by contamination of feeding stuffs, pasture or drinking water with faecal material of animal or human origin; by vermin or other animals; or in concentrated feeding stuffs.

In this case, no stock had been purchased since the previous year, and then only three animals; there was no history of flooding, or of contamination of pasture by any faecal material other than the sewage effluent; the cattle had no access to drinking water which was likely to be contaminated from outside sources. The farmer was found to be an excretor but his infection was almost certainly derived from the cows. Contamination of cattle food by rats was possible but unlikely, since regular control measures were used on the farm. Contamination of food or pasture by birds was a slight possibility; various salmonella serotypes have been found in birds, and there are records of association with disease in grazing animals (Gibson, 1965). Animal feeding stuffs are a recognized source of salmonellas, although it is established that the process of pelleting or cubing considerably

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reduces the numbers present in the raw ingredients and that the finished product is likely to contain only small numbers of organisms (Report, 1959, 1961). On this farm, the concentrate food was a cubed product, supplied by a large national compounder; it was not examined for salmonella infection but seems unlikely to have produced such a large number of cases over a short period, on one farm.

There can be no doubt that of all the possible sources of infection, the sewage effluent was the most likely one. This hypothesis is supported by the illness of the cows that were in the field at the time the overflow was occurring; the illness of a number of cows at one time, suggesting a common source of infection; and the isolation of *S. aberdeen* from both effluent and sewage pipe. It can be postulated that the following chain of events occurred. The first group of cows became ill in field A, after eating rye contaminated by effluent. At this time they walked through field B on their way to and from milking, and contaminated the road drainage pond whilst drinking from it. When the cows were in field B all day the second group became infected through drinking from the pond, to which they had continuous access. As soon as access to the pond was prevented, no further illness occurred.

*S. aberdeen* was first typed in 1934, after it had been isolated from an infant suffering from acute enteritis (Smith, 1934). An extensive food poisoning outbreak in Britain in 1949 was recorded by Brockbank, Brown & Parker (1950) and sporadic cases of human infection were recorded by Taylor *et al.* (1965) and Vernon (1967).

There are few records of isolations from animals. Mallman, Ryff & Matthews (1942) and Edwards, Bruner & Moran (1948) in the USA mentioned its isolation from poultry; Taylor *et al.* (1965) recorded single isolations from the hippopotamus and an unspecified bovine in Africa and from the pig and sheep in India. An analysis of the salmonella incidents diagnosed by the Veterinary Investigation Centres of England and Wales and the Central Veterinary Laboratory, Weybridge, for the period 1958 to 1967 inclusive (Sojka & Field, 1970) makes no mention of *S. aberdeen*; in addition no incidents were recorded from these laboratories for 1968 or 1969 (W. J. Sojka, personal communication).

A number of isolations have been made from dried egg and egg products, (Newell, Hobbs & Wallace, 1955, Taylor *et al.* 1965) and occasional isolations from natural water and sewage (Taylor *et al.* 1965).

The lack of records of *S. aberdeen* infection may be due in part to its relatively low pathogenicity, or to its requirements for a special set of circumstances to produce disease. This may be an explanation, in part at least, for one of the puzzling features of this case, namely the presence in the sewage effluent of sufficient organisms to cause disease in a number of cows, when there is no evidence of previous human infection in the area from which the effluent came.

The overflow of effluent was directly due to improper use of a temporary but quite adequate sewage disposal system, and responsibility was accepted by the local authority. The farmer was fully compensated for loss in milk production which occurred whilst the cows were ill, a loss estimated at approximately 2000 gallons.

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## REFERENCES

BEDERKE, G. & LUNDT, P. V. (1954). Ergebnisse der Zusammenarbeit von Veterinär – und Humanmedizin bei der Paratyphusbekämpfung im ostfriesischen Inselgebiet. *Deutsche tierärztliche Wochenschrift* **61**, 52–4.

BROCKBANK, W., BROWN, C. M., & PARKER, M. T. (1950). Outbreak of food-poisoning due to *Salmonella aberdeen*. *Lancet* ii, 873–6.

EDWARDS, P. R., BRUNER, D. W. & MORAN, A. B. (1948). *Salmonella* infections of fowls. *Cornell Veterinarian* **38**, 247–56.

GIBSON, E. A. (1965). Reviews of the progress of dairy science. Section E. Diseases of dairy cattle. Salmonella infection in cattle. *Journal of Dairy Research* **32**, 97–134.

HENSEL, L. & FRERKING, H. (1964). Eine vom Menschen stammende Paratyphus-B-Infektion als Abortursache bei einer Kuh. *Landarzt (Stuttgart)* **40**, 1518–20.

HOFLUND, S. (1961). Wasserverunreinigungen als Krankheitsursache in Rinder – und Schafbeständen. *Deutsche tierärztliche Wochenschrift* **68**, 97–100.

LENK, V., RASCH, K. & BULLING, E. (1960). Über das Vorkommen von *S. paratyphi B* (d-Tartrat negativ) bei Tieren. *Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene. I. Originale* **180**, 304–9.

MALLMANN, W. L., RYFF, J. F. & MATTHEWS, E. (1942). Studies on the Salmonella Group – methods of isolation and pathogenicity of strains occurring in the intestines of chickens. *Journal of Infectious Diseases* **70**, 253–62.

MESSERLI, W. (1962). Salmonellose bei Mensch und Tier im gleichen Gehöft. *Schweizer Archiv für Tierheilkunde* **104**, 294–7.

MORTEN, D. H. (1962). Salmonellosis: A serious outbreak in a dairy herd. *Veterinary Record* **74**, 423–5.

NEWELL, K. W., HOBBS, B. C. & WALLACE, E. J. G. (1955). Paratyphoid fever associated with Chinese frozen whole egg: outbreaks in two bakeries. *British Medical Journal* ii, 1296–8.

PIENING, W. (1955). Durch Fäkalabwässer verseuchtes Heu-Ursache des sogennanten Kälbertyphus. *Städtehygiene* **6**, 180–1.

REPORT (1959). Salmonella organisms in animal feeding stuffs and fertilizer. *Monthly Bulletin of the Ministry of Health and the Public Health Laboratory Service* **18**, 26–35.

REPORT (1961). Salmonella organisms in animal feeding stuffs. *Monthly Bulletin of the Ministry of Health and the Public Health Laboratory Service* **20**, 73–85.

SMITH, J. (1934). Sporadic salmonella infections: a new Salmonella type. *Journal of Hygiene* **34**, 351–60.

SOJKA, W. J. & FIELD, H. I. (1970). Salmonellosis in England and Wales 1958–1967. *Veterinary Bulletin* **40**, 515–31.

TAYLOR, J., LAPAGE, S. P., BROOKES, M., KING, G. J. G., PAYNE, D. J. H., SANDIFORD, B. R. & STEVENSON, J. S. (1965). Sources of Salmonellae, 1951–1963. I. *S. aba* to *S. muenchen*. *Monthly Bulletin of the Ministry of Health and the Public Health Laboratory Service* **24**, 164–229.

VERNON, E. (1967). Food poisoning in England & Wales, 1966. *Monthly Bulletin of the Ministry of Health and the Public Health Laboratory Service* **26**, 235–49.

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