

MILK-BORNE SONNE DYSENTERY.

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(With one Graph.)

AN outbreak of milk-borne bacillary dysentery of considerable dimensions, which has been proved to be due to infection of milk with *B. dysenteriae* Sonne occurred in St Andrews in September 1926. As a review of literature reveals the fact that no milk-borne outbreak of Sonne dysentery has been recorded, it appears advisable to record the St Andrews outbreak in considerable detail.

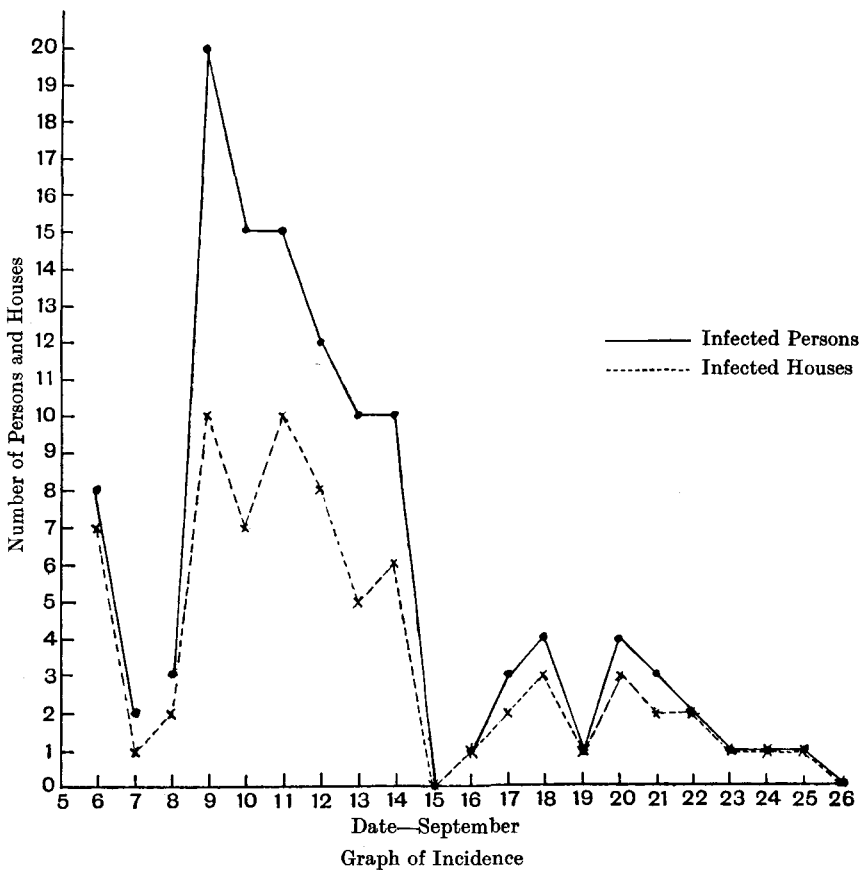
Since Sonne (1915) indicated that the main cause of dysentery in Copenhagen was a late lactose fermenting bacillus, increasing proof has been forthcoming of the prevalence of this type of dysenteric infection. Smith (1923), in recording a small outbreak of Sonne dysentery in Aberdeen in 1923, reviewed the literature of Sonne dysentery and referred to the work of Thjøtta (1919), who, in investigating cases of dysentery in Norway, obtained 40 strains of Flexner dysentery bacilli and 25 strains of the Sonne type, and added the explanation that the less frequent isolation of the Sonne type was due to the fact that this organism often caused such a mild attack of diarrhoea that medical advice was not sought, with the result that many cases were not subjected to bacteriological investigation. In a recent paper Fraser, Kinloch and Smith (1926) give a description of the clinical and bacteriological features of Sonne dysentery and show that, in the absence of epidemic prevalence of the dysenteries in Aberdeen over a period of 30 months, cases of the various forms of dysentery have been in the proportion of 1 amoebic to 3 Flexner to 6 Sonne dysenteries. They conclude that *B. dysenteriae* Sonne is the most frequent cause of dysenteric outbreaks in non-epidemic times.

Epidemiology.

On 12. IX. 26 there was isolated from a specimen of faeces from a boy suffering from diarrhoea, organisms which gave all the cultural and serological reactions of *B. dysenteriae* Sonne. On inquiry it was found that there were three other persons in the household suffering from symptoms similar to those presented by the original case. On further inquiry among the general practitioners of the Burgh the fact was revealed that a condition of sickness, vomiting, diarrhoea and collapse was rife in the Burgh, and finally it was ascertained that some 150 individuals in 80 households were suffering from the infection.

The Graph shows the number of persons and households that were ultimately found to be involved in the dysentery outbreak.

Age and sex distribution. As is usual in milk-borne infections the age incidence was that of the young and the old, the cases that occurred in the age group 20-40 years being very clearly due to contact with infected persons. From figures available it appeared that 45 per cent. of the cases were under 20 years of age, and of these the majority were under twelve years of age. 30 per cent. of cases of whom most were mothers were in the age group 20-40



years. 25 per cent. of cases were over 40 years of age. Almost twice as many females as males were infected although in the later age groups the preponderance was with the males.

Vehicle of spread. It was early established that the large majority of the persons suffering from the dysentery was consuming milk supplied from a certain dairy premises at a farm situated outside the Burgh. At the farm it was found that the two children of the farmer and at least one of the milkers were suffering from a disorder of similar nature to that prevalent in the Burgh. A list of customers supplied by the farmer was obtained and it was

found, at that time, that 23 houses supplied directly by the farmer and 20 houses, supplied indirectly through retailers of his milk, were infected. The children at the farm were completely isolated and the ailing milker was prohibited from milking and from, in any way, handling the milk as from 13. IX. 26. The result of this action is demonstrated by reference to the graph, from which it will be seen that no further cases of dysentery occurred on 15. IX. 26. From 16. IX. 26 onwards a few fresh cases continued to occur daily, and on a further visit to the farm it was ascertained that while the infected girl milker was securely isolated from the milk supply, she was being nursed by her mother who was herself a milker. The girl was removed to hospital on 24. IX. 26 with the result that no further cases, supplied directly or indirectly from the farm, occurred.

Conditions at the farm, in reference to events in the Burgh, were decidedly interesting. Dairy work was in the hands of Mr L. (the farmer), Mr M., Mrs M., A. M., and M. M. (members of a family employed by the farmer) and of L. H. (a housemaid who filled bottles with the assistance of A. M. and M. M.). When enquiry was completed the following sequence of events was ascertained. Mrs M. had, what she termed, "a touch of diarrhoea" on the 5th. In the Burgh there was a mild outbreak of diarrhoea on the 6th. On the 7th and 8th the two children of Mr L. sickened with vomiting and diarrhoea, and no special precautions were taken by Mr L. or the housemaid L. H. In the Burgh 10 houses supplied by the farm were infected on the 9th. On the same day at the farm M. M. sickened, with subsequent violent diarrhoea, and continued to milk until the 13th when she was removed from contact with the supply, she then presenting no symptoms of the disease. In the Burgh fresh houses continued to be infected from the 9th onwards, in numbers decreasing daily until, on the 15th, two days after the isolation of M. M. no fresh cases were reported. About the 16th M. M., who had not regained full vigour, had a recrudescence—a not uncommon characteristic of the type of infection in the Burgh—and was nursed by her mother, Mrs M., until her removal to hospital on the 24th. In the Burgh from the 16th till the 25th there was a small daily incidence of fresh infections which ceased on the 26th.

As a control investigation the milk supply of dairy farms within the Burgh was investigated and it was found that six persons residing in five different houses were infected. Very definite evidence of contact with infected persons or of outdoor consumption of infected milk was obtained in these cases. There was an exception—a hotel in which were six infected persons and which received milk from a local dairy farm. No proof as to the origin of this outbreak was obtained, but contradictory statements regarding a previous disability of the cook, who had been exposed to infection, placed that person under suspicion of being the source of infection.

With the exception of water, no article of diet other than the infected milk was consumed in common by the infected households, and the water supply of the Burgh, which is under constant bacteriological supervision, in no way gave evidence of contamination.

Incubation period. The incubation period was short being well under 24 hours. Symptoms were invariably found to be well developed 10 to 12 hours after consumption of infected milk. In one noticeable case abdominal discomfort was experienced five hours after the consumption of a glass of the milk, followed in four hours' time by all the signs characterising the infection.

Symptoms. I am indebted to Dr W. F. Mair, M.D., M.R.C.P.E., and to the Medical Staff of the Clinical Institute for the following account:

Broadly speaking the disease manifested itself in one of two ways—a type with sudden onset, much prostration and bloody diarrhoea; a second type of less acute nature in which medical advice was not sought for some days after the onset, diarrhoea being less severe but more persistent and blood not so frequently present in the stools. The latter type tended to a longer course of illness and was less amenable to treatment. A third type might be mentioned—that in which the symptoms were of such a mild and transient nature as to contra-indicate any necessity for consulting a physician.

The first type of case was most frequently met and the clinical sequence of events was as follows. The onset was invariably sudden and usually ushered in by a rigor of greater or less severity and a degree of malaise of sufficient intensity to render the subject glad to seek rest in bed. Headache quickly supervened and sometimes was very severe. Within an hour or two the temperature rose and ranged from 101° to 103° F., the higher figures being more characteristic of children. There quickly followed either vomiting, which in some cases was projectile in character, or simple nausea. These symptoms were invariably accompanied either by a very definite abdominal colic or by a lesser degree of abdominal discomfort. Pain, in the majority of cases, was not localised. In a few, however, it was referred to the hypogastric area. There was no localised tenderness, and abdominal distension, in even a slight degree, was not observed. The number of motions varied very considerably, in some cases being so frequent and urgent as to necessitate even adults wearing napkins, while in others there were from eight to ten motions per day. In one case thirty-two motions were reported in the course of 48 hours. The stool was invariably green in colour, containing fresh liquid blood, much mucus and little faecal matter. The odour was particularly offensive.

These remarks fully describe the clinical picture but in every case of any severity there was present either from the very onset or at some subsequent time, a greater or less degree of collapse. The initial collapse was very definite, so much so that children, for example, were suddenly seized at play and within a very few minutes were prostrate, pallid, unwilling to respond and obviously suffering from mental and physical lethargy. Recovery in the majority of cases was uninterrupted and complete in about a week. In two cases, however, convalescence was interrupted by the onset of severe muscular cramp.

The catarrh of the respiratory system as described by Fraser, Kinloch and Smith (1919) was noticeably absent in all cases reported and no confirmatory evidence was obtained that “the involvement of the respiratory system in a catarrhal process is a notable feature of Sonne dysentery.”

Treatment. The majority of cases responded to aperient treatment with castor oil combined with absolute starvation, except for the ingestion of water, for a period of 24 hours. Those cases which were not relieved thereby made response to the administration of Morphia, in the form of Pulv. Ipecac. Co. combined with Bismuth Salicylate. Some cases were so markedly prostrated as to require hypodermic injections of strychnine.

Incidence and mortality. In all 116 cases, living in 73 different residences

were notified. These figures, however, do not indicate the total incidence in the Burgh. Some persons were so slightly inconvenienced by the infection that medical attention was not deemed necessary. It has been estimated from information derived from various sources that some 80 houses and 150 persons were infected, although it is conceivable that even a figure of 200 persons would not be an over estimation.

None of the many cases of Sonne dysentery, which were confirmed bacteriologically, died, although some were very severely ill, two cases only gave rise to anxiety, both of them adults. The majority of cases had fully recovered within a week. A marked contrast is provided in the case of a milk-borne epidemic of Flexner dysentery wherein of 1000 cases reported 72 died (Kinloch, 1919).

Bacteriological Investigation.

Appearance of faeces. In consistence the specimens were invariably watery. Their colour varied from a dark brown to a light yellow, an irregular green coloration, due to the presence of green flocculi, being characteristic of the stools of cases clinically severe. Mucus was always present, sometimes in such quantity as to give the specimen a jelly-like appearance. Out of 66 samples examined, blood, in sufficient quantity to be observed with the naked eye, was present in 19. In reaction freshly passed specimens were usually definitely alkaline even in severe cases after 24 hours' starvation. Microscopically numerous pus cells, arranged in clusters, and large phagocytic cells were observed entangled in the mucous shreds.

Cultural characteristics. On MacConkey's medium colonies of *B. dysenteriae* Sonne appeared as slightly opaque, convex growths with bevelled, crenated borders (Type *C*). In colour they were pinkish by direct and yellowish brown by transmitted light, while in size their diameter varied from one to the more usual, three millimetres. There was another type of colony which occurred less frequently—smooth, slightly pink in colour, opaque and not crenated, with a uniformly larger diameter (Type *S*). Sugar reactions varied according to the type of colony. Type *C* showed no change in saccharose and acid, after three to five days' incubation, in lactose. Type *S* showed acid in saccharose and lactose after 24 hours' incubation.

Sugar fermentation reactions.

	Glucose	Laevulose	Dulcite	Mannite	Saccharose	Lactose
Type <i>C</i>	A.	A.	O.	A.	O.	A. 3rd day
Type <i>S</i>	A.	A.	O.	A.	A.	A.

Both types produced acid in arabinose, galactose, mannose and maltose, while adonite, inosite, inulin, salicin, sorbite and xylose remained unchanged. Both types also produced acid without clot in litmus milk. Indol and Voges Pröskauer reactions were negative. Rapid blackening occurred on lead acetate agar.

Virulence and toxicity tests. The pathogenicity of a strain was tested in

rabbits and guinea-pigs. Two of each were infected intraperitoneally with a living emulsion of the organisms. Both rabbits sickened in 24 hours with marked prostration and diarrhoea but in three days' time had fully recovered. Both guinea-pigs died on the fourth day and *B. dysenteriae* Sonne was recovered from the blood and from various organs. Two rabbits and two guinea-pigs were inoculated intraperitoneally with killed broth cultures of a strain. The rabbits showed no appreciable change and the guinea-pigs after refusing food for 48 hours recovered fully.

Bacteriological examination of cases. Table I summarises the bacteriological findings in the individuals at the farm.

Table I.

Case	Bacteriological exam. of faeces	Serum agglutination
1. Mr L.	Positive	Not done
2. A. L.	"	"
3. B. L.	"	"
4. Mr M.	Negative	"
5. Mrs M.	Positive	1 in 550
6. A. M.	Negative	Not done
7. M. M.	"	1 in 100
8. L. H.	"	Not done

The serum of Mrs M. was examined on the 14th day after the onset of her "touch of diarrhoea" and that of M. M. on the 9th day after the onset of her illness.

Sixty-six specimens of faeces were examined during the course of the epidemic, from thirty of which *B. dysenteriae* Sonne was isolated. As shown in Table II three agglutinating sera were used.

I. Stock serum prepared from *B. dysenteriae* Sonne, No. 268 National Collection of type cultures.

II. Serum prepared by rabbit inoculation from *B. dysenteriae* Sonne isolated from the faeces of one of the cases.

III. Serum of Mrs M.—case 5 at the farm.

Table II. *Showing results of agglutination of faecal strains by Sera I, II and III.*

Case	Serum I			Serum II Tertiary subculture	Serum III Tertiary subculture
	Primary subculture	Secondary subculture	Tertiary subculture		
1	1 in 1600	—	1 in 3200	1 in 3200	1 in 150
4	" 400	—	" 6400	" 3200	" 300
11	Nil	Nil	" 50	" 50	" 25
15	" 50	—	" 6400	" 6400	" 150
24	" 1000	1 in 3200	" 6400	" 6400	" 300
25	" 1000	" 500	" 1000	" 800	" 250
35	Nil	" 800	" 6400	" 3200	" 150
43	Nil	" 400	" 6400	" 6400	" 50
45	Nil	" 800	" 800	" 600	—
50	1 in 3200	Nil	" 3200	" 1600	1 in 600
51	" 1600	1 in 1600	" 3200	" 3200	—
65	" 700	" 1200	" 1600	" 800	1 in 100

The daily variation in agglutination titre obtained with Serum I and first, second and third day subcultures is in accordance with the previously recorded statement that certain strains have to be subcultured several times before they can be agglutinated to full titre (Fraser, Kinloch and Smith, 1926). Serum II, prepared by intravenous and intraperitoneal inoculation of a rabbit with a killed culture of *B. dysenteriae* Sonne isolated from one of the infected cases, did not agglutinate the various strains to such a high titre as did stock Serum I. Serum III agglutinated in low dilutions only, in a few instances to such a low titre as to be definitely perceptible only by the use of a lens.

Agglutinating sera prepared against *B. dysenteriae* Flexner V, W, X, Y and Z and against *B. typhosus*, *B. paratyphosus* A, *B. paratyphosus* B and *B. enteritidis* Gaertner gave no reaction with any of the strains isolated.

As regards the comparative agglutination reactions of the two types isolated by sugar fermentation reactions, it was found that Type S (that which fermented lactose after 24 hours' incubation) was agglutinated to a lower titre than Type C, never exceeding a dilution of 1 in 1000, and requiring repeated subculturing before the appearance of any reaction whatsoever, whereas Type C agglutinated to full titre with much less subculturing, frequently on primary subculture.

Reciprocal absorption tests resulted in the complete absorption of agglutinins from Serum II by strain No. 268 and from the stock agglutinating serum by various strains isolated from the cases.

For purposes of investigating the specific agglutinating power of the blood of patients, suspensions of fresh cultures of *B. dysenteriae* Sonne No. 268 were used. Table III shows the results in the cases recorded in Table I.

Table III. *Showing agglutination of strain No. 268 by sera from patients.*

Case	Blood obtained	Titre
1	12th day	1 in 200
4	16th "	" 400
11	14th "	" 550
15	12th "	" 300
24	8th "	" 800
35	27th "	" 25
38	3rd "	Nil
38	10th "	1 in 50
38	17th "	" 500
43	14th "	" 50
45	8th "	" 800
50	20th "	" 1600
51	17th "	" 550
65	6th "	" 600

Serum from cases, at intervals of from 6 to 27 days after the onset of illness, agglutinated suspensions of the stock culture of *B. dysenteriae* Sonne in dilutions of from 1 in 25 to 1600. The comparatively high agglutination titre of Case 65 on the sixth day, was rather exceptional as it was found that the great majority of bloods tested showed little or no specific agglutination powers until a full week had elapsed after the onset of illness, as for example Case 38.

Cultures were submitted to Dr A. Gardner, Standards Laboratory, Oxford,

and to Dr J. Smith, City Bacteriologist, Aberdeen, both of whom confirmed the biochemical and serological reactions described.

The occurrence at the farm, prior to the time of infection of the first case, of a condition of "white" dysentery among calves may have been of some relative significance, more especially as the first case (Mrs M.) had been attending them. Arrangements have now been completed for a systematic investigation of this condition in sucklings of different species of animals in an endeavour to ascertain the presence or absence of a type of infection communicable to man.

Summary.

1. There is recorded for the first time an outbreak of milk-borne bacillary dysentery which has been proved to be due to *B. dysenteriae* Sonne.

2. In this milk-borne outbreak of Sonne dysentery there were over 150 cases and no deaths, the absence of mortality being in marked contrast to the high mortality rate which accompanies milk-borne outbreaks of Flexner dysentery.

3. Several milk-borne outbreaks of enteritis simulating dysenteric infections have been recorded in which the evidence has pointed to a living bacillus of unrecognised type as the causal agent. It is obvious that in future *B. dysenteriae* Sonne will require to be excluded from the group of the unrecognised viruses.

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