ON AN OUTBREAK OF SORE THROATS AND OF SCARLET FEVER CAUSED BY INFECTED MILK.

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THE outbreak about to be described raises issues of practical importance which appear to make it worthy of record, in spite of the fact that owing to fear of injury to a particular dairyman it was impracticable to complete the evidence by making inquiries at every house supplied with milk by him.

It will be convenient to describe the four branches of the outbreak in the order in which they came to my knowledge, subsequently placing these branches in their relationship to each other and to the milk, which could only be suspected when definite notifications of scarlet fever (group C, p. 155) gave the data required for pursuing an investigation.

Group A. About the 25th November I was consulted by Dr N., the medical attendant on the scholars at Miss S.'s day school. This school has 16 day pupils varying from 7 to 16 years of age. Two days earlier a boy M. S. aged 7 attending this school had been notified to be suffering from scarlet fever, date of onset Nov. 16th. For several days the doctor had been doubtful of the diagnosis, the symptoms being very mild. Dr N. now informed me that Miss S. was anxious to know what school precautions she should take; but at the same time expressed the opinion that M. S. had acquired his attack at a hippodrome performance in the town. She very wisely however gave Dr N. a list of sore throats in the school during that term. This list is embodied in the following tabular statement:

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	Date of onset	Symptoms	Remarks
(1) Y. N. boy, aged 8	Oct. 29	sore throat	A slight attack.
(2) D. T. boy, aged 7	Nov. 6	sore throat	Discontinued attending school from the 6th to 13th Nov.
(3) N. Sp. girl, aged 11	Nov. 13	sore throat	Returned to school Nov. 17.
(4) M. S. boy, aged 7	Nov. 16	scarlet fever	
(5) S. P. boy, aged 9	Nov. 18	sore throat	Had vomiting as well as sore throat. Returned to school in a few days. Had scarlet fever a year earlier.
(6) K. Sp. girl, aged 13 (sister of N. Sp.)	Nov. 18	sore throat	

Further particulars were subsequently obtained about N. Sp. She was ill enough at the onset to be kept in bed for three days, but returned to school on the next day. Her father, who is a doctor, states that she had no rash. Some time after her return to school she was noticed to be picking rough skin on her fingers and was sent home. Her father was still of opinion that there was no true desquamation. Her sister K. Sp. failed with a sore throat on Nov. 18th, and the mother Mrs Sp. is stated to have had a severe sore throat apparently beginning on the same date as N. Sp. There are five children (varying in age from 14 to 5 years) and two servants in this house. Only one child has had scarlet fever previously, namely a boy aged 9, several years ago. He, a brother aged 5, a brother aged 14, the father and the two servants have not had sore throats recently. It is quite certain that with the possible exception of N. Sp. and the definite case of scarlet fever M. S., none of the above patients desquamated to any appreciable extent after their attacks of sore throat. The bearings of these cases on milk supply will be subsequently discussed.

Group B. On the 7th Nov. I received from Dr S. three swabs from sore throats. The result of the examination of growths on blood-serum was telephoned to Dr S. next morning, a pure culture of *Streptococci* having been found in each instance. I heard nothing more of these cases until Dec. 17th, when a letter from Dr S., of which the following are the pertinent paragraphs, was received:

I send a report of the epidemic of "streptococcus throats" which occurred at Miss C.'s school in November, the first three cases of which I took swabs of, and on which you kindly reported as shewing pure cultures of a Streptococcus.

In the course of the succeeding five days after the date of your report the number of cases rapidly increased and reached a total of 14. In three cases the symptoms of general septicaemia were severe, high temperature, rapid pulse, and greyish fibrinous exudate on the tonsils—none on the soft palate.

In two cases there was an evanescent rash very like the slight erythema seen

after an enema or a poultice. It lasted only a few hours, and there has not in any case been the slightest sign of desquamation.

The cases were all convalescent except one by Dec. 1st, and this one recovered completely by Dec. 4th, and there have been no subsequent cases.

On receiving Dr S.'s valuable letter, I arranged an interview with Miss C. and she supplied me with very full information as to the series of sore throats. For reasons which will be shortly apparent, it will be convenient to begin with case II., as case I. was only mentioned towards the end of the inquiry, and was only seen by Dr S. at a much later date.

II. On Nov. 4th Dorothy B. aged 10, had shivering at 4 p.m., was kept in bed next day, no sore throat until the 6th. No rash, except a slight rash on one day in the following week. She resumed her lessons at the end of three weeks.

III. Mrs B. mother of the above patient, had been out of the town from the 1st to the 4th Nov. On the 5th she was well until the evening, when she felt ill. In the night her temperature was 102° F. Next morning severe sore throat, high temperature. No subsequent desquamation.

IV. Miss W. aged 25 years, onset Nov. 6th with headache and sore throat.

V. Miss M. aged 16 years, onset Nov. 6th with headache and sore throat.

These two cases were much milder than II. and III. They remained in bed three weeks. No desquamation.

VI. On 8th Nov. Miss Mr. aged 11 years, failed with severe headache, sore throat and high temperature. Temperature remained elevated for several days.

VII. On 9th Nov. 4 cases began, viz. Miss Br. aged 12,

VIII. Miss A. aged 15,

IX. Miss M. Br. aged 8, and

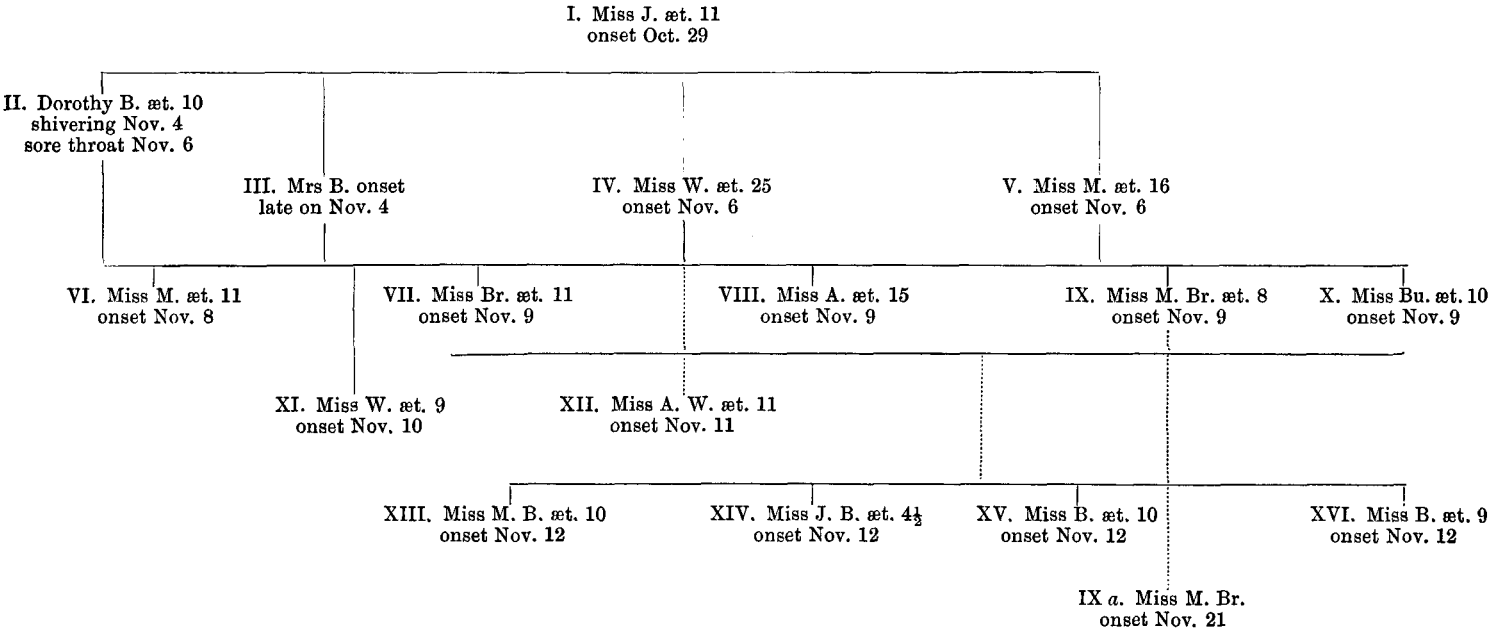
X. Miss Bu. aged 10. These had similar symptoms to the other cases. Miss M. Br. had "acute tonsillitis."

XI. On the 10th Nov. Miss W. aged 9 began in a similar way.

XII. On the 11th Miss A. W. aged 11 began in a similar way.

On the 12th five cases began, some of them very slight, viz. XIII. Miss Mo. Br. aged 10. XIV. Miss J. B. aged 4½. XV. Miss Bl. aged 10, and XVI. Miss — Bl. aged 9.

Case XIII. had a slight erythema, but with this exception and case II. there was no rash. No desquamation occurred in any case. The



sore throats varied in severity from a slight sore throat to acute tonsillitis.

There were four servants in the house. The cook and one housemaid remained well, the parlourmaid and one housemaid had a "congested throat" during the week in which the majority of the above cases occurred. These patients' temperatures remained normal. Three governesses in the house and the lady principal remained well.

Owing to the preceding outbreak the school was temporarily broken up, resuming on the 21st Nov. On the evening of that day case XIII. who had come downstairs shivered, and was found to have a temperature of 103° F. followed by acute tonsillitis. Her previous attack had been slight, the temperature not reaching 100°; and she had only been kept in bed one day.

It will be noted that in none of the preceding cases did the symptoms lead to the slightest suspicion of scarlet fever. Diphtheria was suspected, but negatived both bacteriologically and clinically.

Further inquiry shewed that an earlier case had occurred—case I. Miss J. aged 11 goes home to another house in the town each Saturday to Monday. She returned to school on Monday, 28th Oct., looking poorly, and next morning vomited on the first-floor landing, after hurriedly leaving the breakfast table. She was laid on a bed in the bedroom occupied by cases II. and III., and she again vomited while lying on III.'s bed. Her dress was changed while lying on this bed. She remained on it until the evening, when she returned to her own bedroom (3rd floor east): her temperature on this day was 100° F., next day 99°. Next day she returned to the bedroom of cases I. and II. which was used as a sitting-room by convalescent patients. Miss J. was not very ill, but is stated to have had slight sore throat and a little fever. No rash was noticed, and no desquamation occurred. She was specially examined by the doctor for desquamation. As Miss J. was subject to "bilious attacks" little would have been thought of this attack had it not been followed by unusual weakness and a subnormal temperature. The probable relationship of the series of cases to each other is brought out more clearly by the scheme on p. 153.

The most likely explanation of the outbreak appeared to be that case I. brought the infection—the nature of which will be more conveniently discussed later—into the school, that she passed it on to cases II. and III. and probably to other girls who frequently entered the same room. The bedroom accommodation of patients and of pupils who remained well was as follows:

Bedroom on 1st floor	Case I. Case II. Case III.	One girl sleeping in this room remained well.
2nd floor west	Case VI. Case XII.	Two girls sleeping in this room remained well.
2nd floor east	Case V. Case VIII.	Two girls sleeping in this room remained well.
3rd floor west	Case X. Case XV. Case XVI.	
3rd floor east	Case IV. Case VII. Case IX. Case XIII. Case XIV. and Case I.	
3rd floor east, 2nd room	Case XI.	

Thus the total number of boarders was 19, of whom 14 were ill.
The „ „ teachers „ 6 „ „ 2 „ „
„ „ „ servants „ 4 „ „ 2 were slightly ill.

In addition there were six day boarders, all of whom have remained well. These arrive at 9.30 a.m. and leave at 5 p.m. They all attended school until the 6th of November, subsequently being kept at home until the 21st Nov. They take the same food including milk as the boarders. They do not however go into any bedroom except once a week to change clothes for a dancing class. If the infection be assumed to be located in the bedrooms, it was likely therefore that the day scholars would escape, as at the most they only entered a bedroom once after the cases began; and this was not a bedroom in which a sore throat had already occurred.

Group C, consisted of cases of definite scarlet fever. The relationship between the total amount of scarlet fever in the town and in group C. is brought out by the following weekly statement for the last two months of the year, in which dates of onset are taken instead of the somewhat irregular dates of notification.

Week ending	Total cases	Group C	Week ending	Total cases	Group C
Nov. 2	6	–	Dec. 7	6	5
„ 9	3	–	„ 14	2	–
„ 16	2	–	„ 21	3	–
„ 23	2	2	„ 28	4	–
„ 30	3	–			

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As already related one case of scarlet fever (M. S. a boy aged 7) occurred in connection with group A. For convenience this case is restated in the following list:

			Date of Onset	Date of Notification	Disease
Group C	1st Section	M. S. boy, aged 7	Nov. 16	Nov. 25	Scarlet fever[1]
		W. C. ,, ,, 12	,, 18	,, 20	,,
	2nd Section[2]	E. W. girl, aged 14	Dec. 2	Dec. 5	,,
		E. H. B. ,, ,, 7	,, 3	,, 6	,,
		E. S. woman, ,, 45	,, 4	,, 9	,,
		A. P. ,, ,, 40	,, 4	,, 9	,,
		H. B. man ,, 24	,, 5	,, 9	,,

At the time when the two first of the above cases were notified no definite history of infection could be ascertained. The two patients did not know each other, lived in different streets, and attended different schools. At M. S.'s house there was a sister aged 4, father and mother, and several servants, among whom no sore throat or other symptoms of illness occurred. At W. C.'s house there is a mother, a governess, two sisters aged 10 and 15 years, and two servants, none of whom had sore throats at or near the date of onset of W. C.'s attack of scarlet fever. As the home supply of milk in these two houses was different, no suspicion as to milk infection was entertained.

On the 5th Dec. I was asked by the doctor in attendance to see E. W., a girl aged 14, who was then suffering from an intensely severe attack of scarlet fever with an unusually bad type of sore throat. The other persons then living in this house were father and mother and three servants, who none of them had sore throats or other symptoms of illness about this time. School infection and other possibilities of personal infection were apparently excluded.

E. H. B. aged 7, the daughter of a doctor, was poorly on the evening of Dec. 3rd, vomited in the night; during the next two days she was better, but on the 5th complained of sore throat, and on the 6th a scarlatinal rash appeared. Otorrhoea followed in a few days. No evidence of personal infection. At a later date the following further facts were ascertained. The father on the evening of the 4th Dec. was suddenly seized with giddiness and cold sweat. Next morning he had

[1] Also given as (4) Group A.

[2] In the neighbouring town of H. to which the dairyman P. (see p. 158) also supplies a portion of his milk one case of scarlet fever in which his milk was drunk was notified on Dec. 6th.

a slight sore throat, which was much worse on the 6th and 7th. He continued at his work; his temperature was not taken. There was no rash and no subsequent desquamation. He has noticed that he has suffered from similar sore throats on former occasions when attending scarlet fever patients. He has never had scarlet fever. The child of the last patient, a boy aged 10 months, vomited on the evening of the 3rd Dec., and had diarrhoea and was "sadly" for five or six days. His throat was examined, but nothing abnormal was discovered. There was no dysphagia and there were no enlarged glands, no rash, and no subsequent desquamation. A boy aged 4 who has not previously had scarlet fever remained well. The mother, who has had scarlet fever, also remained well. There are four servants in the house all of whom have remained well.

E. S. aged 45, failed with scarlet fever on the 4th Dec. No history of source of infection could be obtained. No children live in this house, but six other female adults, concerning whom it has since been ascertained that they had no sore throats or other symptoms of illness near the date of onset of E. S.'s attack. Her attack was a dangerous one.

A. P. aged about 40, failed with scarlet fever on Dec. 4th. She is a lady district visitor, but no cases of scarlet fever have recently been notified in the district in which she visits. This also was a very severe case. The only other persons living in this house were an adult female cousin and two servants, all of whom have remained well.

H. B. aged 24, failed with scarlet fever on Dec. 5th. He was in London from the 30th Nov. to 2nd Dec., but was not known to have come in contact with a case of infectious disease. There were living in the same house the patient's father and mother, sisters aged 12, 19 and 20 years and a brother aged 16 years, and two servants. The mother and two servants had slight sore throat about the time of onset of H. B.'s attack of scarlet fever. None of them were sufficiently ill to ask the doctor to see them.

The preceding patients all lived in houses and streets remote from each other. No other cases of scarlet fever were known to exist at the time in the neighbourhood, except the two given in the table (group C. sec. 1), and these were carefully isolated. In only one of these two cases was the home supply of milk from P. On Dec. 9th however when the three last cases in group C. sec. 2 were notified, strong suspicion was aroused that the milk supply from P., which was common to all the seven cases in group C. except, as was then supposed, the first, might be at fault. A visit was therefore made to the farm from

which the majority of the dairyman P.'s milk is supplied, and on the strength of the information obtained at this visit immediate arrangements were made for keeping two milkmen away from their work.

The result of a more detailed inspection of P.'s dairy and employés which I made on the following day is appended:

Account of visit to P.'s farm, December 10th.

Mr P. states that he distributes from 330 to 350 gallons of milk a day in the town from his own farm at Z, and about 64 gallons a day from other sources. Thus between November 21st and December 9th he has had milk from seven farms, the milk coming almost daily from two of these farms. One of these auxiliary sources of supply is a creamery which collects milk from a large number of farms.

Seven families live in cottages close to Mr P.'s cowsheds. Among four of these families, including five children, there was no history of recent illness. The members of the other three families were examined with the following results.

T. K. and his wife, a girl aged 7, a girl aged 10, and a boy aged 16 form one of these families. On October 30th Edith K., the girl aged 10, had an attack which began with a headache. There is stated to have been no rash. She was examined by a doctor who said she had influenza[1]. On returning to school at the end of a fortnight she was examined by the Medical Officer to the School Board, for evidence of possible diphtheria. He did not detect anything wrong. No cases of scarlet fever have since occurred at this school. K. milks once a day. The other children at this house have remained well. Edith K. had scarlet fever when a year and eight months old. The children are stated never to take cold milk. The milk is generally boiled and they drink it chiefly in tea.

Next door live L. and his wife and two girls aged 9 and 5. Dorothy L. aged 5, began with a sore throat and enlarged cervical glands on or about November 2nd, three days after the girl Edith K. The mother when further questioned stated that E. K. began with a

[1] This doctor subsequently sent me the following letter:—"I saw K.'s child on 1st Nov. suffering if I remember right from a mild influenza. There was certainly no throat affection or anything else suspicious. I gave directions for treatment and told them to let me know if the child did not at once get better, and I heard no more. The reason K. sent for me was, I think, that she was afraid it might be something infectious, as P. is very particular."

"cold in her head," and that she often has enlarged glands in the neck. She also states that not much milk is drunk and chiefly in tea. Mrs K. informed me that there was definite sore throat when Dorothy L. was ill.

Mrs B. who lives next door to Mrs L. on one side (Mrs K. living next door on the opposite side) informed me that when she first came to this house the L. children frequently came in to play with her baby, and Mrs L. said to her, "I know your baby will have it, as they have all had it up here." Mrs L. also showed Mrs B. some peeling of her child's hand, and when Mrs B. saw this she said, "I should certainly have advice." Mrs L.'s answer was, "I do not want any advice if the child is not downright ill."

Mrs B. noticed at this time there was thick peeling on the palm of one hand and new skin coming up underneath. She also said that there was a similar state of things on the back of the same hand. It is stated however by the mother that this desquamation followed a sore place on the hand.

B. is a young man aged about 25, living in a cottage with his wife, and a baby 6 months old. They came to this house from a house in the neighbouring town, on November 2nd. The baby began to be ill on November 4th. She had a bad cough. There is said to have been no rash or sore throat. Mrs B. began with a bad cold about a week later. She had a cough and slight sore throat and was husky. B. himself had a sore throat beginning on November 30th, which hurt him in swallowing. Examined on Decr. 10th he had a suspicious looking tongue and an injected throat. He occasionally drinks cold milk. His baby is breast-fed and Mrs B. does not drink milk.

After my visit and the exclusion of the B. family, the L. family and the K. family from any communication with the dairy, no further cases of scarlet fever definitely connected with this milk supply occurred.

Statement of Evidence connecting P.'s milk with the cases in groups A. B. and C.

It must be admitted that the illnesses among the three families living in cottages adjoining the farm dairy were slight and atypical. In none of them could it be asserted with a high degree of probability that scarlet fever had occurred, unless regard be had to the circumstances in connection with groups A. B. and C. to be now explained.

The cases of scarlet fever in group C. did not alone justify a

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dogmatic statement that the infection was acquired from P.'s milk. Two cases Nov. 16—18 and five cases Dec. 2nd—5th in a milk supply averaging 330—350 gallons daily (of which the greater part was distributed in the town, and only a small portion in the neighbouring town H., in which one case of scarlet fever was notified on Dec. 6th) were fewer than might reasonably be anticipated in accordance with past experience of milk scarlatinal epidemics. Furthermore the last case directly ascribable to milk failed on Dec. 5th, while my measures of exclusion of the cowmen belonging to suspected or infected families did not take effect until the evening of Dec. 9th. Assuming the milk to be infectious, it was clearly only so spasmodically and at irregular intervals.

Assuming however that P.'s milk had caused the seven cases of scarlet fever occurring among his customers (group C. sec. 1 and 2) it became a matter of importance to determine whether the 270 to 290 gallons from his own farm or the 64 gallons coming from seven other farms had conveyed the infection. Three lines of inquiry were open. (*a*). The method of distribution of the milk from the different sources might possibly have helped. No records had however been kept of the method of distribution of milk from different sources. The milk from other farms than his own had been used by P. according to daily varying requirements, his own milk or his milk mixed with milk from these other sources being distributed in a manner which varied from day to day. (*b*). The necessity for an investigation at each farm was avoided by the discovery of (*c*) a crucial case. This was the very severe attack of E. W. (group C. sec. 2). Some months previously her father had complained of his milk supply, and it had always subsequently been sent direct from P.'s farm to his house in a padlocked can. As the simultaneous occurrence of scarlatinal infection in more than one farm supplying a dairyman was highly improbable, and as E. W.'s attack if caused by infected milk was caused by the milk from P.'s own farm, it was henceforth assumed that we had only P.'s milk to deal with.

We may now proceed to strengthen our chain of evidence by referring to groups A. and B. It will be convenient to refer first to group B. As will be remembered my attention was first drawn to the outbreak of sore throats at Miss C.'s school by a letter reaching me on Dec. 17th.

On interviewing the head teacher of this school I was informed that the milk supply was from X. dairy, a totally different source from P. This fact appeared at first to negative any connection between

groups B. and C. But the first patient in group B. was Miss J. (p. 153). This patient went home from Saturday to Monday and failed early on Tuesday morning. The milk at her home was supplied by P. and she had drunk this milk at home. No further inquiries could be made, but apparently Miss J.'s father and mother, infant brother, and the servants at her home had remained well. Assuming that she was infected by P.'s milk, the series of cases in group B. is comprehensible on the supposition that there was a direct transference of scarlatinal or some other form of infectious sore throat from her to them. No other source of infectious sore throat could be detected at this school; and I had no hesitation in linking the 16 cases in group B. on to the outbreak due to infected milk, through the intermediation of case I. (Miss J.), especially after I had re-investigated group A. in the light of the facts discovered as to groups B. and C.

Group A. consisted of 5 primary and 1 secondary case of sore throat (one of the five being undoubted scarlet fever) occurring among 16 day pupils. Seven of the pupils at this day school take unboiled milk at 11 a.m. This milk is supplied by P.

Of the seven who drink milk at school

2 had sore throat (2) (5),
1 had scarlet fever (4)
4 remained well.

Of the nine who did not drink milk at school

1 had a slight sore throat (1)
2 had a more severe sore throat (3) and (6),
6 remained well.

It appeared therefore improbable that P.'s milk had caused the outbreak. Further inquiry seemed to shew that case (1) was an ordinary sore throat (Oct. 19th) probably independent of the other cases. On questioning the doctor, who is the father of patients (3) and (6), it was ascertained that *P. supplies his household with milk.* These children therefore partook of the presumably infected milk at home. This important fact increases the probability that the cases in group A. were due to the same infection as groups B. and C.: and I am I think justified in view of the cumulative evidence which has been adduced, in inferring that this was probably the fact.

The three groups of cases may now be examined on the assumption that they were caused by P.'s milk, and their facts investigated from this standpoint. Their relationship in point of time to the cases on P.'s farm is shown in the following scheme.

(1). *As to Dates of Onset of Cases.*

Cases on P.'s farm	Group A	Group B	Group C
	(Oct. 29)	Oct. 29	
Oct. 30		Secondarily infected cases	
Nov. 2			
(?) ,, 4		Nov. 4	
		,, 5	
	Nov. 6	,, 6	
		,, 6	
		,, 8	
		,, 9	
		,, 9	
		,, 9	
		,, 9	
		,, 10	
(?) Nov. 11		,, 11	
		,, 12	
		,, 12	
		,, 12	
		,, 12	

Cases on P.'s farm	Group A	Group B	Group C
	Nov. 13...		
	Nov. 18		
	Nov. 16 (scarlet fever)		
	Nov. 18		Nov. 18 (scarlet fever)
Nov. 30			
			Dec. 2 (do.)
			,, 3 ,,
			,, 4 ,,
			,, 4 ,,
			,, 5 ,,
			,, 6 ,,
			,, 6 ,, (in another sanitary district)

The first case in group A. I regard as probably not belonging to the outbreak. The first case in group B. undoubtedly did belong to it: and it will be noticed that she failed a day prior to the first known case on P.'s farm, which *ex hypothesi* infected the milk. On the hypothesis of milk infection, either the dates must be wrong, which I think can be excluded, or an earlier case of infectious illness on the farm was not discovered, or the outbreak was caused by bovine disease independent of human infection. When the facts were investigated early in Dec. no evidence of udder disease was found, and fairly frequent veterinary inspections of the dairy had been made. I am inclined to think there was an earlier undetected human case of infectious sore throat. It was found that the children of the farm labourers had occasionally run in and out of the dairy, and been close to the cooling apparatus, and opportunities for infecting milk probably had arisen.

(2). *As to Multiplicity of Infection of Milk.*

If the milk caused the cases given in the preceding scheme, these cases including those on the farm divide themselves into three groups:

I. Cases originating Oct. 29th to Nov. 6th. In these cases symptoms resembling influenza occurred, or there was more or less

severe sore throat like the *Streptococcus* group B. (It will be remembered that all the cases in group B. are regarded as secondary to the case on Oct. 29th.)

II. Cases originating Nov. 12th to Nov. 18th. Two of these were scarlet fever: one was suspected of desquamating, and one other had only sore throat. This case however (group A. (5)) had had scarlet fever a year previously. He vomited at the onset of the present attack: and altogether his attack may be regarded as conforming to the more truly scarlatinal type shewn by the cases in group II. than those of group I.

III. Cases originating Nov. 30th to Dec. 6th. These with the possible exception of the farm labourer B. (onset Nov. 30th) were all true scarlet fever, most of them severe cases.

There was thus an increasing virulence of infection. B.'s condition when examined by myself on 10th Dec. I regarded as very suspicious. He could not remember whether he had suffered from scarlet fever in childhood.

It appears likely that there were three occasions on which the milk became infected. The total amount of infection must have been small or its infectivity slight, in view of the small proportion between the total number of cases and the volume of milk consumed. On the first occasion, only about 6 primary cases, including the farm cases, with 15 secondary cases are known to have arisen. On the second occasion four primary cases, two of them certainly scarlatinal, one other probably so, and one occurring in a boy partially protected by a previous attack of scarlet fever, and one secondary case occurred. This second group cannot be traced to any recent cases on the farm. The third group in my opinion was caused by infection from the farm labourer B. and all the cases belonging to it were severe scarlet fever.

(3). *As to the Amount of Infection.*

In calculating this, it will be advisable to omit all secondary cases, especially the 15 secondary cases in group B. The case in brackets at the head of group A. and the two farm cases marked ? are also omitted. With these deductions there were from Oct. 29th to Dec. 6th 16 cases in a milk supply averaging 330 to 950 gallons daily. Of these 7 were notified as scarlet fever, two others were very suspicious. The facts thus stated show that assuming the milk to have been the source of infection, the amount of infective material conveyed by it was small,

and the conveyance was only on exceptional occasions. These facts appear to me to exclude bovine infection, and to favour such casual human infection as may have arisen from P.'s workmen and their children.

(4). *As to the Character of the Infection.*

Were all the sore throats as well as the officially notified cases scarlatinal, or were two infections operating? The gradually increasing virulence of the cases, first sore throats, then sore throats mixed with undoubted scarlet fever, then a group composed entirely of cases of severe scarlet fever, supports the first view.

Some light may be thrown on this problem by the facts as to protection by a previous attack of scarlet fever of those attacked during this outbreak. Circumstances made it very difficult to obtain complete information under this head.

No information was obtained as to the children of P.'s labourers, except that the first case (supposed influenza) had scarlet fever eight years previously. In group A. one patient with sore throat had scarlet fever a year earlier. Cases (3) and (6) of this group, the former of whom was suspected of desquamating, had not had scarlet fever previously. In two cases of sore throat in this group the facts could not be ascertained.

In group B. complete data were similarly not obtainable. It is certain however that cases 2, 3, 7, 9, and 11 to 16 inclusive had not previously had scarlet fever, *i.e.* in 10 out of the total 16 cases in this group the fact that the attacks did not assume the typical type of scarlet fever was not due to a previous attack of scarlet fever. The cases in this group were undoubtedly infectious; from the throats of three of them pure cultures of *Streptococci* were obtained, which reminded me at the time of similar cultures from scarlatinal throats, and I incline to the view that the cases were truly scarlatinal although the only rash noticed was an evanescent erythema in two out of the 16 cases, and no desquamation was apparent in any case.

If this view be accepted, the most remarkable feature of this outbreak is the large proportion of cases of scarlatinal sore throat (*sine scarlatinâ*) which occurred.

Thus

	Scarlatinal Sore Throats.	Scarlet Fever.
Group A.	4 (or 5)	1.
Group B.	1 (primary case) 12 (secondary cases)	0.
Group C.	?	7 (or 8).

The facts as regards scarlet fever are complete. The same cannot be said as to cases of sore throat. There may have been a considerable number of such cases in this milk supply of which I have no knowledge. The outbreak illustrates the desirability of notifying all anomalous and untraced attacks of possibly infectious disease outside the present limit of the Infectious Disease (Notification) Act to the Medical Officer of Health. This would enable him in many instances to trace sources of infection much earlier than is now practicable.

If the same contagium caused the sore throats and the attacks of scarlet fever, it is evident that infected milk may carry the scarlatinal contagium in such an attenuated form or in such a minute amount that it is not capable of causing all the phenomena of scarlet fever. In group B. many of the attacks were most severe and septicaemic in type. They were apparently infectious: and yet not a single typical case of scarlet fever occurred.

Comparison with other Milk Outbreaks.

It will be useful in conclusion to contrast the experience in the above outbreak with certain well-known milk outbreaks of scarlet fever, as regards

(*a*) Proportion between families supplied with infected milk and the number invaded by scarlet fever.

(*b*) Duration of outbreaks.

(*c*) Occurrence of sore throat without clear evidence of scarlet fever.

The facts enabling this comparison to be made are embodied in the following table (p. 166):

(*a*). It will be noted that the lowest percentage of families supplied with the infecting milk who were invaded was 4 per cent. (Newcastle-on-Tyne), the highest 67 per cent. (Wimbledon). In the outbreak described in the preceding pages only 7 cases of scarlet fever were notified. If we add to these the 4 primary cases of sore throat in group A., the one primary case in group B., and all the 4 suspiciously invaded families connected with P.'s farm, the total number of cases is only 16. P. supplied 890 families, and the percentage of families implicated is 1·6. As already pointed out, no house-to-house investigation was made among P.'s customers, and probably more sore throats than those recorded above occurred. A similar state of things must almost certainly have occurred in many of the outbreaks with which comparison is made.

Date of outbreak	Locality	Reporter	(a) No. of families supplied by milkman	(a) No. of such families invaded	(a) Per-centage	(b) Duration of cause of infection	(c) Occurrence of sore throat apart from scarlet fever
[1]June 1867	Penrith	Dr M. W. Taylor	14	6	42	A few days	None reported
[1]April—May 1877	New Barnet	Dr C. E. Saunders	135	58	43	128 cases between Apr. 29 and May 4	140 total cases and 12 of sore throat
[1]May—June 1879	Newcastle-on-Tyne	Dr H. E. Armstrong	350	14	4	Not clear from summary	None reported
[2]Aug. 1879	Fallowfield near Manchester	Dr H. Airy	60 or 70	18	30 or 23	Of 35 total cases 24 within 36 hours	Two cases of sore throat reported
[1]Jan. 1881	Halifax	Dr Ainley	135	53	39	In 39 out of 51 houses in which the date of invasion was known, it was between Dec. 29 and Jan. 8	Of 53 invaded households, 35 had scarlatinal cases and 18 had cases of sore throat; and among the 35 households in which definite scarlet fever was recognised, sore throat occurred in other members of the family in 9 instances.
[3]Dec. 1880 to Jan. 1881	Wimbledon	Mr Cooper and Mr Power	273	174	67	25th Dec. to 8th Jan.	The epidemic is described as one of scarlatina and "throat illness." Mr Power remarks: "some (medical practitioners of the district) had noted now and again among attacks of comparatively speaking trifling sore throat occurring in fever-stricken households and elsewhere, anomalous cases, the precise nature of which might, but for this relation with the scarlatina, have been open to doubt"
[4]Aug. 1892	Glasgow	Drs J. B. Russell and Chalmers	359	94	26	1st to 12th Aug.	152 families altogether were attacked, but of these 58 were supplied by countertrade, and the number of families out of which these attacks occurred could not be ascertained
[5]1900	Clifton	Dr D. S. Davies	269	42	16		

[1] Extracted from "The Influence of Milk in Spreading Zymotic Disease," by Ernest Hart, *Trans. Internat. Med. Congress, London*, 1881, Vol. IV. p. 491.

[2] *Ann. Rep. of the Med. Off. of the Local Gov. Board* for the year 1879, p. 93.

[3] *ibid.* 1886, p. 327.

[4] *Glasgow Med. Journ.* Jan. 1893, p. 1.

[5] *Journal of Hygiene*, Vol. I.

(*b*). In duration of the cause of infection, as judged by the dates of notification of cases, the present outbreak is very exceptional, and it appears to lend itself best to the supposition given on p. 162 of three successive infections of the milk.

(*c*). In many of the other outbreaks sore throat apart from other evidence of scarlet fever frequently occurred alongside of definite cases of scarlet fever. So far as I can ascertain, however, the present outbreak is unique in regard to group B., unless it be maintained that the members of this group were not secondarily infected by the milk-infected sore throat of Miss J. (group B. I.). This must remain to some extent a matter of opinion. In view of all the facts, I am of opinion that group B. consisted of scarlatinal sore throats occurring chiefly among girls unprotected by previous attacks of scarlet fever, and that Miss J. introduced this mitigated infection into the school.

The following two outbreaks may be adduced in conclusion. The late Dr (afterwards Sir R.) Buchanan describes[1] an outbreak in Kensington in which 12 persons "were attacked with scarlet fever and six others with sore throat or with sore throat and other symptoms resembling scarlatina" within 5 days of June 9th, 1875. Dr Buchanan adds, "I note that 4 persons who had not to their knowledge had scarlatina before and who were exposed to circumstances apparently identical with those that produced scarlatina in 13 others, had no scarlatina rash, but some form of sore throat: one of these four having serious laryngeal symptoms." This outbreak was traced to infected cream.

Dr J. K. Warry[2] reports on "a recent outbreak of septic sore throat disease apparently caused by infected milk." The outbreak as near as could be ascertained prevailed during nearly the whole of April and the first week in May. This protracted duration may be compared with the dates given on p. 162. In ten cases in this outbreak observed by one doctor, the symptoms were tonsillitis (not follicular), with considerable swelling of the cervical lymphatic glands, an elevated temperature lasting in nearly all the cases for at least a fortnight, great prostration, in one case acute septicaemia ending in septic pneumonia and death, in two cases acute nephritis, etc. In some of the families the suspected milk was always boiled before use. No complete notification of cases could be obtained, but in two areas a house-to-house visitation was made with the following result:

[1] *Report of Med. Off. to the Loc. Gov. Board*, New Series, No. VII. 1876, p. 72.

[2] *Annual Report, Borough of Hackney*, 1900, p. 60.

	No. of Houses.	Percentage Households affected with sore throat.	
		(*a*) Among households supplied with the suspected milk	(*b*) Among other households
Area A.	168	29·1	2·0
Area B.	75	14·2	0·0

In none of the implicated families did any recognisable cases of scarlet fever occur. I place the bare outline of the interesting outbreak described by Dr Warry on record, but am unprepared to give an opinion as to whether they were "septic sore throats," or were sore throats like those of group B. in the present outbreak, which I have preferred to regard as scarlatinal in nature. If my view as to group B. is correct, it opens up a vista of increased difficulty in the recognition and therefore in the prevention of scarlet fever. That this difficulty must be recognised and admitted, as we already recognise and admit it in the case of diphtheria, is I think an important practical inference from the facts narrated in the preceding pages.

Conclusions.

If the view taken as to the connection between the groups of cases described in this paper be correct, the following conclusions are suggested:

1. Scarlet fever may be caused by infected milk containing the contagium in such an attenuated form or minute quantity that no symptoms manifest themselves except an anomalous sore throat with fever.

2. Scarlet fever may assume this type in a large number of children who have not been partially protected by a previous attack of scarlet fever.

3. If such anomalous cases occur among milkmen or their families the milk may be infected at intervals for a much longer time than has been recognized in previously described milk-outbreaks of scarlet fever and scarlatinal sore throat.

4. The fact that only a few cases of scarlet fever are traceable to a given milk supply does not necessarily shew that this milk is not infective. The fewness of the cases in this outbreak, and their sporadic character, is analogous to the suspected connection between sporadic cases of enteric fever in the metropolis and the presence of excessive amount of organic matter in the metropolitan river water-supply

(Corfield) or the occurrence of floods a fortnight before the onset of the cases in question (Shirley Murphy). In each instance the dose of the contagium is small, and the detection of causative connection between the infecting material and the cases of disease is difficult. The demonstration of the connection is impossible.

5. The occurrence of anomalous attacks of sore throat, as in this outbreak, indicates the desirability of the notification of all such cases to the Medical Officer of Health. He would by this means be placed in a much more favourable position to trace sources of infection. My views on this subject are set out in full elsewhere[1].

[1] "A National System of Notification and Registration of Sickness," *Journ. Roy. Statist. Soc.* Vol. LIX. Part I.; and "Possible Medical Extensions of Public Health Work," *Journ. State Med.* Sept. 1901.