

MILK EPIDEMIC OF SCARLET FEVER AND ANGINA, ORIGINATING FROM A MILKMAID WITH SCARLATINAL OTITIS MEDIA

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(With 2 Figures in the Text)

NOTWITHSTANDING the comprehensive literature on the subject, we think that this milk epidemic of scarlatinal angina ought to be published because, for one thing, the significance of the type classification given by F. Griffith, as far as we have been able to find out, has been elucidated only by two milk epidemics—the Chelmsford epidemic (Camps & Miller Wood, 1936) and the Doncaster epidemic (Watson 1937)—and also because this epidemic differs from most of the larger epidemics described before in that direct infection from one person to the milk took place and was then followed by infection of the consumers of the milk, without a cow as the intermediate link.

SURVEY OF THE EPIDEMIC

In Vejle (a town in Jutland, with about 25,000 inhabitants) on 13 April 1937, about twenty cases of scarlet fever were reported; on the next day about forty cases of this disease were reported to Dr Ingböl, the county medical officer. This was the culmination of the epidemic.

The explosive character of the epidemic suggested milk as the distributing agent. A brief questioning of several of these patients showed that they had been receiving raw milk from the same dairy, "F", in Vejle. When the owner of the dairy was given the names of the streets in which the frequency of the disease was particularly pronounced, he was able at once to state which milk-cart supplied this part of the town, and from which farms the milk was obtained.

An investigation carried out by the county medical officer on these farms revealed the presence of a milkmaid with desquamation of the skin of the hands and a purulent discharge from the ear. She was hospitalized at once in the Vejle County Hospital. All the milk from this dairy was submitted to pasteurization. (14 April.)

During the following days the epidemic continued to subside. A total of 128 patients were admitted to the hospitals of this town and neighbouring towns with the diagnosis scarlet fever. Every patient with a rash was hospitalized. Families in which scarlet fever appeared showed not infrequently one or more cases of angina (usually in a mild form); these were not hospitalized.

One of us (H.) went to Vejle in order to assist the county medical officer in an investigation of the possible causes of the epidemic.

The investigation included: (1) a general epidemiological inquiry; (2) an examination of cultures from the throat of all the hospitalized patients and of all the inhabitants of the suspected farm; (3) examination of the cows on the suspected farm. Dr Krogh, the supervising veterinary surgeon of the Vejle district, examined the stock of the suspected farm for mastitis, and took samples of milk from every cow. This examination was performed twice, with an interval of 6 days. The milk was examined partly in the State Veterinary Serum Laboratory, partly in the State Serum Institute. In both investigations, the cows as well as the milk were found to be normal.

The results of the various examinations are in close agreement, and they form the basis for the following description.

CHARACTER AND NATURE OF THE EPIDEMIC

Clinically, the local physicians made the diagnosis scarlet fever without hesitation as soon as the first cases occurred. The patients presented a characteristic angina, exanthema, enanthema, and glossitis. In many of the patients, however, the exanthema was slight and of brief duration.

The bacteriological examination showed that everyone of the affected persons was infected with β -haemolytic streptococci, belonging to group A, type 3. Biochemically these streptococci behaved as follows:

Lancefield grouping	A
Griffith typing	3
Haemolysin in solution	+
Haemolysin on plates	β
Hydrolysis of sodium hippurate	-
Reduction of methylene blue in milk	-
10 % Growth on bile-blood 40 % agar plates	-
Trehalose	+
Sorbitol	-
Lactose	+
Sucrose	+
Salicin	+
Mannitol	-
Inulin	-
Raffinose	-
Aesculin	+

Epidemic curve. On the basis of the data obtained the curve for the epidemic could be plotted as shown in Fig. 1. This curve illustrates clearly the origin and course of the epidemic.

An analysis of the curve leaves no doubt that the infectious agent had been spread only during a short time, possibly only 1 day.

Extension of the epidemic. The investigation showed that the epidemic affected the whole town of Vejle; in addition it showed that more than half of all the cases made their appearance in the part of the town, marked in black on the map of the town (Fig. 2). The other cases were distributed over the rest of the town and the surrounding country. All the patients who had their residence outside Vejle were working or going to school in Vejle, where

**Milk epidemic of scarlatina,
Vejele, 1937**

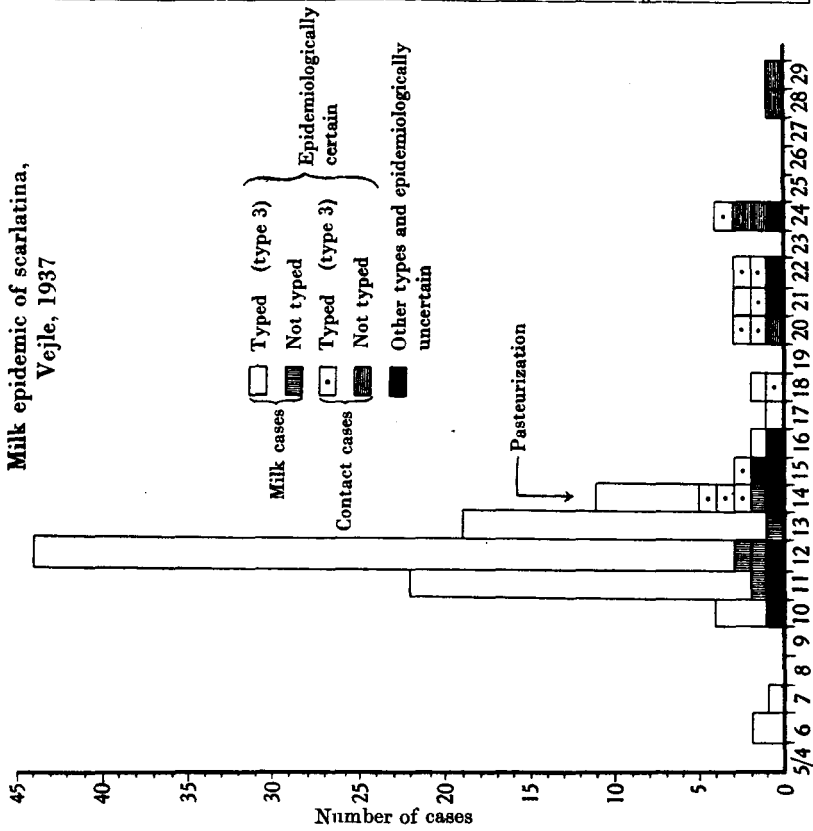


Fig. 1. Curve for the milk epidemic of scarlatina

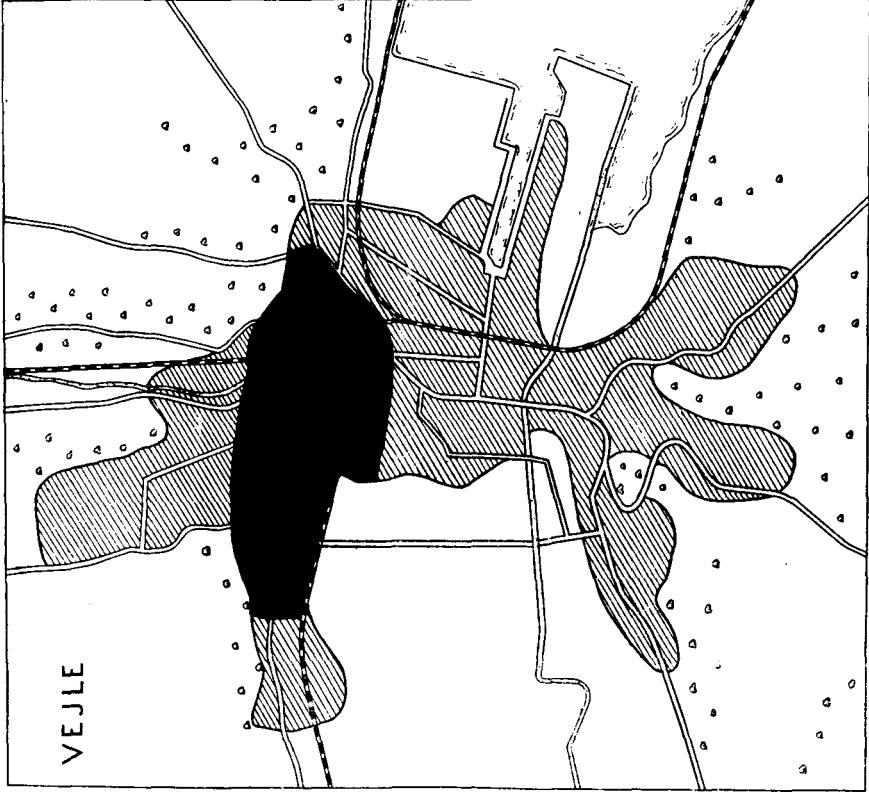


Fig. 2. Map of the town of Vejele and surroundings.

they got the milk for their lunch from the dairy "F", while the respective households were supplied with milk from other dairies.

Extent of the epidemic. The investigation comprised altogether 128 patients. To be reckoned as a case belonging to this epidemic it was required that the patient had taken raw milk distributed through the dairy "F", or had been in direct contact with a "milk case", or that the throat culture showed growth of *Streptococcus* type 3. Most of these patients complied with at least one of the epidemiological criteria and with the bacteriological one.

Table I. *Survey of cases examined*

	Patients
Belonging to the epidemic, typed (type 3)	108
Belonging to the epidemic, non-typed	10
Not belonging to the epidemic, typed	8
Not belonging to the epidemic, non-typed	2
Total	128

Among the ten cases that were judged as not belonging to this epidemic, five patients showed growth of streptococci type 4, while two patients showed type 11, and one patient showed type X; in two cases the cultures showed no growth of streptococci. Of these ten patients two (one of type 4, the other of type X) had taken raw milk from the dairy "F"—one of them on the day before the outbreak of the epidemic. The others had never consumed milk from this dairy.

In one scarlet fever patient with type 11, otitis media appeared 3 weeks after the onset; cultures from the pus of this patient gave a growth of *Streptococcus* type 3. In the hospital this patient was warded in the same room as patients with type 3.

Among the 118 cases that had to be reckoned as belonging to the epidemic, direct infection through the milk was the more likely in 107. In the remaining eleven cases (9 %) infection through contact seemed more likely.

Among the 107 primary milk cases, thirteen developed in families in which no milk from "F" was used in the household, whereas milk from this dairy was consumed by the respective patients at their working place.

PERCENTAGE OF "TAKES"

Detailed information was obtained of seventy-eight households with 339 members, among whom ninety-three cases of the infection was observed, namely: eighty-nine primary milk cases and four contact cases. (No reliable data were available concerning the households corresponding to the remaining 14 cases.) The total percentage of "takes" was 27. Calculating the *primary milk cases* in proportion to the number of *milk consumers* (i.e. 89 out of 284) the total percentage of "takes" is 31. Grossly these figures are in keeping with the percentage found in the gymnasium, where seven cases developed among twenty-seven milk consumers (=25 %). These figures do not give precisely

the number of *Streptococcus* infections, as in several families some members, besides the scarlet fever patients, complained of sore throat, hoarseness for a few days or merely a little difficulty in swallowing.

SEX AND AGE DISTRIBUTION

As may be seen in Table II, the sex distribution was fairly equal, corresponding to the fact that the total material contained about the same number of males and females.

Table II. *Age and sex distribution of patients*

Age years	Females	Males
0-4	6	8
5-9	13	14
10-14	19	13
15-19	12	12
20-24	2	3
25-29	3	2
>30	7	2
	62	54

50 = 81 % 47 = 87 %
 12 = 19 % 7 = 13 %

The younger age groups are represented relatively more plentifully, as about 85 % of all the patients were less than 20 years old, although these age groups made only about one-half (52 %) of all the persons exposed. No explanation of this fact can be offered.

INCUBATION PERIOD

From the data obtained, the incubation period appears in most cases to have been 1-2 days—which is quite in agreement with experiences from other milk epidemics due to *Streptococcus*.

Whether the late "milk cases" on 16, 17 (and 18) April are instances with a long incubation period (up to 8 days), or whether they indicate a contamination of the milk in the days between 10 and 14 April, is a question that cannot be settled.

CLINICAL FEATURES

As mentioned already, all the hospitalized patients showed signs of typical scarlet fever. On the whole the disease has to be characterized as relatively mild. One case, that of a woman, aged 66 years, infected through contact with a grandchild, terminated fatally—from bronchopneumonia—after confinement to bed for 3 weeks.

Complications were relatively few, and they all took a fairly benign course (Table III).

Table III. *Complications*

	Cases
Cervical adenitis	26
Otitis media	5
Albuminuria (only a few days)	4
Joint complaints	10
Bronchopneumonia	1

Relapse occurred in 2 cases

On questioning the patients and the local physicians it was learned that within the same period about fifty patients with sore throat had been treated at home. Several of these cases occurred in families in which other members had contracted scarlet fever. Some of them were designated as "suspected" of scarlet fever; others presented joint complaints, albuminuria or otitis media.

Even though no cultures were made from these patients, it is justifiable to look upon a majority of them as originating from infection through milk or contact with "milk cases" and thus belonging to the epidemic.

ORIGIN OF THE EPIDEMIC

The investigation confirmed the original assumption that here we were dealing with a milk epidemic. As mentioned, it was established at once that on one of the farms supplying the town with milk a milkmaid had had an attack of scarlet fever. In abstract, her case history is as follows:

E. A., female, born 1 February 1910, employed by Mr C., a farmer of V. . . .

On 8 March 1937 she underwent an operation in the nose (bilateral inferior conchotomy). Four days later she had a sore throat and fever, but the temperature subsided to normal within a couple of days. On 18 March she again had sore throat and fever (38.6° C.). She was hospitalized for peritonissillar abscess, where she was treated with hot poultices. On 23 March she again had sore throat; and on the following day a diffuse exanthema was observed, which was taken to be a drug rash. On 28 March she was discharged from the hospital. *Soon after, she had a purulent discharge from the right ear.* For this she was given ambulatory treatment by an otologist. On 8 April the patient noticed that the skin of her hands was peeling off. On the farm she was milking in the morning and evening. She stated herself that the discharge from her ear was so copious that to prevent the pus running down her cheek she had to keep on a bandage. The discharge was so profuse, moreover, that she was exempted from cooking "because the pus would drop down in the cooking pots" (!).

On 13 April the patient was isolated in the hospital. Cultures from her ear and throat showed *growth of β -haemolytic streptococci, group A, type 3, in every respect identical with the streptococci obtained from the epidemic patients.* Cultures from her hands, however, gave no growth of this organism.

There could be no doubt that the milk had been contaminated directly with pus from the ear of this milkmaid. Examinations of the cows showed, as mentioned, that they had not become infected and thus could not have formed an intermediate link—through streptococcal mastitis—between the human source of infection and the milk. Inquiry into the conditions concerning the transport of the milk from the producer to the dairy and from the dairy to the consumers further confirmed the connexion between the scarlet fever in the milkmaid and the outbreak of the epidemic.

The dairy "F", furnishing a part of the milk consumed in Vejle received milk from eight farms in V. . . . On one of these farms the woman E. A. was

servicing as a maid. The milk produced on this farm amounted to about 75 l. daily (morning and evening milk together); but only a part of this daily output was distributed to consumers in Vejle—namely, the morning milk (about 35 l.).

When the milk arrived at the dairy, it was weighed at once and then conveyed to the cleaning centrifuge, from which it was led to a chilling apparatus, and then bottled. Subsequently the milk from the other farms (about 800 l. altogether) passed through the same vessels, but *no real mixing of the first 35 l. with the following 800 l. was ever carried out*, since the bottling proceeded gradually as the milk was treated in the cleaning centrifuge and in the chilling apparatus.

The milk was distributed through nine carts and eight shops. The owner of the dairy was able with certainty to state that the milk from V. . . was sold chiefly from cart no. 2, and to a lesser extent from cart no. 1 and from four shops.

More than half of the scarlet fever cases occurred along the route supplied through cart no. 2, this route covering essentially the black area on the map. It seems obvious to assume that on 10 April this cart was just provided with that relatively small portion of the milk that came from the farm here concerned (from this cart a total of 50–70 l. of raw milk was sold daily).

As mentioned, this part of the milk was never separated sharply from the rest of the milk, as this passed through the same vessels. Also the other carts and shops have sold milk containing streptococci, but presumably the contamination was not so massive. This explains the cases scattered over the other parts of the town.

COMBATING THE EPIDEMIC

The first measure taken by the county medical officer was to insist upon the pasteurization of all milk from the dairy "F". The first day that this took place was 14 April; if we correlate this date with the curve for the epidemic, we find that the pasteurization may hardly have had any influence upon the course of the epidemic. Furthermore, delivery of milk from the farm here concerned to the dairy was prohibited till the conclusion of this investigation.

All the patients diagnosed as scarlet fever were hospitalized in the epidemic wards of various hospitals in the county.

COMMENTS

It is hard to see how contamination of the milk from a human source of infection may reach such a degree that the milk is able to infect so many persons, unless we assume that the streptococci have been multiplying in the milk.

We did not have the opportunity of examining the strain of *Streptococcus* here concerned, freshly isolated, in milk from the cows on this farm. Nor have

we examined the cultural behaviour of this strain in milk after it was transplanted several times and thus had been accustomed to artificial culture media. According to general experience, streptococci of group A grow in raw milk but very poorly. It would be difficult, however, to exclude the possibility that under particular conditions a *Streptococcus* strain of this group may multiply in the raw milk of a certain cow.

In this connexion it is to be kept in mind that we know nothing about how small the disease-producing dose of streptococci may be under suitable conditions. One feature common to all streptococcal milk epidemics is that they show many primary milk cases and very few contact cases. This suggests that conditions favourable to the "take" of the infection are present when the streptococci are ingested in milk.

Minett (1932) claims that direct infection of the milk from man is conceivable only in solitary cases or in very small epidemics, and that "the history of larger outbreaks points unmistakably to heavy and continuous contamination of milk supply"—and further "it can scarcely be doubted that such contamination can only arise from an actual infection of the cow's udder". Gollidge (1932) subscribes to this view.

We think that the epidemic here reported illustrates undisputably that even fairly large epidemics may break out without any cow as the intermediate link between the human source of infection and the milk.

SUMMARY

A report is given of a milk epidemic of scarlatinal angina, comprising 118 cases of scarlet fever and about fifty cases of sore throat.

The infection was spread through contamination of the milk from a milkmaid with purulent otitis media after non-recognized scarlet fever.

On cultivation, *Streptococcus pyrogenes*, group A (Lancefield), type 3 (Griffith) was isolated from 108 of these patients and from pus from the ear of the milkmaid. The cows, on the other hand, and their milk were found to be normal (two examinations at an interval of 6 days).

Inquiry into the conditions under which the milk was transported from the producer via the dairy to the consumers and information concerning the distribution and consumption of the milk confirmed in all details the assumption as to the causal connexion between the otitis media in the milkmaid and the outbreak of the epidemic.

This epidemic furnishes an example of transmission of the infection from man directly through the milk to a fairly large number of consumers without any intermediate infection (mastitis) in the cows.

Clinically the cases in this epidemic may be said, on the whole, to be mild; still, one of the patients died of complicating bronchopneumonia.

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