Report on an outbreak of scarlet fever in Glasgow connected with an epidemic teat eruption on milch cows at Jaapston / by Jas. B. Russell and Arch. K. Chalmers ; with a report by E. Klein on certain material sent him.

REPORT

(8)

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CONNECTED WITH

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BY

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WITH A

Report by E. Klein, M.D., F.R.S.,

Professor of Bacteriology in the College of State Medicine, London,

ON CERTAIN MATERIALS SENT HIM.

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ON CERTAIN MATERIALS SENT HIM.

On Friday, 5th August, 1892, when the inspectors returned from their usual round to report upon the cases notified that morning, it was learned that two out of four cases of scarlet fever reported from the southern district of the city were customers of a dairy which had on the previous day been noted as bearing a similar relationship to another case of scarlet fever then reported. On looking over the record of the preceding days, it was seen that on Friday, 29th July, one member of a fourth family consuming milk from the same source had been reported as having also developed scarlet fever, so that it was with some anxiety that the notifications from this district, of Saturday, 6th August, were awaited. When they came to be investigated, it was found that they represented seven cases in six families, all of which were customers of the dairy in question. We had thus

in the three days, 4th, 5th, and 6th August, ten cases of scarlet fever in the southern district, all using the same purveyor's milk, and seven of them had come to our knowledge on the last of the days mentioned. Although there had been, during the previous weeks, an upward movement in the number of cases of scarlet fever occurring throughout the city generally, it was sufficiently evident that, in this instance, we were in the presence of a stream of infection which was more than usually active, and was also, from the rapid increase of the numbers attacked within a limited area, probably concentrated. Accordingly, written intimation was at once made to the proprietor of the dairy in question that a number of his customers were being attacked by scarlet fever, and with this was coupled the request that he should furnish us with the source and distribution of his supply. Following this communication events were rapid in their development. The accumulated notifications delivered in course of post between the evening of Saturday, 6th, and morning of Monday, the 8th August, applicable to this district, and with reference to scarlet fever alone, numbered between 60 and 70. It was now manifest that an explosion of some considerable magnitude had occurred, and almost coincidently we learned that the immediate cause thereof had been discovered, and further injury averted. It remained therefore for us to ascertain the extent of the mischief already done, and to enquire whether the source of the outbreak could be traced. But, before answering either of these questions, it will be well to relate what transpired at an interview with the purveyor of the milk in question on the morning of 8th current; for, as will be seen, it was owing to his rapid apprehension of the bearing of the queries contained in our communication to him of the 6th August, already referred to, and the prompt action which followed the enquiries he thereupon made, that the outbreak was quelled almost in its incipiency. When the carts delivering the supply of milk to the dairy arrived on the morning of 7th August, he made enquiry at those in charge as to the health of the inmates of the farms from which they came, and later in the day he visited the farms, and in the family of one of them found that one member had sickened of scarlet fever on the evening of 4th August. He thereupon directed the supply from this farm to be stopped, and, returning to town, withheld from sale between 40

and 50 gallons of that morning's supply from the farm in question (about half the quantity). This he retained until it was afterwards, by direction, destroyed. We had thus gained something like 24 hours in our movements.

Enquiries at the Farm.

Immediately on learning that the implicated farm was situated in Renfrewshire, communications were opened up with Dr. Campbell Munro, the County Medical Officer, and in each subsequent step in the investigation, outwith the boundary of the city, suggested by what came to our knowledge of the incidents of the epidemic within it, we had the hearty co-operation of Dr. Munro and other members of the sanitary organisation of that county. It should here be stated that when the dates of sickening of the earlier cases occurring among the customers of the Glasgow dairy were compared with the date on which the patient at the farm was attacked, it was impossible to regard the latter's illness as having any causal relationship to the others, and we had, therefore, provisionally formulated the opinion that the cause in operation was common to both. It so happened that our telegram to Dr. Munro, intimating the connection of the outbreak in town with the farm in question, was transmitted to him when he was already in the vicinity of the farm, making enquiry in connection with the illness there, notification of which had, in course, been transmitted to him by the medical attendant. When, therefore, on the following day (9th August), we had an opportunity of consulting with him on the matter, and had heard from him of the condition of things present among the farm stock, it was decided to invite Principal M'Call, of the Veterinary College, to assist us in this branch of the inquiry. Accordingly, on the afternoon of the same day, a conjoint visit was made to the farm, and during this and subsequent visits the following condition of affairs was ascertained:—The farm, or rather farms (for there were two separate houses, Jaapston and Aboon-the-Brae, situated about a mile apart, but under the same control), are situated in an upland and bracing district of Renfrewshire, and on examining the byres and milk-houses, it was at once seen, and we were unanimously of opinion, that the business of the dairy was conducted with scrupulous attention to cleanliness, and that none of the conditions usually

regarded as insanitary were present. Further, it should be stated, that although by this time the delivery of milk had been completely suspended, the farmer and all his dependents received us courteously, and displayed every wish to impart information, and to assist us in our enquiries.

Previous to Whitsunday, his milch cows were kept at one of the farms—Jaapston—and at that date the number in the byres was 45. Two or three days after the term, owing to the business of the dairy increasing, a division was made, and 20 of the cows were sent to Aboon-the-Brae. Between that date and the present occurrence, additions had been made to both stocks—viz., 3 to the lower, and 5 to the upper herd—so that at the time of our enquiry there were in all 53 cows yielding milk. Further, when the illness from scarlet fever in the farmer's family at Jaapston had been brought to the knowledge of the Renfrewshire Authorities, the cattle then in these byres were, by their orders, moved to Aboon-the-Brae, where we found the whole herd on the day of our visit as above.

History of Eruption on the Milch Cows.

In dealing with this, it will, for the sake of historic coherence, be advantageous to place together, in the form of a continuous narrative, all the information which we became possessed of at one time or another during our investigation, it being premised that the importance of many facts, as they came to our knowledge, was only fully apprehended when others, which we subsequently became possessed of, were also known.

One point may be here referred to, and meanwhile dismissed, because its significance can only acquire due emphasis from the testimony of Principal M'Call. Its importance, however, when placed in conjunction with the conditions to be immediately described, will be readily recognised, and as some mention of it is necessary to give completeness to this statement of the problem which presented itself to us, no further apology need be made for the digression. Mention has already been made of the favourable impression created by the evidences of careful management which were present in all the surroundings of the byres and milk rooms, and it now remains to add that this impression was maintained by the appearance of the animals themselves. They were much

of the time in the open air; they ate well, and were well nourished. It was noticed that there was no evidence of general disturbance of the system in any of them—no persistent cough, no increase of temperature, no rough or "staring" character of their coats—and nothing unusual in the quality of their milk had been observed. The only thing, indeed, that did attract attention or create suspicion was an eruption on their teats. This had made its appearance after the following manner:—Prior to the division of the herd at Whitsunday, it cannot, with precision, be affirmed that this eruption was present on any of them. Our first information created the impression that it was not. Later we found that it may have been, because, at Whitsunday, one of the milkers had a sore hand (pimple behind the nail of an index finger), which she connected with some similar condition on the cattle. Questioned further on this point, her impression at first seemed to have arisen from the recollection of one or two of the cows becoming restive while being milked, but it assumed to us a different complexion when she added, in a phraseology which we had now learned demanded careful scrutiny, "But it was different from now; it began as a scab." Nothing more definite than this seems to have happened until about four weeks before our visit. At that period there began in the herd at Aboon-the-Brae a very definite outbreak of the teat eruption, and within a fortnight every animal in the byre was affected. The virulence of the outbreak clearly fixed its occurrence in the memory of all the farm hands, and from this period the succession of events could be distinctly traced. After this had continued for about two weeks in the upper herd, an outbreak occurred in the Jaapston byre, and at our first visit almost all the animals of the latter were suffering.

Appearance of the Eruption on the Cows.

The character of this in its earlier stages cannot be described with even approximate accuracy. It is evidently small, and apparently insignificant in its beginning, and does not attract the milker's attention until tenderness causes restiveness in the cow during milking. By this time an ulcerating stage has usually been reached. In one animal only did we find a subcutaneous vesicle not attracting the eye until the finger had first detected a

slight thickening or undue resistance on manipulating the teat. This vesicle, on being punctured, exuded a straw-coloured serum. In others there was seen a quasi-papular form, with viscid whitish-coloured contents, which could not be taken up by capillary attraction, while on most of the animals the sore existed as a reddish-brown crust, blackening in the centre, and which could, without much difficulty, be detached from a superficial ulceration of varying dimensions. When this was done, some faintly-coloured, and probably blood-stained fluid exuded, or could be pressed out. Three or four of these would be present on a teat, and sometimes all the teats were affected. It was rare to find one present alone. Nor was it with any certainty that their presence could be recognised on the udder. Some few spots did exist, chiefly in the neighbourhood of the base of the teat, but they were of small size, and in appearance suggested drying pustules. There was no attempt here to simulate the scabbing so prevalent on the teats, most likely because of the absence of friction by the finger in milking. Neither was it possible to say that any of the teats were swollen or œdematous, although many were very tender to pressure. Regarding the stage immediately preceding the formation of the crusts, it is impossible to affirm that there was indubitable evidence of umbilication. As to size, many of the spots were barely of the diameter of a threepenny piece, and these were circular. Most, however, were larger than this, and these tended to assume an elongated form—in some cows, of more than 1 inch in length—in the long diameter of the teat. The margin of the ulcers left on separating these crusts was not raised, and, while sharply demarcated, there was no surrounding areola, or secondary vesiculation. In one or two examples, where a previously existing sore (chapped teat) seemed to have afforded the centre for inoculation, a transverse fissure through the crust was present, recalling the appearance of the sore on the fingers of a milker which is still to be described.

Sores on the Hands of the Milkers.

Some questions of importance here arise as to the effect of the teat eruption on the hands of the milkers. The uncertain relationship existing between the possible presence of sores on the teats of some animals in the Jaapston byres about Whitsunday

and a sore on the hand of a milker has already been mentioned. This girl went with the part of the herd which was sent to the other byre at Aboon-the-Brae at that time, and, with two others, thereafter attended exclusively to them. In the Jaapston byres there were four milkers also exclusively engaged with the cows there. These had the occasional assistance of the farmer himself, and it seems at least possible, although there is no evidence in his own recollection, that he would occasionally examine, although he never milked, the cows of the Aboon-the-Brae herd. This broad distinction, however, remains, that none of the milkers in the Aboon-the-Brae farm were affected (excepting as after-mentioned), while two of the four who regularly milked the Jaapston herd suffered as well as the farmer himself, who, as has been said, only occasionally did so. Further, and with reference to the above exception, it may especially be remarked, as having some as yet uncertain bearing on the possible specific and varied nature of these eruptions, that the girl who originally suffered while milking the lower herd was again affected under the following condition :— On the afternoon of Friday, 12th August, it was possible to separate from the combined herds several cattle, most of which had recovered, and one or two which probably had not been attacked at all, and this girl was one of those told off to attend to these alone. The milking of Friday morning (August 12th) was the last time she was in contact with the affected cattle, and while in church on the following Sunday she felt her left forearm becoming painful, and afterwards discovered that a spot was present thereon near the elbow. On the following Tuesday a second spot appeared on the right eyebrow, and when seen on the following day both sores were (evidently from the irritation of scratching) in a state of pustulation. The character of the sore which she had on her finger while in the lower byre at Whitsunday thus becomes doubtful—and, indeed, the girl states that she had suffered in a somewhat similar manner on previous occasions on other farms. The hands of the farmer presented, when we first saw him, two sores of a somewhat definite character. In front of the wrist there was a small circular spot of about the diameter of a split pea, having no inflammatory areola, but with sharply-defined edges and of a distinctly vesicular nature. The centre of the spot was blackening on the surface, apparently from desiccation, but there was nothing

suggestive of depression or umbilication. The fluid contents increased, and on 12th August we obtained, by puncturing, some faintly straw-coloured lymph therefrom. Subsequently this sore healed by scabbing. On the inner aspect of the thumb posteriorly there was a second sore, larger in size and more irregularly shaped, but presenting some features corresponding with those already described. On the site of this sore prior to inoculation, there had existed an abrasion of the skin, caused by friction, and its appearance was angry and erysipelatous-looking, differing only in degree apparently from one or two sores on the cows, which had manifestly arisen in the neighbourhood of a "chapped" or "fissured" teat. Two others of the Jaapston milkers had also suffered, but one had in consequence been compelled to stop work and go home, and the other, the farmer's wife, was then in attendance on her sick child. She attributed her sores to inoculation from the teats on the site of punctures and scratches received while picking fruit, in which occupation all the farm hands at Jaapston were more or less engaged at the time. In her case there were vesicles on several fingers of right hand, and the local inflammation during maturation was such as to compel her to keep her hand raised across her breast as much as possible.

Collection and Distribution of the Milk.

The premises from which the distribution of the milk took place are among the most recently constructed of the kind in Glasgow, and are admirably suited for the purpose. The quantity of milk and cream received and delivered daily, between the middle of July and the time of the present enquiry, averaged 150 gallons, consisting of 75 gallons sweet milk, 61 gallons skim milk, and 13 gallons of cream. Of this daily quantity the amount received from the suspected farms represented 94 gallons (46 gallons sweet milk, 39 gallons skim milk, and 8½ gallons cream), the remaining 56 gallons being obtained from another farm. In both cases the milk was delivered at the purveyor's dairy by the farm carts, which were driven direct from the farms. In regard to the suspected milk, it will be remembered that it was the combined yield of two separate herds, collected in the following manner, and delivered to the purveyor, without distinction of source, as one supply :— The milk from the herd at Aboon-the-Brae was first driven to

Jaapston, and the butts were then transferred to a Jaapston cart, and, along with those containing the portion of the milk there obtained, were driven by a man-servant of that farm to the purveyor's premises, as already mentioned. The custom here followed was to allow each driver to empty his butts into the vessels of the purveyor on arrival, under this restriction that the cart first to arrive had the contents of its butts emptied and measured before any milk was discharged from the other cart, if it had by that time arrived. Further, the custom also was to empty all the butts and return them at once by the carts, although it occasionally happened that a butt would be left over unemptied at the time, from temporary want of a vessel into which its contents might be received. In particular, about the Fair holidays, when many customers were from home, it happened that on one morning six butts, containing the implicated milk, were thus retained, and although their contents were emptied during the day, the butts were not returned for a few days thereafter. This, though noted at the time, was not afterwards regarded as having any bearing on the enquiry.

In endeavouring to follow the course of the milk through the purveyor's hands until it reached the houses of the consumers, advantage was taken of a division ascertained to exist in the purveyor's business, and which may be described as follows:—

From the time of arrival of the milk in the morning—between 6 and 7—till about 10 o'clock a considerable quantity was delivered by carriers at the houses of customers, and there was also a considerable counter trade. After 10 o'clock the business was exclusively a counter one, and for the supply of this a quantity, usually amounting to 30 gallons in all, 14 gallons of sweet milk, a similar quantity of skim, and 2 gallons cream, was retained from the morning's delivery. Moreover, as the servant who took charge of this believed that what in time came to be the "suspected milk" was richer in quality than that obtained from the other farm, she invariably put aside the quantity required for the day's counter sale from the former. The delivery of the milk at the houses of customers was accomplished by a band of messengers 23 in number. Two separate "rakes" were necessary to overtake the work, regulated not by considerations of distance or locality, but entirely by the varying hours at which the

customers wished their supply to reach them, and, for the following reason, it was here again possible to follow a second and somewhat larger stream of unmixed "suspected" milk. The cart bringing this milk was invariably the first to arrive in the morning, and from this the quantity required for the first "rake" was taken. Although the second cart might, and now and then did, reach the dairy before the messengers had started with their first "rake" it was not allowed to unload its contents until they had gone, because of the difficulty which would thereby have been introduced of measuring accurately the amount which each cart brought. The quantity distributed in this first "rake" amounted usually to something over 33 gallons—viz., 16 gallons each of sweet and skim milk and 1½ gallons cream. Adding to this quantity the amount retained for the day counter trade, something like 63½ gallons are accounted for, and, it may be observed, in regard to the remaining 30½ gallons, that the proportion of sweet milk and cream contained therein is in excess of that originally present.*

After the first "rake" was despatched, the milk from the second cart was added to the vessels required both for the second "rake" and for the morning counter trade, and it is not possible to ascertain in what proportion either was present in one or the other. About 86 gallons in all would be thus disposed of. This amount is subject to a deduction of an average daily quantity of 5½ gallons, spread irregularly over 10 days, in the period between 26th July and 7th August, which was transferred to two other dairies under the same purveyor, in connection with which no case has been notified. *The milk thus transferred was invariably from the farm not implicated in the present investigation.*

Incidence of the Disease.

Before further following these several streams of suspected milk, it may be well here to insert a note of the number of cases with which we were called upon to deal. 254 cases in all came under observation, representing 159 families. 134 were removed to hospital, and 120 were treated at home; 11 deaths occurred, 7 of

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	Sweet.	Skim.	Cream.
* The quantities originally were, - - -	46	39	8½
After deducting first "rake" and day counter trade, there remained, - - - -	16	9	5

which were of the cases treated at home, and 4 were of those removed to hospital. For departmental purposes an analyses of the cases known to exist as at 20th August last was prepared. These at that date were 236 in number, representing 152 families. Of the 18 additional cases which were reported in connection with this dairy between that date and 20th September, 11 were secondary to cases in households already attacked; 3 were in tenements where scarlet fever was present, or from which cases had been removed to hospital; 3 were cases sickening on 6th, 7th, and 9th August—mild in their onset, and consequently missed; and 1 has probably only an accidental connection with the outbreak under review. It is, therefore, possible to limit our view to the cases known to exist as at 20th August, because, with the exception of the 3 missed cases just mentioned, these include all who are directly related to the infected milk supply. As has been stated, there were at that date 236 cases under observation. From this number there may be deducted 4 cases occurring in July, and sickening on the 1st, 7th, and 19th respectively. They are too far removed in time from the others to have their relationship to them properly defined. A further deduction may also be made of 8 cases sickening after 12th August, for the reason that 6 were in families already attacked, and 2 were in tenements where scarlet fever was being treated. 224 cases, therefore, remain, which sickened between the 1st and 12th of August, and were distributed over the several days of the period as follows*:—

		Nos. Reported.
August 1st, . .	1 sickened, . . .	—
,, 2nd, . .	4 ,, . . .	—
,, 3rd, . .	6 ,, . . .	—
,, 4th, . .	16 ,, . . .	1
,, 5th, . .	59 ,, . . .	2
,, 6th, . .	66 ,, . . .	7
,, 7th,† . .	41 ,, . .	Sunday.
,, 8th, . .	11 ,, . . .	62
,, 9th, . .	6 ,, . . .	77
Carry forward, .	210 ,, . .	149

* A third parallel column is here introduced to show the progress of events as recorded by notification.

† The sale of milk was stopped on this date after about one-half of the usual daily quantity had been sold.

		Nos. Reported.
Brought forward, .	210 sickened, . .	. 149
August 10th, . .	5 ,, . .	. 20
,, 11th, . .	8* ,, . .	. 21
,, 12th, . .	1 ,, . .	. 9
,, 13th, . .	— ,, . .	. 10
,, 14th, . .	— ,, . .	Sunday.
,, 15th, . .	— ,, . .	. 7
,, 16th, . .	— ,, . .	. 7
,, 17th, . .	— ,, . .	. 4
,, 18th, . .	— ,, . .	. —
,, 19th, . .	— ,, . .	. 1
,, 20th, . .	— ,, . .	. 4
	224	232

The total number of cases reported from this district between 1st and 20th August was 305.

It remains now to learn in what way the cases were distributed among the consumers.

From lists supplied by the purveyor, and afterward verified or corrected by the Inspectors, it has been ascertained that about 359 families were supplied with milk at their own houses. This is the number remaining, after deduction of a few families, at whom, from changed address or some similar reason, personal enquiry could not be made, and it is substantially accurate. Of this number, 94 families were attacked in one or more of their members; and, in regard to at least 12 other families, it may be remarked that some evidence of specific infection was present, in the form of a throat affection, which was unaccompanied, and in some cases not followed by, any other symptoms of the disease. These 94 families received their supply as shown in the accompanying table :—

Source of Supply,	Families Supplied.	Families Attacked.	Individuals Attacked.
1st Rake, . . .	193	57	91
2nd ,, . . .	166	37	59
Counter Trade, .	not known.	58	86
	359	152	236†

It will be remembered that on a previous page notice was taken of a division of the implicated milk into three somewhat unequal

* Including 3 in families already affected.

† These figures include the July cases.

quantities, and that, while the first rake and day counter trade were sold unmixed, the quantity distributed in the second rake and morning counter trade most probably was mixed, but the proportions present in this mixing could not be stated. This much, however, was known, that there was thus sold fully one-third of the original quantity of sweet milk, much less than one-third of skim milk, and fully one-half of the cream. In the table just given, the families and individuals within these sections of the distribution are stated, and in relation to the proportionately smaller number of families of the second rake which suffered as compared with the first, it will be remembered that the milk distributed in the second rake was in some unknown proportion derived from an unsuspected source. It is to be observed, however, that the proportion borne by the families attacked to the individual cases occurring in both rakes, as ascertained, is in strict correspondence. Further, the family distribution of the cases was as follows:—

92	Families of 1 each,	=	92
43	,, 2 ,,	=	86
13	,, 3 ,,	=	39
1	Family of 4 ,,	=	4
3	Families of 5 ,,	=	15
152			236*

And by following the path of the rake distribution a concentration in particular streets was found to exist. In some streets few of the families supplied were attacked; in two or three streets no cases occurred, although the milk was being consumed by several families residing in them; while in one street 21 families—more than half those supplied—yielded 29 cases. These considerations, together with the fact that only 94 were attacked of the 359 families supplied in both rakes, suggest that the active principle of contagion present was not uniformly distributed throughout the infected milk.

In following thus far the incidence of the present epidemic, the endeavour has been to produce a series of impressions which might suggest relationships existing between events co-related in time, but coming to our knowledge in such a way as to render it

* These figures include the July cases.

impossible to deal with them in the order of their occurrence. Reference was made at an early part of the report to an opinion hurriedly formed, from the facts within our knowledge on the morning of 8th August, that the cases in Glasgow and that at the farm had one common origin in infected milk. It therefore remained for us to ascertain how far this would be confirmed or corrected by further enquiry. The children carrying milk from the dairy to the houses of consumers were 23 in number, and 7 were connected with households (5 in number) in which scarlet fever appeared. Four of the carriers were themselves attacked, and 3 were implicated only through illness in other members of their households. Arranging the 5 families of carriers according to the date of sickening, we found as follows :—

Family	S,	Sickened	3rd	August,	2	carriers,	1 ill.
,,	C,	,,	5th	,,	1	,,	Well.
,,	R,	,,	5th	,,	1	,,	Well.
,,	B,	,,	6th	,,	2	,,	Both ill.
,,	D,	,,	7th	,,	1	,,	1 ill.

As has been shown, by the 5th of August the epidemic was well on its way, so that interest in the above table chiefly centres in the family S, and the area of milk distribution supplied by the members of it who were carriers.

Between 1st and 3rd August, 10 families, residing in Crookston Street, Bedford Street, Cathcart Street, Ardgowan Street, Paterson Street, and Clarence Street, were invaded, while milk was delivered in only one of these streets (Clarence Street) by the carriers of family S.

Further, Crookston Street and Cathcart Street supplied 32 and 38 cases respectively of the total number—figures both much in excess of those contributed by any other street, and in neither of these streets was the delivery of milk conducted by any of the families of carriers attacked.

The shop assistants, 3 in number, did not suffer in themselves or their families, and recalling what on a former page was said regarding the dairy premises, there remains not the slightest moiety of evidence which would suggest contamination of the milk after its delivery in town.

While in transit between this and the farm from which it came, the milk was in charge of a farm servant, and we found no reason

for impugning the manner in which he had conducted his work, or for doubting his assertion that the milk left his hands as it was given to him. Indeed, the coincidence of disease at both ends of the milk stream—at the farm and in town—simplified the enquiry in this direction, for the milk used at the farm was not at any time under his charge, and the sickness there only occurred when 27, if not 31, of the town customers were already ill. The farm hands were, except as formerly stated, healthy.

Re-delivery of Milk Followed by Further Cases.

The whole herd had at the date of our first visit been placed under the charge of Principal M'Call, of the Veterinary College. On 12th August arrangements were made for separating from the rest of the herd as many of the cattle as seemed to have recovered from the local affection of the udders and teats, and on 23rd August the milk from such as were thus regarded as having recovered was sent to a dairy in Glasgow, in a locality quite apart from that previously referred to. This milk was sold under direction that it was not to be mixed with the produce of any other byre, and the following succession of cases then occurred among the consumers :—

August	25th,	1	Sickened.	August	31st,	2	Sickened.
,,	26th,	3	,,	Sept.	4th,	1	,,
,,	28th,	3	,,	,,	6th,	2	,,
,,	29th,	2	,,	,,	8th,	3	,,
,,	30th,	2	,,				

On 30th August the milk was again stopped, and none was sold after that date, the cases sickening thereafter having used the milk during the period from 23rd to 30th August.

Conclusion. — With Remarks on the probably Specific Nature of Certain Forms of Teat Eruptions known as Spurious Cow-pox.

From the sores existing on the cattle, as previously described, we removed, during our first and one or two subsequent visits, the adhering crusts, and collected some of the lymph exuding from the underlying sores. These were sent to Dr. Klein, whose report thereon is attached. We could not learn how long the

individual animals from which these were collected had been ill, but in regard to the material numbered (1) and (4) in Dr. Klein's report, this was obtained from an animal of the Jaapston byre.

In Dr. Klein's report it will be seen that an organism was present with properties similar to that obtained in the Hendon outbreak, and sores produced by inoculation of the material presented the character of those in the Camberwell outbreak. In addition the virus of vaccinia was present. This leads us to remark that one of the earlier difficulties which we met with in this investigation arose from the prevailing disposition to regard every form of teat eruption as being either true cow-pox or spurious ; and this with little regard to the presence of characters which might serve to distinguish between members of the spurious class. And there is this to be said in explanation, that the milker only, as a rule, has his attention directed to the teats when the animal becomes restive in milking, and when friction and manipulation have produced a similarity in the appearances of all sores existing in the region without distinction of cause. The unrecognised existence of true cow-pox in the byres is an illustration of this.

As a contrast to the condition of the cattle described in connection both with the Hendon and Camberwell outbreaks, these Jaapston cattle presented no desquamating condition of the skin, and no other evidence of a constitutional affection, and we have the testimony of Principal M'Call, already quoted, in support of the healthy appearance of the cattle apart from the local sores. Consequently, the reappearance of scarlet fever following the delivery between 23rd and 30th August is a question of some moment.

It has been said that the crusts which formed on the local sores could be without much difficulty removed ; but, under such circumstances, they readily formed again, and this alternating separation and reformation could be repeated as long as any ulcerating surface remained under the superjacent crust. When this process in a given animal had been repeated several times, there was a disposition to regard the crusts, which were thus many removes from the primary one, as having nothing of a specific nature about them ; but the limited outbreak after 23rd August is possibly an indication that this view is erroneous.

The cattle affection being so entirely a local one in this instance, it would seem a straining of terms to apply to it the name bovine scarlatina; but the existence of a local eruption on the cow standing related, as this does, to scarlatina in man at once suggests the parallelism which is on every hand accorded to vaccinia and small-pox.

REPORT BY DR. KLEIN.

St. Bartholomew's Hospital,
London, *5th November*, 1892.

Dr. Russell,

Sir,

I beg herewith to report on the results of the observations that I made with the materials sent to me by Drs. Munro and Chalmers. The materials, as described in letters by yourself, Dr. Chalmers, and Dr. Munro, were sent to me through Dr. Thorne Thorne, the Medical Officer of the Local Government Board, and were of the following nature :—

(1) Lymph in tubes taken from the eruption of a cow in Renfrewshire on 9th August.

(2) Lymph in tubes (marked A) from an unruptured vesicle on the wrist of a milker, sent 13th August.

(3) Lymph in tube (marked B) taken from a subcutaneous vesicle on the teat (unruptured) of cow No. III., also sent 13th August. (This lymph could not be used for experiment ; it was quite clogged, and could not be got out from the tube.)

(4) Scabs from teats of cow taken 14th August. This was the same cow from which lymph was taken on 9th August. (See No. 1.)

A.—*Experiments with lymph taken on 9th August.*

This lymph was used for two sets of experiments :—

(1) With a trace of this lymph, cultivations in gelatine plates and in agar plates were made. As a result of these, the following micro-organisms were isolated :—(*a*) A few colonies of staphylococcus aureus liquescens ; (*b*) a few colonies of staphylococcus albus liquescens ; (*c*) very numerous colonies of moulds ; (*d*) numerous colonies of streptococcus. These last were further examined by subcultures in gelatine (streak and stab cultures) on agar and in milk. As is well known, the various species of streptococci are practically indistinguishable in gelatine plate cultures, and in stab and streak cultures ; but the streptococcus,

isolated above, belonged to the group of streptococci, which I have designated as forming opaque growths, *e.g.*, streptococcus pyogenes, streptococcus scarlatinæ, and streptococcus of the Edinburgh disease; that is to say, the colonies on the surface of the gelatine, the growth in streak and stab cultures in the gelatine, when looked at in reflected light appear white, when looked at in transmitted light appear somewhat opaque; but in the mode and rapidity of growth, in their non-liquefaction of the gelatine and in their microscopic characters, all these streptococci appear practically indistinguishable, presenting appearances of about the same kind. I have, however, insisted in my report to the Medical Officer of the Local Government Board for 1885-86, and in further reports, that the streptococcus which I isolated from the ulcers on the teats of cows in the Hendon outbreak, which, it will be remembered, was associated with an extensive outbreak of Scarlet Fever in the North of London, as also from the blood of cases of human Scarlatina, had the special character of markedly coagulating milk when growing in this at 37° C.

The streptococcus which was isolated from the lymph sent from the Renfrewshire cow in the present enquiry had this power of coagulating milk in a very conspicuous degree.

Sterile milk, contained in tubes, was inoculated from a pure subculture of the above streptococcus—that is, the one obtained in the present inquiry—the tubes were then placed into the incubator and kept at 37° C. After thirty hours incubation the milk had completely solidified; after two days there was a complete separation of a very slightly turbid serum from a solid clot. Both the serum and the clot were tested by cultivation, and were found to contain a pure culture of the streptococcus. Milk in tubes, inoculated from these subcultures, or from the above clotted milk, turned solid in thirty hours.

Comparative experiments of milk cultivations were made with fresh cultures of the streptococcus pyogenes and of the active streptococcus erysipelatis, which at the time I happened to possess, but neither of them produced the change of clotting in the milk.

With recent broth cultures of the Renfrewshire streptococcus, tame white mice, as also wild house mice, were inoculated subcutaneously. The result was this:—Out of four white mice thus

inoculated, one was found distinctly ill on the second and third day. It was quiet, did not feed, its hair erect, its back curved; but it had completely recovered by the fifth day. The other three mice remained apparently quite unaltered after the inoculation, but one of them became thin after a week, and died after twenty days. With the same broth culture of the streptococcus four grey house mice were inoculated. On the second day after inoculation they were all found affected—quiet, did not feed, back curved, eyes sunk. One of them gradually recovered by the end of the week, while the other three remained abnormal more or less till death. One died on the fifth, one on the eighth, and one on the morning of the ninth day. The *post-mortem* appearances were these:—The seat of inoculation showed no change; the spleen was enlarged and congested; the small intestine distended, relaxed, and filled with sanguineous mucus; the lungs, liver, and kidney congested; small amount of sanguineous exudation in the pleura and pericardium. From the spleen tissue the streptococci were recovered by cultivation.

From this it is seen that with the cultivations of the Renfrewshire streptococcus the same results were obtained by inoculation of tame and wild mice as was the case with the cultivations of the streptococcus isolated from the ulcers of the Hendon cows in 1886. (Report of the Medical Officer of the Local Government Board, 1886-87.)

Both acted virulently on the wild house mice, and only slightly on the tame white mice.

(2) The second set of experiments with the lymph (1) sent from the Renfrewshire cows consisted in introducing the lymph into linear cutaneous incisions of two calves.

Both these calves had a few weeks previously passed through typical vaccinia, and had at the time of the present inoculation (12th August) 30-36 characteristic vaccinal cicatrices; on 12th August, six insertions were made into linear cutaneous incisions, each about $\frac{1}{2}$ to 1 inch long, on the abdomen of each animal, and lymph rubbed into them.

On inspection on 15th August, one calf had completely failed, the other showed the insertion tumid, surrounded by redness, the incision itself pustular, *i.e.*, a narrow vesicle filled with purulent matter.

On inspection of this calf on 17th August, all the pustules were transformed into brown scabs; these became loose on 18th August, and gradually crumbled away, leaving an indistinct healed linear scar behind.

B.—*Experiments with lymph marked A, sent 13th August.*

This lymph was derived from a vesicle on the wrist of a milker.

Calf No. I. was inoculated in five linear cutaneous incisions on the scrotum and in two of the groin. Failed completely.

C.—*Experiments with scabs taken on 14th August from Renfrewshire cow.*

The scabs were rubbed up, on 9th September, in sterile salt solution, and with this inoculations were made in thirty cutaneous incisions in groin and on belly of calf II.

On 12th September, the first signs appeared that the inoculation had taken—all incisions being raised and surrounded by a distinct red areola, the line of incision being marked as a thin scab.

On 15th September, the redness and swelling more pronounced, the central linear scab broader than before. Five of these insertions showed at a spot either at one end or in the middle of the original incision a round vesicle, much resembling a vaccine vesicle, viz.: much raised, pale and vesicular in the peripheral part, a central depression with dark scab, red areola surrounding the pock. On clamping the pock with vaccine forceps a considerable amount of clear lymph oozes out of the pock. The other twenty-five insertions developed no vesicle during the subsequent days.

On 19th September, all insertions were covered with broad brown crusts, very little redness around them. With lymph squeezed out of the five vaccine-like pox on 15th September, inoculated calf I. (that is the calf that had failed after inoculation with lymph A from the vesicle on the wrist of a milker), and a fresh calf, No. III. Calf I. received the lymph in twenty incisions (eight on scrotum); calf III. in thirty-six incisions.

The result of this inoculation was the development of what, in aspect and course, resembled vaccinia. Charged points with scrapings of vesicles of calf I., they being then on the sixth day, and with these points inoculated one, calf V., in twelve linear

cutaneous incisions. The result was the development of what, in appearance and course, looked like typical vaccinia.

It was stated above that in calf II. only five out of thirty insertions did develop partially, *i.e.*, at one point into raised, round vesicles, with central depressed crust. The main part of these five insertions and the other twenty-five passed a totally different course—a course which differed in this important respect that at no time was there an umbilicated vesicle formed, but the insertion was slightly raised, and red on the fourth day. This increased in the subsequent days, while in the line of the incision a crust, at first narrow, and then gradually thickening and broadening, appeared. On the ninth, tenth, and further days, this crust was as broad as the original areola, and remained firmly adherent, while becoming of considerable thickness. Only after about a fortnight did it begin to show transverse fissures and to become loose; but when before this date it was forcibly removed, a sore was exposed, and in twenty-four hours a new crust was formed on this. The falling off of the crusts and the healing of the sore was not completed till about three weeks after the inoculation. The whole course of the eruption reminded me of, and was, in fact, very similar to, the eruption produced on calves in the Camberwell Scarlatina outbreak, with a crust from the sore on the teat of a cow, and described and figured in my report to the Medical Officer of the Local Government Board for 1888-89, p. 377, and following.

This became more firmly established by the following experiment:—

As mentioned above, calf II. had twenty-five insertions, which followed a course different from the other five; several of the former non-vesicular eruptions were scraped on the seventh day, and with the scrapings one calf, No. IV., was inoculated in thirty-one cutaneous incisions. These scrapings were therefore of the same age as the lymph obtained from the five vesicles of same calf II., *i.e.*, the seventh day.

Now, in this calf IV., all thirty-one insertions took well; on the fourth day all insertions were raised and surrounded by areola, the original incision occupied by a thin narrow scab. This condition increased during the fifth, sixth, and seventh days, by which time the scab broadened and thickened; the redness then subsided, while the scab proceeded to thicken and to become

broader; by the ninth and tenth day it was as broad as the original areola; when taken off forcibly, a raw, bleeding ulcer was exposed; next day this was found again covered with brown scab. The scabs did not become loose till about the eighteenth day, and by the end of the third week most of them had fallen off, partially or wholly, leaving a dry reddish raised cicatrix behind, which, however, for some days remained covered with a sort of imperfect scab. At no time was there a vesicle present. From this calf IV. scrapings were taken on the seventh day, and inoculated in sixteen linear cutaneous incisions in calf VI. Also here the result was exactly the same as in calf IV., a result identical with that obtained in 1888 in the Camberwell inquiry (l.c., p. 378, 379).

From these experiments it follows, then, that in calf II., inoculated with the crusts of a Renfrewshire cow, two kinds of eruptions were produced:—(*a*) in five out of thirty insertions vesicles appeared which, in aspect and course, resembled vaccinia; and (*b*) twenty-five insertions did not develop anything like vaccinia, but, from the fourth day after inoculation, became raised and possessed of an areola, and covered with a gradually broadening and thickening brown crust, without the intermediate stage of an umbilicated vesicle. By transferring the lymph from the vaccinia-like pox (*a*) to calves I. and III., and from calf I. to calf V. again, vaccinia-like pox were produced, and by transferring matter from the non-vesicular eruptions (*b*) on to calf IV., and from this again to calf VI., the same non-vesicular type was reproduced; so that we are justified in saying that though in calf II. the two viruses were present, one in one set (5) and the other in the other set (25) of the insertions, by further separate transference to calf I. and III. in the one case, and to calf IV. in the other, the two viruses became differentiated, and this differentiation became finally well established in the third generation, viz., the one virus in calf V., the other in calf VI. It will, I think, hardly be contended that the twenty-five eruptions in calf II., and all the eruptions in calves IV. and VI., were perhaps only modified, mitigated, or abortive vaccinia, for it is in the highest degree improbable that the virus, if abortive vaccinia, should "breed true" in two successive generations of calves, and should cause so typical and severe an eruption as

was the case in calves IV. and VI. I have already, in 1888-1889, shown that the eruption in the Camberwell inquiry did not protect the calves against vaccinia, and it is impossible to assume that calves which have passed through such a severe eruption as was produced in the Camberwell inquiry, assuming this to be some kind of vaccinia, should be susceptible to subsequent vaccinia, taking a perfectly normal course.

As in 1888-89, so also in the present inquiry, I have subjected calves IV. and VI. to vaccination with lymph, on points obtained from the Government Animal Vaccine Establishment, and found them fully susceptible to it. Both calves were vaccinated about two weeks after the results of the previous eruption had passed off (though on eight of the original insertions there were still traces of loose scabs), each in twelve insertions. *Every one of these insertions developed into a typical vaccine vesicle.* When inspected on the fifth, sixth, and seventh day, the appearances were those of typical vaccine vesicles in a normal unprotected calf.

But altogether different from this was the result produced in calves III. and V., which at the same time as the above calves IV. and VI. were subjected to vaccination with the vaccine matter obtained from the Government Animal Vaccine Establishment, for every one of the eight insertions in calves III. and V. had by the fourth and fifth day completely failed, no redness, no swelling, no vesicle, all the incisions were dry and pale, and only the place of the linear incision could be recognised.

Your obedient Servant,

E. KLEIN.