An account of a Milk Epidemic of Enteric Fever, with some remarks on cases seen in children.

I propose to give an account of an outbreak of Enteric Fever in a small country town with special reference to its causation, as this was a matter of dispute for some time after the epidemic began. The town I refer to is Helmsley. It is a small market town with an estimated population of 1508, situated on the north bank of the River Rye at the extreme western end of the Vale of Pickering. The land on which the town is built slopes gently upwards from the river. The rising

ground behind the town is well wooded, and Helmsley may almost be said to be shut in by hills on three sides.

Through the High Street & Castlegate flows the Boro Beck, a tributary of the Rye which it joins within the limits of the town, at the upper end of Ryegate.

Helmsley is a market centre for a wide, thinly populated agricultural district.

Owing to its picturesque surroundings and its proximity to places of historical and antiquarian interest, the town and neighbourhood are much frequented especially in the summer months by tourists and holiday makers.

The inhabitants of Helmsley are chiefly engaged in agriculture,

in shopkeeping, and in the various occupations pertaining to a small country town. A number of persons find employment in the woods, and in other ways, on the extensive estates of the Earl of Feversham whose seat Duncombe Park is situated close to the town.

Water Supply —:

This is derived from the Foothead Spring situated in a valley (Beckdale) a mile from Helmsley. It is piped to a covered reservoir in Beckdale, and thence distributed by gravitation to the houses. There is no filtration of this water.

Drainage —:

About two-thirds of Helmsley is provided with sewers,

the outfalls of which discharge into the Rye directly or indirectly. The rest of the houses discharge their sewage by separate or by conjoined drains into the Boro Beck. Excrement and refuse disposal is mainly by means of ashpit or midden privies, the contents of which are removed from time to time by the house-holders and utilised on garden ground.

Houses —:

For some years old houses have been gradually replaced by new ones of a better kind; but there are still left some of antiquated construction with damp walls, and with low roofs sometimes of thatch, which occasionally is not weather proof. Ventilation

and cubic space in such dwellings are often deficient, especially in bedrooms which sometimes are unprovided with fire places.

Enteric Fever had not been heard of in the town for many years. The water supply was thought to be above suspicion, and the first two cases in different houses, seen by me were young children, so the diagnosis made was gastro-enteric catarrh, such as one often sees in children during the Summer months. (The epidemic began in the beginning of August 1895.) Valuable time was certainly lost by this unfortunate mistake, and it was not till the cases had lasted quite a week, that it occurred to me to ask the

parents where the milk consumed by the children had come from. Not expecting to connect the milk supply with the illness, I was surprised to find that both children had had milk from the same dairy. Still I could not have acted in any way as I did not recognise the disease. In a day or two (Aug^{t} 15th) a servant in one of the infected houses became ill, and in a few days a definite diagnosis of Enteric Fever was made. (It afterwards was quite clear that the whole outbreak was due to this contaminated milk supply)

I reported the matter at once to the Medical Officer of Health of the town, and he had the supply of milk from the suspected dairy

stopped. The question then came to be – Was the outbreak really due to contaminated milk, or in what other way did the typhoid poison get into the town?
At this time a servant girl had gone home from Helmsley, and developed Enteric Fever there.
Another medical man in Helmsley on Aug.t 19th notified nine cases, five of them he called "Relapsing Fever", and three "Remittent Fever". From this time till Sept.r 1st, cases were reported nearly every day.
I afterwards heard of no less than eight persons who had been residing in Helmsley during the first week of August, or earlier, and were found to have developed the disease during the month, in places to which they had removed.

I have since been able to get a fairly accurate estimate of the number of people attacked.
Forty three cases occurred during the outbreak.
Twenty five households were infected.
Twenty two being invaded in August and three in September.
A plurality of cases occurred in eight houses, in nineteen there were only single cases met with.

Origin of Outbreak.

Three theories were brought forward to account for the outbreak

1. Influence of insanitary conditions, including deficient sewerage.
2. Pollution of Water Supply.
3. Contamination of Milk supply from a certain dairy.

I The town has sewers for two-thirds of its population, with two outfalls, one direct into the Boro Beck close to where it enters the Rye, the second into a tank on the banks of the Rye, which overflows into the stream. The remainder of the town is unsewered and comprises High St., Church St. and Castlegate, practically one long, wide street through which the Boro Beck flows. Near the top of High Street stands the Workhouse, with drains from water closets discharging into a culverted portion of the beck. Two other parts of the Stream in its course down the street are covered in. Into one or other of the culverted portions several water closets discharge, and into the lowest portion the main outfall of one of the sewered parts

of the town also discharges.
The bed of the beck is not prepared in any way under the covered parts, and so among the loose stones, garbage and house refuse is apt to be retained. In summer when the water in the beck is low, this is not swept away, and gives rise to bad smells in the vicinity of the archways. The worst is that situated lowest down as it naturally receives the most filth.
When a flood comes this accumulated matter is carried into the Rye, the water of which is drunk by the inhabitants of villages lower down on the banks of the River. As one would naturally expect these unfortunate people did not escape. Seventeen cases were recorded, which were undoubtedly due to drinking the

polluted water of the Rye. The people either through carelessness or ignorance did not take the trouble to boil their drinking water, although they had sufficient warning of the danger of not doing so.

On July 26th an extraordinary thunder-storm broke over the neighbourhood of Helmsley, and an enormous quantity of rain fell in a very short space of time, causing a sudden and unprecedented flooding of the Boro Beck. So sudden and great a rise had not occurred it was said, during the present generation. The beck overflowed its banks, and scoured away parts of the roadway of the High Street. The archways were swept clear of filth accumulations. Between the culverted portions of the beck in High Street, the water extended itself

on either side, as behind a dam. When the flood subsided, there was left behind on the street, sand and mud, which had an unpleasant odour as it dried. This sand &c left by the flood was used for repairing the road, and some of it was placed under the windows of two adjacent houses where later on, two fatal cases of enteric fever developed. It was suggested, that this mud and sand which had been washed through the first archway had been dried, and wafted by the wind through the open windows of the houses; that it contained infection, and that the poison had in this way reached the persons attacked, perhaps through contamination of food, or in some other way, after entrance into the houses.

It was also thought by some, that the fouling of the surface produced by deposit of infected mud, might have accounted for the fact that the largest number of houses attacked by the fever were situated in the High Street and Castlegate.
As I will show later on, this theory was quite untenable, at least as regards the origin of the outbreak. The mud was however almost certainly infected, for two persons just convalescent of Enteric Fever, came to Helmsley on July 11th, and lived in houses above the first archway in the High Street. It is asserted that the bowel discharges in both cases, may have still contained the poison when they came to the town.

II "Pollution of Water Supply."

This was the second theory brought forward.

The fact that there were two convalescents from Enteric Fever in Helmsley, in the last three weeks in July, made it possible that specific dejections had been deposited by them in the narrow valley of Beckdale, above the point where the reservoir is situated. This theory of the outbreak may also be dismissed, as the distribution of cases lends no support to it. That the disease fell heaviest on High Street and Castlegate, was held by some persons as supporting a theory, that the pollution by sewage of the Boro Beck, which flows through these streets had more to do with the outbreak,

than had the water supply. This can be explained by the remaining theory which was certainly the correct one.

III Specific contamination of a particular Milk Supply.

There are nine registered milk sellers in Helmsley. Many cottagers keep a cow, so that the milk supply is much divided. Five of the milk sellers do a very small business, and need not be taken into account, but four who do a somewhat similar amount of business, may be taken as affording a basis of comparison. I found the number of households supplied by these milk sellers was between thirty-five and forty.

It was noticed that sellers No 1 2 and 3 had none of their customers attacked, and No 4 had twenty houses in August, out of thirty five which were usually supplied. This shows conclusively where the disease originated.

Of twenty four households invaded in August, twenty had been regularly supplied from vendor No 4. In one case the milk was taken in by the child's grandmother, with whom the child had often had meals, and therefore almost certainly had some of the infected milk.

There remains now only one house to be accounted for. In this case the mother refused to give me any information. She was very careless about her children.

and the neighbours thought it was possible, that the child may have had milk from some Charitable person in the town, and so been infected. It is therefore possible that the people in the whole twenty two houses had consumed the contaminated milk.

Many of the patients were fond of milk and drank milk for supper.

Several were servant girls, who would have opportunities of getting milk which had stood in the house for some time, and was consequently more dangerous than fresh milk. The earlier cases were nearly all children. Of the three households invaded in September, another explanation

had to be found, as by this time we had reached the limit of time, during which we expected to get cases caused by the milk, as its consumption had been stopped quite fourteen days. In these cases also, the possibility of their having had any of the contaminated milk was very remote.

As soon as the milk supply had been stopped, I made a prophecy that in fourteen days we would see the end of the epidemic. (The incubation period may be longer but fourteen days was long enough for my purpose.) Three cases in different houses occurred after the fortnight, and some explanation had to be offered.

Case I lived in a house in High St., under the windows of which as already mentioned, some of the infected gravel from the Beck had been put. She was a farmers daughter, and had certainly not had any of the contaminated milk. On making inquiry, I found that this girl had been in the habit of brushing the boots of the inmates of the house, and also of sweeping the floor of the passage leading from the front door of the house. Is it not possible that this infected sand was carried into the house on the boots of the residents, and particles of it inhaled by the girl, as she brushed the boots, or swept the floor? Or, she may have swallowed the germs with food on which

they had settled, or which had been infected from her hands. Another explanation of this case is not a very likely one, as the incubation period could not have been more than one day. (Moore amongst others states that the incubation period may last one or two days only.)

A cesspool into which undoubtedly specific stools had been put, was emptied into a drain, which opened into the second of the culverted portions of the Beck, already mentioned. On the day on which this happened, a strong smell was noticed coming from the archway, which is not more than twenty yards from the house where this girl lived. The girl did not notice the smell

particularly, but case No 2 who lived in the next house, stoutly affirmed that it caused the fever in him, as he felt sick at the time, and never was well afterwards. The incubation period here also is too short, as he had a temperature on the day following. I did not see this case, but offer the suggestion that it was one of what the Dublin physicians call "Pythogenic Pneumonia" to begin with. I think it is possible, that sewer gas carrying a variety of germs or spores, could cause a rise of temperature for some days, during which Enteric Fever might be incubating, and so make it appear as if the case had been one of that disease from the first. Case II already mentioned occurred in the house next door to Case I,

and as I have said, the patient stuck to the opinion that his illness had been brought on by this "bad smell", from the archway on the day the cesspool was cleaned out. The "infected sand" theory would account for this case, as well as Case I, as the sand had been spread in front of the windows of his house also.

Case III was a girl of 10. Here at least two, possible sources of infection were traced. She was known to have eaten an apple picked from the Beck. The apple may have had some bacilli on it. She also played amongst some gas lime, in which some enteric stools had been buried a week before. It is quite likely that some of this material had come in contact

with her hands, and so been conveyed to the mouth.
Thus all cases due to the milk have been accounted for.

As to how the milk became contaminated

The following story was obtained after a considerable expenditure of time and patience, as the poor woman who owned the offending dairy, was depending on it for her living, and was afraid she might be prevented from selling milk altogether. The milk seller had a daughter married to a corporal in the Army Hospital Corps Stationed at Colchester. She became ill with Enteric Fever on May 28th and was nursed by her husband during her illness. On July 11th she travelled from Colchester to

Helmsley, accompanied by her husband who was not feeling well. He had some obscure abdominal symptoms. He left Helmsley on Aug 10th. On his return home, Corporal C is said to have received medical treatment for what is stated to have been typhlitis. One of the milk sellers children had some febrile attack about Aug 2nd, but no medical man was called in. On Aug 19th when seen by a medical man he notified the case as one of 'Relapsing Fever'. The house is at the top of High Street, on the right side, and its drains discharge into the Boro Beck. How the germs got into the milk is not at all clear. It is just possible that Mrs C was still through her dejections, in an infective state when she came

to Helmsley, or that she brought linen with her which had not been disinfected. It is just possible that Corporal C had a mild or ambulant form of Enteric Fever which gave rise later on to symptoms of Hyphlitis. If the milk seller washed her daughters linen, and then milked her cow with undisinfected hands, it is easy to imagine how infection of the milk occurred. Another point is of some interest! How long was the milk infected? It may have been from July 11th, when Mrs C came to Helmsley, till Aug 19th, when the sale of milk was stopped.

Considering the number of cases, I think the milk could not have been infected all that time. It is impossible to say, because

the actual way in which the germs gained access to the milk is mere conjecture.

In whatever way the germs may have actually reached the milk, after the infection had been brought to the house, there is no doubt that the milk supply did become infected, and that, as a consequence, some of the customers got Enteric Fever. The reason why so many cases occurred in High Street, is because many of the people residing there naturally took their milk from the nearest dairy, which in this case happened to be the infected one.

With regard to individual cases:-

I did not see all the cases, and am unable to state the cause of

death in at least two instances.

Diagnosis —: In the early cases this was difficult, chiefly because the water supply, which is generally the carrier of the enteric fever poison, was thought to be above suspicion. After the possibility of the cases being enteric fever was suggested, the diagnosis became clear. Some of the early cases did not run a typical course. Many of them had constipation throughout the attack, and in the case of children the disease seemed to run a shorter course than usual. Some were regarded as being ill only from ten to fourteen days. Some cases did not appear to have abdominal symptoms at all. In only a small proportion of cases

were spots seen, but I must admit that they were not looked for so carefully as they might have been.

In one case, a lad aet 18 yrs, felt ill and his mother gave him some castor oil and Epsom salts. This set up a profuse diarrhoea, and he died ultimately of hoemorrhage from the bowel. Tremor was a prominent symptom in this case, and Sir Wm. Jenner states that in cases of deep ulceration, tremor is usually present.

Another young man, who lived in Edinburgh, came to Helmsley in the middle of August, drank some milk from the infected dairy on the night of his arrival. He returned to Edinburgh soon afterwards, and developed an illness

which was not diagnosed with certainty, although the medical man in charge of the case was suspicious of Enteric Fever. One Sunday the patient was allowed to eat a hearty dinner. He was dead of perforation on the following Tuesday.

A very interesting case was the child already mentioned, (Case III). She was 10 years of age, lived in a wretched house, and was badly nursed. During the second week of the fever, the evening temperature was always found above 103·5° F. The tongue was typical, but there was no abdominal distension. She took very little nourishment. The mother insisted that during one period of three days, the only nourishment taken by the

child was one cupful of milk. At the commencement of the illness the bowels did not act for eight days. She was wasting rapidly but otherwise quite holding her own with the disease. A glycerine enema brought away some hard faeces. Then for another period of eight days the bowels were confined and a repetition of the enema had the same result. By this time the child was painfully thin, but the pulse was good and the tongue not very dry. Convalescence was unusually rapid. I think the satisfactory result was due to the small quantity of food taken, together with a healthy constitution in the child. She had no medicine by the mouth whatever.

One case only had a relapse. The subject was a boy of eight years, who had a sharp attack. He was sent away too soon, and probably unsuitable food was responsible for the relapse.

Table showing cases of Enteric Fever in Helmsley and deaths therefrom in age periods

Age periods	Cases			Deaths		
	Males	Females	Totals	Males	Females	Totals
Under 1 year	—	—	—	—	—	—
1 – 5 years	2	6	8	—	1	1
5 – 15 years	10	5	15	—	—	—
15 – 25 years	3	3	6	2	3	5
25 – 60 years	2	12	14	1	1	2
60 upward	—	—	—	—	—	—
	17	26	43*	3	5	8

* Including 8 persons who were attacked subsequently to their removal from Helmsley.

The greater incidence of the fever on adult females, is no doubt accounted for by the fact, that at least four of them contracted the disease whilst nursing sick persons in the family. In one instance a trained nurse was attacked, although she must have been well aware of the danger of infection.

Causes of death in 6 of the 8 fatal Cases

1. Case No 1 already referred to, was a girl aet 18 years, who wandered about for a week before being put to bed. As soon as she was told she had the disease, she seemed to give up all hope of recovery. Many years before a sister had died of Enteric Fever, and her father had

had a very severe attack. In every other way she was a good patient, and seemed to be doing well, till one day in the beginning of the third week I was called to her in a hurry. I found the abdomen distended and very tender. She was quite collapsed. I diagnosed perforation, and she was dead in 24 hours. I was impressed at the time with the condition of this patients state of mind. She was anything but a hysterical girl, but had evidently made up her mind as to the result in her case. I am sure such a state of mind must prejudice a patients chance of recovery very much. This case did have diarrhoea, and no doubt the ulceration which unfortunately ended in haemorrhage was deep.

11 This was the case already mentioned

as dying of hemorrhage after purgatives.

III A servant girl aet 25 yrs. of tubercular family. Did well for a fortnight then developed pneumonia, and died at the end of the third week of the fever.

IV a child aet 2 yrs, died of exhaustion at the end of the second week.

V The Edinburgh case who died of perforation.

VI An 'alcoholic' who died of exhaustion. I did not see this case.

It is worth noting that in 43 cases due to milk 8 died, and that only 1 in 17, who contracted the disease by drinking the polluted water of the Rye died. It may be that they had the poison more diluted than the others.

As house-surgeon to the Childrens Hospital, Birkenhead, I saw 15 cases of Enteric Fever. The age varied from 2½ to 12 years. The number of cases is far too small from which to draw any definite conclusions, but the following points attracted my attention on looking over notes of the Cases.

I The duration of the fever was very variable.

Henoch says the disease may last as short as 7 to 9 days or as long as 49 days. The reason for cases running a short course is that the second stage is not so well marked in children as it is in adults, owing to resolution, or only superficial sloughing of the Peyers patches occurring.

The morning remissions and evening exacerbations are greater in children than in adults, but this occurs in other febrile conditions, and is to be expected, owing to the rapidity of the metabolic changes going on in the tissues, and also to the unstable nervous System of the child

In one case the primary attack lasted 28 or 30 days. After an apyretic interval of four days, a true relapse which lasted 13 days occurred. This was supposed to have been caused by a sweet which the child had eaten unknown to the nurse, at any rate, the child became worse that day. The highest temperature recorded during the relapse was 103·8° F. One Case did not seem to last

more than 14 or 15 days.

ii Absence of diarrhoea

In no case did diarrhoea require treatment, although the treatment generally adopted might have been expected to cause some diarrhoea. Typical pea soup stools were not often seen. In one or two cases bright green stools were passed soon after admission. The smell of the enteric stool is often peculiar. I have heard a hospital physician say he could sometimes make a diagnosis from the smell of the stool alone.

iii Absence of troublesome abdominal symptoms such as tympanites, haemorrhage, or perforation of the bowel, even in severe cases.

In only one case was hoemorrhage seen. It was not severe. Pain in the abdomen was a frequent complaint

IV Diagnostic value of tongue appearances

The appearance of the tongue is of great value for diagnosis during the first week.
At first the tip and edges are red, the surface covered with a creamy fur. After a time the fur gets brownish, and cracks may appear running transversely. Occasionally a longitudinal, dry band, half an inch wide, was seen running down the centre of the organ. In the later stages, the whole tongue looks shrunken and pointed.

V Relapses —: Only one case was noted, it has already been mentioned

VI Complications —:

Cough, and bronchial symptoms were so frequent that they seemed almost part of the disease. In three cases distinct bronchitis was noted. At least half the cases had bronchial catarrh.

One case was complicated by Tetany. This came on three days before the end of the attack, and disappeared when the temperature became normal. The condition of tetany was well marked, but not severe. The hands and feet were affected, and when the child cried, some implication of the laryngeal muscles was noticable.

VI Rapidity of Convalescence.—:

With one or two exceptions the children rapidly put on flesh after the disease had run its course.

VII Mortality —:

No case died, although two of them looked rather hopeless for a few days.

VIII Effect of Treatment —:

Intestinal disinfectants were used in nearly all cases.

If the case was seen early Calomel gr. ii was administered at once, and the drug continued in 1/6 or 1/8 gr doses every four hours, in most cases.

Wassiljeff showed by experiment, that Calomel stopped putrefaction in the bowel.

Salol or Benzonaphthol were used occasionally.
In some cases chlorine water, freshly prepared, was used in addition to the small doses of calomel.
Children seem to take it well.
I thought the general effect of these disinfectants was good.
Routine treatment may not be advisable, but I would certainly use some form of intestinal disinfectant if I had the opportunity again.
Occasionally an antipyretic seemed indicated. Phenacetin or antipyrine in doses of 5 grains is occasionally useful but I am sure the frequent administration of such drugs in any febrile state, is not sound practice. In children the effect is sudden, but

transient. I am sure cold or tepid sponging is much better for the patient.

Tx Diet -

This is the most important Consideration of all.
In no case, was more than two pints of milk with lime or barley water allowed in 24 hours.
The addition of lime or barley water ensures a more flaky curd than that formed from pure milk. It is more readily acted on by the impaired intestinal secretions. I think it a mistake to give more than two pints of milk unless there is a very good reason for so doing. In cases where there was any tendency to distension, a

reduction in the quantity of milk taken, was generally followed by improvement. By watching for undigested milk in the stools, we have a good guide to the quantity of milk which can be advantageously given.

Stimulants were occasionally indicated, and in two or three of the worst cases, 3ī doses of brandy every hour were administered

Infection –

From what I have seen of Enteric Fever, I think the danger of infection is greater than is often supposed. It is probable that the disease is alone produced by the Bacillus Typhosus. This germ is usually taken into

the mouth with either food or drink, but there is no reason why the germ should not be found floating in the air, and get drawn into the mouth with the breath. There are so many ways in which food may become contaminated, leaving air infection out of account, that it is not to be wondered at, if the attendants on the sick occasionally contract the disease.
Collie mentions an outbreak in the island of Colonsay, where the disease spread from house to house, in a widely scattered population, till the line of infection extended for 17 miles. No doubt disinfectants were not carefully used, but it shows how the disease may spread

if care is not taken.
He also gives statistics which show that occasionally nurses in Homerton Fever Hospital contracted Enteric Fever, while nursing cases. In hospital, I remember an interesting case. In a general ward of 14 beds, there were three cases of Enteric Fever being treated. A boy of 12 who was convalescing of acute nephritis, was allowed to get up, and wander about the ward.
He was warned not to go near the fever cases. He developed Enteric Fever which ran a typical course. Naturally the fever had a bad effect on the kidneys. Before the rise of temperature the urine showed a mere trace of albumen.

During the first week, the urine became loaded with albumen, and gave a blue reaction with Guaiac & Ozonic Ether. The kidneys gradually improved when the temperature became normal, and at the end of six weeks, there was no albumen in the urine. It is worthy of note that when the urine contains albumen, the Typhoid bacillus is also present. It is therefore necessary in all cases to disinfect the urine.