OUTBREAK OF TYPHOID FEVER AT KILDWICK.

By F. E. ATKINSON, L.R.C.P. LOND., M.R.C.S.,

Medical Officer of Health of Craven Combined Sanitary District.

KILDWICK is a village and township in the Rural Sanitary District of Skipton. It is bounded on the north and east by Silsden, on the west by Farnhill, and on the south by Glusburn, and by the River Aire, and is crossed shortly above the boundary by the Leeds and Liverpool Canal.

A single case of typhoid fever was notified on January 12th, 1899, that of a young man, aged twenty-two, living in a house below the Kildwick Old Churchyard. He had been removed the day before to the Keighley and Bingley Joint Hospital at Morton Banks. Inquiries were made into the case, and the sanitary condition of the premises examined, but no clue could be found to the origin of the disease. He was said to have been ailing for some time, and it was difficult to ascertain the actual date of attack, but this was thought to be January 4th. Single outbreaks are of frequent occurrence in rural districts, and this was regarded as one of such cases. The premises were disinfected.

On January 16th three other cases were notified, which were removed to the hospital on the 14th. Two of these cases were inmates of the same house as the first case, a woman of twenty-four and a girl of eight years, and the other was a girl of thirteen years from a house opposite. Although the woman (twenty-four) had been nursing the man (twenty-two) previous to his removal, it appeared that all four cases had practically begun their illness at the same time, viz., about the beginning of the year.

Two houses were now involved, and the inmates of both used the same water-supply, but had nothing else in common. No complaints were made of the water, which was said to be excellent in quality, abundant, and had been in constant use for over twenty years. The water upon examination looked perfectly clear, and showed no signs of the likelihood of contamination.

The villages of Kildwick and Farnhill are continuous, Kildwick consisting of the fourteen houses situated below the Leeds and Liverpool Canal and the ancient parish church and churchyard. Farnhill, which is a much larger and more modern community, is supplied with water piped into the houses by a private company. We inquired into the source of the water supplying the Kildwick houses, and found that it was piped in an iron pipe under the

Canal from a double-covered cistern situated in Park Field on the Kildwick Hall Estate, and about twenty-seven yards above the Canal. Water is conveyed into these cisterns by means of stone drains from springs situated above, the principal one rising at some distance above and to the right of the cisterns. This water, besides being piped into the fourteen houses, is supplied to a trough or fountain in the wall below the school playground for the use of the children attending the Kildwick school.

On the same day (the 16th) we inquired into the drainage from the Hall, the only person able to give any information being the old gardener, who had been there for eighteen years. We found that there was no tank or cesspool, but that the outfall drain, which was of stone, after taking a somewhat circuitous course, discharged into a second stone drain, which ran straight down the park field in a natural hollow and emptied into the Leeds and Liverpool Canal. At this outfall a quantity of perfectly clear water was running into the Canal, and there was no evidence of any previous or present sewage pollution, any solids being evidently lost in the ground before they reached this point. This line of stone drain was 60 feet distant from the receiving tank in connection with the water-cisterns at the nearest point. At this stage there was no evidence or indication of any probable contamination of the water-supply by sewage from the Hall. No one had any reason to suspect an unsatisfactory condition of the drainage from Kildwick Hall, which has now afforded another evidence of the danger which may arise from dry-steined wall drains.

On the morning of the 20th two more cases were notified in two fresh houses, a woman, aged forty-nine, in one house, and a boy, aged fifteen, in the other. Both were supplied with water from this same source. Upon receipt of these notifications, I immediately wired to Mr. Rodwell, the Surveyor, to stop the use of the supply, and he then sent a clerk round to all the houses supplied from this source, telling the occupants not to use this water for drinking purposes unless it had been previously boiled. The same day a printed notice was sent round to the consumers. A notice was also put up at the school well, that the water was not fit to drink.

A standpipe in connection with the Farnhill Water Company's Supply was erected at a central point within reasonable distance of the houses. Hearing the next day that, in spite of the warning, some persons were still using the Kildwick water, it was cut off, and the school well was subsequently filled up with stones.

I analyzed a sample of the water drawn from a tap in the first house attacked, but the results by Wanklyn's process showed no

evidence of the presence of sewage or other organic impurities. The water was perfectly clear, and showed no sediment or turbidity. This absence of organic impurities was subsequently corroborated by Dr. Kaye, the County Medical Officer, who analyzed a sample of the water with similar negative results.

KILDWICK WATER.

Date of Analysis.	Hardness.	Chlorine.	Alkalinity in terms of Carbonate of Soda.	SOLID MATTER.		Oxidized Nitrogen.	AMMONIA.		Oxygen con- sumed in two hours at 100° C.
				Total.	Loss on Ignition.		Free.	Albu- minoid.	
	Clark's Degrees.	Grains per Gallon.					Parts per Million.		
Jan. 20. Examined by F. E. Atkinson	—	1·3	—	—	—	0·15	0·025	0·065	—
Feb. 14. Examined by Dr. J. R. Kaye									
	6·7	1·6	0·7	11·2	3·5	0·14	0·030	0·074	2·9

The absence of suspicious chemical results was probably due to the dilution caused by the excessive rainfall during the months of December and January, more especially during the first half of January. The average monthly rainfall for the year 1898 was 2·31 inches, which amount was much exceeded in December (3·55 inches) and January (5·37 inches).

An examination of the drainage at Kildwick Hall was made, and of the water-tanks supplying the village of Kildwick. The water-tank was first uncovered, and consisted of two cisterns, each about 5 feet by 4 feet, made of thick flags, and covered with similar ones, the cisterns being connected by a pipe near the bottom. On uncovering the cisterns the water looked perfectly clear, and showed no evidence of contamination. Probably this may be ascribed to the excessive rainfall above referred to. A few feet further up the hill is a small receiving-tank, also covered with a flag, the supply-pipe to the cisterns being protected with a perforated rose. This tank was supplied with water from two sources, entering it by stone drains. A hole was next dug at a point about 35 yards up the hill, and a stone drain about 6 inches by 6 inches, with a good flow of water running underneath the drain, was found. A second hole was dug about 45 yards higher up, and at a depth of about 1 foot 6 inches, a similar drain was found with flagged bottom and cover, but very much broken, so that water was again running alongside and underneath the drain. A third opening was made, where similar conditions were found. Some scarlet aniline dye was then mixed in a pail of water and

poured down a closet at the Hall, and in fifteen minutes the dye-water made its appearance in the drain at the second opening, and directly afterwards in the receiving-tank connected with the water-supply, thus proving without a doubt immediate connection between the Hall drainage and the water-supply. The dye-water also showed itself at the outlet of the drain into the Canal, and at the open drinking-trough at the school.

The further course of the outbreak may be gathered from the table on page 800.

In nearly all the cases, with one or two exceptions, the onset of the disease was most insidious, and it was very difficult to obtain the actual date of attack, the patients having been ailing in an indefinite manner before calling in the doctor, or being watched for some days before the doctor was in a position to certify as to the nature of the disease; but it would appear roughly that all the cases, with the exception of the two secondary or derivative cases which occurred, date their attacks between January 4th and February 2nd. As the period of incubation in this disease is from two to three weeks, the dates of original infection would be thus much earlier in each case, so that nearly all the cases had originated previous to the date of the first notification.

There was an interval, from February 6th to the 16th, during which time no cases were notified. The subsequent cases, however, were not found to be freshly arisen cases, for all those notified after February 6th had been watched for some time, because ailing, though without definite symptoms. They were not secondary cases, but due to the original cause, though the notification was delayed.

Of the total fifty cases it will be seen that twenty-eight were those of inmates of houses in Kildwick to which the water was laid on, and sixteen others occurred amongst children living outside the area supplied by this water, but attending the Kildwick school, which was so supplied. Of the remainder, one was the young man living at Bradley, who attended the dinner at Kildwick on January 2nd and then drank the water; another was an old man living at Cononley, who was a stonebreaker and was working in Kildwick up to January 11th; the third was a young man living in Farnhill, who had drunk the Kildwick water; the fourth was a young woman living at Farnhill, who on one occasion only drank of the Kildwick water; and the other two were secondary cases—mother and child who contracted the disease through careless nursing of a previous case at home, in Farnhill, the previous case being a scholar at Kildwick.

Typhoid Fever at Kildwick, etc.

Table showing the Number of Cases in order as they were notified, together with Age, Sex, Locality and Dates of Notification, Attack and Removal, Source of Water Supply, and Termination of Case.

No.	Name	Sex	Age	Locality	Date of Notification	Approximate Date of Attack	Date to Hospital	Water Supply	Termination	Notes
1	A	M	22	Kildwick	Jan. 12th	Jan. 4th	Jan. 11th K	Kildwick Supply	Death Jan. 15th	
2	A ²	F	24	"	"	"	"	"	"	
3	A ³	F	8	"	"	"	"	"	"	
4	B	F	13	"	"	"	"	"	"	
5	C	M	15	"	"	"	"	"	"	
6	B	F	49	"	"	"	"	"	"	
7	A ⁴	F	10	"	"	"	"	"	"	
8	A ⁵	M	6	"	"	"	"	"	"	
9	D ²	M	12	"	"	"	"	"	"	
10	E	F	19	"	"	"	"	"	"	
11	E ²	F	23	"	"	"	"	"	"	
12	E ³	F	6	"	"	"	"	"	"	
13	E ⁴	F	21	"	"	"	"	"	"	
14	C ²	F	42	"	"	"	"	"	"	
15	F	F	30	"	"	"	"	"	"	
16	E ⁵	F	16	"	"	"	"	"	"	
17	E ⁶	M	26	"	"	"	"	"	"	
18	G	F	23	"	"	"	"	"	"	
19	H	M	7	Farnhill	"	"	"	"	"	
20	I	M	8	"	"	"	"	"	"	
21	J	M	20	"	"	"	"	"	"	
22	K	M	18	Kildwick	"	"	"	"	"	
23	G ²	M	13	Farnhill	"	"	"	"	"	
24	B ²	P	74	Kildwick	"	"	"	"	"	
25	D ³	M	59	"	"	"	"	"	"	
26	L	M	6	"	"	"	"	"	"	
27	M	M	12	Silsden Moor	"	"	"	"	"	
28	N ²	M	11	"	"	"	"	"	"	
29	N ³	F	8	"	"	"	"	"	"	
30	N	F	7	Farnhill	"	"	"	"	"	
31	O	F	55	Kildwick	"	"	"	"	"	
32	P	M	18	Bradley	"	"	"	"	"	
33	Q	M	8	Kildwick	"	"	"	"	"	
34	G ³	M	18	"	"	"	"	"	"	
35	L ²	M	4	"	"	"	"	"	"	
36	R	M	12	Farnhill	"	"	"	"	"	
37	S	M	10	"	"	"	"	"	"	
38	U	M	64	Cononley	"	"	"	"	"	
39	B ³	M	38	Kildwick	"	"	"	"	"	
40	U	M	7	Farnhill	"	"	"	"	"	
41	S ²	F	35	"	"	"	"	"	"	
42	V	F	9	"	"	"	"	"	"	
43	V ²	M	5	"	"	"	"	"	"	
44	S ³	F	12	"	"	"	"	"	"	
45	W	F	21	"	"	"	"	"	"	
46	X	F	9	"	"	"	"	"	"	
47	Q ²	M	11	Junction	"	"	"	"	"	
48	O ²	M	22	Kildwick	"	"	"	"	"	
49	Y	F	23	Farnhill	"	"	"	"	"	
50	Z	M	10	Junction	"	"	"	"	"	

NOTES.—Milk: The above cases were supplied with milk from 10 separate sources, so that milk did not come under consideration as a source of conveyance of infection.
 K—Keighley and Bingley Joint Hospital.

TH—Temporary Hospital.

Of the total fifty cases twenty-nine were males, and twenty-one females.

The following table shows the age-period of those who were attacked :

Age.				Number of Cases.	
Under 1 year	...	...	...	0	} 1 under 5 years of age.
1— 5 years	...	...	...	1	
5—10	„	...	...	13	} 49 over 5 years of age.
10—15	„	...	...	11	
15—25	„	...	...	15	
26—60	„	...	...	7	
Over 60	„	...	...	3	

The table on page 802 shows the incidence of the disease upon those liable to attack in the fourteen houses in Kildwick supplied with the contaminated water-supply. Those attacked are marked in heavy figures, and those in parentheses are the fatal ones.

These fourteen houses had a population of sixty-seven persons, of whom twenty-eight were attacked, and thirty-nine escaped. It will be noticed that the inmates of four houses escaped altogether. I endeavoured to ascertain whether any of those unattacked had been rendered insusceptible by a previous attack of fever, but could obtain no evidence of this. They attributed their escape to the fact that they were not drinkers of cold water as supplied, but invariably took it after boiling, as in the form of tea, etc.

As will be seen, there were ten deaths, which show a mortality percentage to those attacked of 20·0. The deaths, however, all took place among the regular consumers of the water, viz., among the inmates of the Kildwick houses supplied by the water, and the mortality percentage of those attacked in this area amounts to 35·7 or 1 in 2·8 attacked, and is equivalent to a death-rate on the population of the fourteen houses of 149·2 per 1,000.

The severity of the attacks within this area is no doubt due to the repeated doses of the poison taken by regular consumers during the period of infectivity of the water. In those who, like the school children living without the area who were attacked, probably only took the water on one or possibly two occasions, as was also the case with the man who lived at Bradley, the character of the disease was milder in type.

Sixteen cases occurred amongst children attending the Kildwick school who lived outside the Kildwick area, and eight others who resided within the area, making a total of twenty-four school-children out of the fifty total cases. The number of children on the books is 127, and the average daily attendance for the week before the Christmas holidays was 101·4. The school reassembled after the holidays on January 9th, and remained open until the

Thus it will be seen that an average of ninety-six children were between January 9th and 20th exposed to the possibility of infection, but owing to the weather being wet and cold, probably only a small percentage of the children would drink water.

Houses.	Number, Age, and Sex of Inmates.							Total Occupants.	Total Attacked.	Total Unattacked.
1	(F 24)	F 24	(M 22)	(F 10)	F 8	F 6		6	5	1
2	(F 74)	F 54	F 52	F 45	F 40	(M 38)	F 13	7	3	4
3	F 42	M 38	M 15					3	2	1
4	M 50	(F 49)	F 45	F 28	(M 20)	M 18	M 12	7	3	4
5	M 51	F 47	(M 26)	M 25	(F 23)	F 21	(F 19)	F 16	M 6	3
6	F 54	F 23	M 18	M 17	M 16	M 13		6	3	3
7	M 68	F 38	M 35	F 26	M 24			5	1	4
8	M 42	F 40	F 8	M 6	M 4			5	2	3
9	M 57	F 55	F 26	M 22				4	2	2
10	M 30	F 30						2	1	1
11	M 71	F 29	F 27	M 6				4	0	4
12	M 33	F 30	M 4					3	0	3
13	M 50	F 42	F 22					3	0	3
14	F 56	M 31	M 21					3	0	3
								67	28	39

The tenant of Kildwick Hall returned home ill on December 6th last. He had had a rigor on the Sunday previous (4th), but his doctor did not see him after his return until the 10th. The patient was found to be suffering from "pneumonia," the origin of which could not then be accounted for. On December 24th I received a letter from the doctor, a medical officer of health of a neighbouring district, notifying the case as one of typhoid fever. In this letter he says: "He (the patient) came home from London with the disease upon him, so that there is no suspicion of anything wrong in the sanitary condition of the Hall—at least, there is no need for any special inspection until after Mr. — is better. The stools are being thoroughly disinfected, and all precautions are being taken."

On January 16th, when three fresh cases in two houses in Kildwick were reported, I received a second letter from the doctor, in which he said: "In view of the other cases of typhoid which have occurred in the village of Kildwick, I may say that the typhoid stools (*i.e.*, at the Hall) were carefully disinfected in carbolic for at least half an hour before being emptied. I mention this, lest it might be supposed that the cases arising in the cottages below the churchyard might be connected with undisinfected stools from the Hall (through the water-supply)." The doctor subsequently informed me that although the disease was indefinite and obscure at the commencement, still, there being some suspicion, the stools were from the time of his first attendance (December 10th) subjected to carbolic acid.

The tenant at the Hall had, previous to his attack, been staying at the house of his son-in-law, a doctor. During the early part of his illness his son-in-law came over to the Hall in order to be with him. On December 19th he finally left, and on his journey home felt ill. He did not consider it necessary, however, to consult a brother practitioner until December 28th, and he then judged him to have been suffering from typhoid fever for about a fortnight. This would bring the date of his attack to December 14th, and he would be at the Hall for a few days during which no disinfection would take place in his case.

Moreover, in the primary case at the Hall, there was also the period from December 6th to December 10th, during which no disinfection of discharges would take place. Irrespective of what might take place at a subsequent period, there is ample evidence to show that here was opportunity for the contamination of the water-supply by means of presumably infected stools finding their way from the Hall through the drains into the water-supply.

Having ascertained that the tenant and his son-in-law both contracted the disease elsewhere, I made inquiries at the home of the latter in the Midlands, where I found that a third case had occurred (that of a housemaid) in the house where the two above mentioned contracted the disease. This began on or about December 24th, and was first seen by the doctor on January 6th. The medical officer of health for the district, who was also the attendant, has kindly favoured me with an account of the cases of typhoid fever which have occurred in his district during the past year, and he therein points out that these three cases most probably had their origin through a milk-supply, from water which had been specifically contaminated by a case of typhoid fever on the dairy farm.

Within the last week or two the owner of the estate has undertaken the provision of an adequate supply of pure and wholesome water. This is being obtained from that supplying Kildwick Hall.

It might be well here to draw a few edifying conclusions from the outbreak which might help to prevent a like occurrence in the future :

1. That chemical analysis of a water, no matter how valuable in some respects, is still deficient in helping our investigations into specifically contaminated water ;
2. That all water-supplies should at intervals undergo examination ; and
3. That sewage-contaminated water may be drunk with impunity for long periods, but immediately specific contamination occurs, then immediately will follow an outbreak of the disease.

PUBLIC HEALTH ACTS AMENDMENT BILL.—The Select Committee to whom this Bill was referred reported that, while many of the powers of the Bill might with advantage be given by a general statute, which might be adopted by local authorities, and that other clauses further amending the Public Health Acts might with equal advantage be embodied in such statute, the Committee were of opinion that the proposals of the Bill were of such magnitude and complexity that they should only be accepted in a more complete measure. The Committee recommended that the Government should consider the question of introducing such a measure at the earliest possible date of next session, and were of opinion that the provisions of the law relating to public health ought to be speedily consolidated.