Dr. Blaxall's report to the Local Government Board upon the sanitary condition of Calne in connexion with an outbreak of diphtheria and typhoid fever in that town / [F.H. Blaxall].

Dr. Blaxall's Report to the Local Government Board upon the Sanitary Condition of Calne in connexion with an Outbreak of Diphtheria and Typhoid Fever in that Town.

George Buchanan,
Medical Department,
June 17, 1884.

The present inquiry was instituted by direction of the Local Government Board in consequence of the Medical Officer of Health having reported the prevalence of diphtheria in the town of Calne, and of the vicar having subsequently informed the Board that typhoid fever had also appeared there, both communications making special mention of the existence of general nuisance caused by the escape of sewer air from the surface ventilators.

It may be premised that the sanitary conditions and circumstances of this town were made the subject of inquiry by me in 1874. I propose, therefore, before treating of recent prevalence of disease, to refer briefly to my report on that occasion, quoting from it such parts as may be equally applicable at the present time, and noting any improvements that may have been effected within recent years.

The following is the general and topographical description of the town as given in my former report:—

Calne, a municipal and parliamentary borough in the county of Wilts, is situated on the slopes of hills and in a valley watered by the river Marden, which enters from the eastward, and flowing to the centre of the town is there dammed for the purpose of supplying a branch of the Berks and Wilts Canal. On leaving the town the river runs in a westerly direction parallel with the canal.

"The soil is of loose rubble and made earth, overlying coralline oolite, which is much traversed by fissures."

"The Urban Sanitary District, comprising the municipal borough and part of the parliamentary borough beyond, contains 721 houses and a population of 3,333." (According to the census of 1881 the houses have increased to 732 and the population to 3,405.) "Two extensive slaughtering and bacon-curing establishments form the chief industry of the town, the number of pigs annually killed amounting to some 100,000 or more."

"Nearly every poor family has a piece of allotment land, varying in extent from a quarter to half an acre, and situated just outside the town."

The conditions then reported as chiefly calling for remedial action may be summarised as follows:—

(1.) The water supply derived from wells greatly exposed to pollution.
(2.) Imperfect and defective sewerage.
(3.) Unwholesome method of excrement disposal by means of cesspit privies.
(4.) Nuisances arising from pig-slaughtering establishments, pigsties, and accumulations of refuse in the vicinity of dwellings.

Sanitary Conditions.

My inspection of the sanitary condition of the town at the present time as compared with 1874 shows good work done by the Authority for the improvement of the water supply and the sewerage, to be presently considered, but in respect of other matters apparently little or nothing has been done to give effect to the recommendations appended to my report, and which had for their object the remedying of the several evils pointed out. Thus, *cesspit privies* are still very general, being only now in progress of abolition by the substitution of closets in communication with the sewers; but these latter closets are not provided with water for flushing, and they thus favour the lodgment of fœcal matter in the drains, and so give rise to a foul state of sewers, which is beyond such remedy as measures of ventilation usually afford. Again, no steps have been taken to secure the systematic and frequent removal of refuse, and as a conse-

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quence large accumulations, amounting to two or three cartloads or more, are frequent in the vicinity of dwellings. Pig-keeping also continues to be the occasion of very general nuisance. The Authority have not adopted byelaws for the prevention of the keeping of animals on premises so as to be injurious to health.

As to the Water Supply.—Here great improvement has been effected. The town is no longer dependent upon local wells; a company having provided it with a plentiful supply of good water derived from a source at Calstone, about three miles distant.

The water as it issues from the green sandstone rock is collected in a covered tank, and passes thence by gravitation through iron pipes to the town, where it is distributed to the several streets. I understand that at present only about 100 houses are supplied with water from this source, but the fact that a wholesome water is now available for that remainder of the town which is still dependent on local wells, which are exposed to pollution, is a circumstance of the highest sanitary importance.

The company's regulations require that all closets supplied with this water for flushing purposes shall be provided with separate service cisterns, and that all connexions with water mains shall be carried out under direction of their own staff.

As to the Sewerage.—At the time of my inspection in 1874 the Authority had in contemplation the re-sewering of the town, but this was not carried into effect until 1881, when the scheme adopted was of a comprehensive character, embracing the laying down of new sewers in certain parts of the town, with provision for their ventilation and flushing, and providing for the conveyance of the sewage to a distance below the town, there to be disposed of on the land.

The system includes three main sewers, viz. :—

(1.) The new road sewer extending from the bottom of Butcher Row to Station Road, a distance of 200 yards. This sewer is formed by its junction with the Butcher Row sewer, which receives the sewage from east of the town, including the Green, Back Lane, Mill Street, Pippin, &c., and the drainage from one of the large slaughter-houses; the drainage of the other slaughter-house going direct into the New Road sewer.

(2.) The Quarry sewer bringing the sewage from Lansdown Road and Silver Street on the south.

(3.) The Patford Street sewer formed by the junction of the Castle Street and High Street sewers. The former (Castle Street) receives the sewage of Hog Street, on the west of the town; the latter (High Street) the sewage from the north-western portion of the town, including Wood Street and Curzon Street, which, together with High Street, retain the old sewers.

These three main sewers (New Road, Quarry, and Patford Street) converge at the Station Road, forming, by their junction, the outlet sewer, which follows the course of the river for a distance of about 1½ miles below the town, passing in its way through meadow land and osier beds, under and over the river, and so on till it arrives at a plot of land about 8 acres in extent, where the sewage is disposed of by irrigation and downward filtration, the latter process being effected by means of subsidence beds, six or seven in number. The beds vary in size, but average each about 45 yards in length by 20 yards in breadth. The effluent sewage is carried to the river by subsoil drains.

The new sewers are constructed of glazed earthenware pipes, and are laid at various gradients, some very steep, others almost flat. For example: In the Castle Street sewer the fall is 1 in 43 at one part, and 1 in 6 at another; in the Quarry sewer, as it approaches the Station Road Junction, 1 in 22, while the New Road sewer is 1 in 610. The Patford Street sewer is shown on the plan to have a fall of 1 in 683, but it is said to be laid at almost a dead level.

The flushing of the sewers is effected partly by admitting the water from the river direct into the sewers, and partly by connexion of the water mains with the man-holes which can be converted into flushing chambers by means of boards fitted for the purpose.

The provision for ventilation consisted originally of surface grates in connexion with the man-holes and lamp-holes, but the nuisance caused by the escape of the sewer air from these openings gave rise to such loud complaint that at the time of my visit I found most of them closed (some by direction of the Authority) and air shafts 6 inches in diameter substituted at certain places. The nuisance arising from the grate near the Post Office, at the junction of the Butcher Row and New Road sewers, would appear to have been of a very aggravated character, and was the subject of very general complaint.

Speaking generally of the scheme as a whole, it is locally regarded as well adapted to the requirements of the town, but the results of my inquiry tend to raise grave

doubts as to the manner in which the constructive details were carried out. Thus the concurrent testimony of many persons is to the effect that the sewers were not laid upon an evenly prepared bed, but that any inequality of gradient was rectified by simply propping up the pipes with a piece of stone or tile, or by pressing them down, as the case might require, the sewers being thus imperfectly supported at such points and so favouring the stagnation of sewage and offensive exhalations. In like manner the joints instead of being properly cemented are said to be formed of clay, while the surveyor informed me that he had frequently detected flaws in the pipes and had brought the same under notice of the Authority.

I am not in a position to verify these representations, but I may state from my own observation that on my employing a man to examine the sewers at the man-holes at Station Road, Patford Street, and the Market Place, he brought up handfuls of black stinking mud which lay, he said, some 3 inches deep. Further, in the Patford Street sewer the sewage might be seen eddying backwards; and on a house drain being opened in the Market Place during my inspection, I was told a considerable leakage was observed to have taken place at the clay joints, blackening the surrounding soil.

As further evidence of departure from certain principles which, according to Sir R. Rawlinson, C.B., the Board's Chief Engineer Inspector, should be observed in sewer construction, I would point out that the outlet of the sewer instead of being protected by a valve-trap is left open, allowing the wind to blow up the sewer, so also the ventilating shafts are at certain places too far apart, the intervening spaces amounting to 200 and 260 yards respectively at certain parts of the outlet sewer, and to 150 yards on the New Road sewer. Lastly, no provision has been made for flushing the Pippin sewer, nor for the ventilation or flushing of the old sewers.

Having regard to the universal complaint of the nuisance caused by the sewer ventilators, the character of the sewage became a question of considerable importance, more particularly as the statements I received were very conflicting as to animal matter from the slaughter-houses being allowed to pass into the sewers. It appears that at the time of slaughtering, the blood is caught in vessels and afterwards removed; and that the intestines are as a rule turned to profitable use, while the offal is carted away. Still, in view of the extensive scale on which the slaughtering is conducted (some 300 or so of pigs per day) it seemed not unlikely that the drainage from these establishments would contain, as reported, much animal matter. In order, therefore, to inform myself upon the point, I paid three visits to the sewage outfall, accompanied on one occasion by certain members of the Local Board, including a member of one of the bacon-curing firms. On my first visit (in the afternoon) the sewage was running free of any appearance of animal matter, but the surface of the sewage plot, and more especially that of the subsidence beds, was strewn with fat and pieces of intestines. On the other occasions (in the mornings) the sewage ran clear until the process of washing down the slaughter-houses commenced, when it became red with blood and laden with nodules of fat from the size of a pea to that of a walnut, and with portions of intestines, measuring from one or two inches to thirteen feet or more in length; and upon a strainer being placed across the main runner the fatty particles conglomerated forming a thick scum on the surface, while the intestines sank to the bottom. I am told that at times the fluid from the subsoil drains as it enters the river is mixed with blood. The stench of the decomposing animal matter and other filth at the sewage plot is sickening to a degree, and besides constituting a serious nuisance involves risk to health. The occupants of two or three cottages and of a farmhouse in the vicinity of the plot stated that at times, and more particularly in the summer, the stench was unbearable. One man (a miller) adding that he and his wife had suffered so much from the effects of the stink causing headache, nausea, loss of appetite, &c. that he feared he should be obliged to give up his employment and go elsewhere to live, while the men employed to clear out the subsidence beds told me that when so engaged they were attacked with headache, sweating, vomiting, and diarrhœa. Another matter of importance as influencing the character of the sewage, is the large quantity of hot water that passes from the slaughter-houses into the sewers, there promoting the decomposition of such sewage deposits as are favoured by faulty construction or otherwise, and so intensifying the pollution of the air in the sewers.

Reviewing all the facts here stated I am of opinion that the nuisance experienced from the ventilating grates may be ascribed to the following causes, viz., the exceptionally offensive character of the sewage; the defective construction of the sewers, which admits of lodgment and consequent decomposition of the sewage; insufficient means of ventilation; and the exposed outlet which allows the wind after blowing over the foul sewage plot freely to enter and pass up the sewers.

In support of this conclusion, I learn from the Medical Officer of Health that the nuisance has been worst when the wind has been from the west, *i.e.*, from the direction of the sewage outfall, and that the grating near the Post Office is particularised as being specially offensive. This grating, I would observe, is situated at the Butcher Row junction at the head of the New Road sewer, already referred to as ill-ventilated and containing much deposit, and which moreover is almost in a direct line from the outlet. Further, the grating is between the drains from the two slaughter-houses, the sewage at this particular spot being thus specially influenced by the hot water which at times shows itself by the volumes of steam escaping from the grating.

To remedy the nuisance complained of, the evils here pointed out must be severally dealt with, for it is obvious that closing the ventilators is simply an attempt to treat the effect while the cause remains untouched. I suggested to the member of the firm who accompanied me to the outfall that the slaughter-houses should be sprinkled with sawdust, and at the end of each day's work the floors should be swept and all the refuse matter collected, burned in a furnace, and the fumes passed through fire to prevent nuisance from the operation.

With regard to Infectious Hospital provision: — The town continued without any accommodation of the kind until 1881, when a severe epidemic of scarlatina forced upon the attention of the Authority the want of such provision, and obliged them in the then pressing emergency to obtain permission of the guardians to make use of certain of the workhouse wards for isolation purposes. Subsequently their endeavours to obtain suitable accommodation in their own district met with much opposition from the inhabitants, and they hence hired a cottage on the Devizes Road about a mile from the town outside the Urban District. The cottage contains six rooms, two of which are appropriated to the caretaker. Of the remaining four, one is on the ground-floor and would serve as a sitting-room for convalescents, two are on the first-floor, one of them being a good sized room with two windows, over this is a roomy attic so cut off from the other rooms that it would offer opportunity for the isolation of a second disease, if necessary, but the ventilation would require improvement. The privy, situated in the yard, empties into a cesspit, and is only a few feet removed from the well. The cottage stands near the public road, and is not sufficiently protected by a wall or other close fencing to preclude patients who may be well enough to get into the open air from communicating with passers by. The Authority having secured the cottage, and put a caretaker into it, did not in the first instance take any further steps to maintain the place in readiness for the reception of infectious cases, the rooms being left void of furniture and bedding; so that on one occasion when a case of diphtheria was sent there bed and bedding had to be borrowed from the workhouse, and only lately, at the time of my inspection, before a typhoid fever patient could be admitted these necessary articles had to be purchased in the town and sent to the cottage. Having observed that the caretaker was employed in making baskets for sale, I would point out that articles of the kind going from an infectious hospital are liable to prove the means of spreading disease.

Epidemic of Diphtheria.

The epidemic of diphtheria, with which this report is more immediately concerned, dates from May 1883, when four families were invaded; the disease continued present from that time till the December following, prevailing with marked activity in June and July, when the newly invaded households numbered 19 and 14 respectively, falling to four in each of the months of August and September, and to one in each of the three following months; no fresh case occurring after December.

The infected houses for the most part were grouped together in certain streets and outlying parts of the town; thus seven were situated in Curzon Street, the main thoroughfare in the north-west of the town; five in the Market Place in the centre of the town, and six in each of the three following localities, viz., the Quarry or Lansdown Road, forming a suburb on the south; the Pippin consisting of about 12 cottages to the east of the town (the narrow river Marden intervening); and the Marsh, including 12 or 14 cottages situated about three-quarters of a mile from the north-eastern extremity of the town, within the parliamentary but not the municipal borough. (The Pippin and the Quarry, as already stated, are included in the new sewerage area, but the Market Place and Curzon Street belong to the old system. The Marsh is beyond the sewers and is undrained.) Besides these small groups of cases scattered ones occurred here and there. In all I have record of 84 cases and 10 deaths, distributed amongst 48 families and extending over eight months (May to December 1883). Two of the deaths are

shown in the Registrar General's Returns as due to "croup," but there is good ground for regarding the disease as diphtheria. In 30 instances the first sufferers in families were children attending one or other of the schools, in the remaining 18 they were non-schoolgoers.

The principal schools are (1) The British schools (infant and upper), situated in Church Street, near the river, in the low-lying part of the town, and subject to flooding. These schools suffered considerably during the notable floods in October 1882 when the water in the schoolrooms was nearly 4 feet deep. (2) The Lansdown school in Mill Street, close to the British school, and equally affected by the flood in 1882. (3.) Trinity school (infant and upper), situated on the outskirts of the town on the Lansdown road. (4.) The National school, consisting of two separate buildings for boys and girls, situated on the Green near the centre of the town. Lastly, Guthrie school in Wood Street, at the northern extremity of the town. The three last-named schools occupy comparatively high situations. The British, National, and Lansdown schools are provided with closets which, though discharging into the sewer, are unprovided with means for flushing. Trinity and Guthrie schools have offensive cesspit privies.

In order to ascertain if the disease had fallen with marked incidence on any of the schools, I obtained the number of children in each school, as shown in the subjoined table, together with the number of primary attacks in pupils of different families :—

TABLE I.

School.	No. of Pupils of each Sex.			No. of primary attacks amongst		
	Males.	Females.	Total Pupils.	Males.	Females.	Total primary attacks in each School.
British Upper -	83	77	160	—	7	19
„ Infant -	58	46	104	7	5	
Trinity Upper -	28	36	64	4	1	5
„ Infant -	—	—	46	—	—	
National - -	186	80	266	1	—	1
Guthrie - -	—	—	99	1	3	4
Lansdown - -	—	—	93	1	—	1

The British school, it will be observed, exhibits a marked excess of attacks, Trinity and Guthrie schools ranking next, while the Lansdown and National schools escaped with one case each.

The question has been raised as to whether the outbreak in the British school may not have been related to conditions of dampness consequent upon the heavy floods in the previous October. But I could find no ground for this opinion; inquiry showing that after the floods not only was the school closed for some days, and every effort made for drying it, but there was no appearance of diphtheria till the school had been re-opened for nearly six months. Even then the cases occurred singly, or at most, two or three at a time, extending over a period of six weeks, instead of, simultaneously, in notable numbers, such as might be looked for in a school of 260 children, had the disease owed its origin to conditions to which all were alike exposed. Moreover, Lansdown school, that suffered equally from the floods, had one case only out of 93 pupils. In short, had the presence of diphtheria in these schools been specially related to physical character of site or to unwholesome conditions on the premises, it might be expected that schools similarly circumstanced in these respects would have suffered alike, whereas it is shown in respect of the three schools that chiefly suffered that the British (with the maximum number of attacks) stands low, while Trinity and Guthrie occupy comparatively high situations; the same argument holding good in respect of the National and Lansdown schools that escaped with one case each. Again, the several schools had nothing in common as regards either means of drainage or excrement disposal. It should also be noted that not a single case occurred in the infant section of Trinity school, including 46 children.

As the inquiry proceeded it became apparent that neither sewer air, nor the unwholesome conditions described as existing in the town, were directly concerned in the origin of the disease, the evidence pointing conclusively to introduction from without, through the independent agencies of a boy A. and a servant girl B., both attacked in May, while the subsequent spread of the disease was shown to be due to the promiscuous intermixing of infected and healthy, some of the schools playing a prominent part in the dissemination of infection.

To trace, first, the introduction of the disease by the boy A. This boy, aged 11 years, resided at Quemerford, in the rural district, about one mile from Calne. He was a pupil at the Trinity school, and continued to attend there up to May 4th, when he was attacked with severe sore-throat, which kept him at home for some weeks. His illness was not regarded as diphtheria; but on his return to school on June 5th his voice and vision were observed to be much affected, the schoolmaster stating that he used to cry because he could not see. There had been no diphtheria in either the town or school prior to this boy's attack on May 4th, and it is noteworthy that during his absence of nearly five weeks the disease was in abeyance, no further case occurring in the school until June 11th, *i.e.*, six days after A.'s return. At that date a little girl, W. R., in the same class with A., was attacked; her brother sickened on June 18th, and later on two other cases occurred in the same family, all of them being pupils at Trinity school, and being present there up to the dates of their respective attacks. The boy taken ill on June 18th was kept at home for eight days only, returning to school on June 26th, while his sister, W. R., previously attacked, did not return till July 2nd. The return of these two children was followed by two fresh cases amongst the pupils, one on June 29th, the other on July 6th. The school was closed for the summer holidays on July 27th, the pupils reassembling on August 27th. A fortnight after this one other case occurred in the school, but in this case the sufferer was known to have been in communication with infected relatives in two families. Thus so far as my information goes the case of July 6th may be regarded as virtually completing the outbreak in Trinity school, which, excluding the introductory case of the boy A., was confined to three families. The attacks were limited to the upper school, not a single case occurring amongst the infants, who sat in a separate room.

As to the origin of the disease in the initial case, the boy A., the lapse time between his attack (May 4, 1883) and the present inquiry prevented my being able to obtain definite information as to his movements, but the fact that the disease had been present at Headington, about 2½ miles to the east of Quemerford, and that a child, a relative of A.'s, died of it there in February, is strongly suggestive of infection derived from an antecedent case. I visited Headington, but could learn nothing reliable respecting this child's illness; but it came to my knowledge that another child, living in the same village, had suffered from diphtheria in the previous January. The nature of her disease was not at first recognised, and hence it spread to others round about Headington. It was, however, clearly diphtheria, the attack being followed by characteristic paralysis.

The second, and more important part of this epidemic, and which was justly referred by the Medical Officer of Health to introduction by the servant girl B., now remains to be considered. The girl was a nurse in Mr. R.'s family, residing on the Strand in the centre of the town. Shortly before her attack she went with her mistress' children to Wilcot, near Pewsey, where they remained for some two or three weeks, during which time one of the children suffered from what was regarded by the medical practitioner called in as sore-throat of a very slight character. From Wilcot they went to Barton Farm, near Marlborough, for a few days, returning to Calne on or about May 11th, at which date the servant was suffering from sore-throat, contracted, as she said, at Wilcot. She went to church on Sunday, May 13th, but her throat becoming worse she went on the Monday to Dr. Campbell's surgery for advice. The next day she was seen by his partner, Dr. Bishop, and the case being obviously one of diphtheria, she was sent to her father's cottage on the Marsh, but she did not take to her bed till Friday the 18th. The source of infection in this girl's case must remain doubtful. The Medical Officers of Health concerned were not aware of any diphtheria at either Wilcot or Marlborough at the time of the girl's visit there; but scarlatina, they stated, was present in a mild form at the village of Huish, near Wilcot, and a death from diphtheria occurred on April 19th at Ogburn, St. Andrew, about 1½ miles from Barton Farm. Further than this, no evidence was forthcoming to explain the orgin of this girl's case.

To resume the history of the epidemic. Within a few days of B.'s arrival at her father's home a man, W., who worked for a baker in the town, and delivered the bread at the different houses, was attacked with severe sore-throat. This man continued to go about his work as usual up to May 26th, when he consulted Dr. Campbell who, having regard to the suspicious character of the case, ordered him to remain at home. On June 6th, W.'s boy little John, a pupil at the British infant school, went home ill, and was very delirious that night; typical diphtheria developed, and the child died on June 14th; meanwhile, on June 12th, one of his little brothers (a twin 2½ years old) was attacked, this case being followed on the 19th by that of the other twin, one case proving fatal on June 27th. Later on the mother herself suffered. These four cases were apparently referable to

direct infection from the man W., who, it is in evidence, visited the infected girl B.'s family after her return home, and probably in this way contracted the disease.* The little boy John in his turn introduced it into the British infant school, for whereas there had been no previous diphtheria in the school, his attack on June 6th was followed by a second case on the 9th, in a pupil named H., who went home ill, but was absent for nine days only. This child returned to school on June 18th. On the same day four fresh cases occurred amongst the scholars, including two children in the infant school and two in the upper school, one of the latter being H.'s sister, who had continued to attend there as usual during her brother's illness, and who, probably, in this way kept up the infection amongst the infants, and was the medium of introducing the disease into the upper school. From this time fresh cases continued to occur in both sections of the British school, notably amongst the infants, where nine fresh cases took place between June 18th and July 2nd, but whether related to H.'s speedy return to school, or due to personal intercommunication with other infected children, could not be precisely determined.

By advice of the Medical Officer of Health the school was closed on July 17th.

Reckoning only primary attacks in families the number of cases in this school, exclusive of the introductory case, John W., amounted to 19.

With regard to Guthrie School.—This school was reopened on August 27th at the expiration of the summer holidays. Shortly afterwards two of the scholars were attacked with diphtheria, one case occurring on the 4th the other on the 10th September; the children having apparently contracted the disease from their friend and schoolfellow E. M., who after suffering from diphtheria throughout the holidays had returned to school in the convalescent stage. In all probability the children in question would not have been brought in contact with her but for the school attendance. (Inquiry showed that E. M. took the infection from one of the British school children (M. R.), with whom she was very intimate.) After this the school remained free of diphtheria till November 22nd, when two sisters, K. S. and E. S., were attacked within a day or two of each other, both cases quickly proving fatal. The sufferers lived on the Quarbarton, next door to a family that had suffered from diphtheria in the summer, the first case having occurred in July, and being followed during a period of several weeks by a succession of cases of specific sore-throat in other members of the family.

With regard to the *solitary cases at the Lansdown and National Schools.*—In both instances there was undoubted evidence of personal communication with previously infected children belonging to the British school.

It may be gathered from what has been here stated with reference to the appearance and spread of diphtheria in the British, Trinity, and Guthrie schools, that the disease was introduced some weeks before the schools broke up for the holidays, thus affording opportunity for it to spread amongst the pupils. Further, in the British school, both sections (infant and upper) were thus early invaded, and to this circumstance the excess in that school may probably be referred. On the other hand, at the National school, the first and only case occurred within two or three days of the holidays. So again at the Lansdown school, the only sufferer had absented himself from school some days before he was attacked. Hence in neither of these schools was the same facility offered for the spread of infection.

Having now shown the manner in which diphtheria was introduced into Calne by A. and B., and having traced the subsequent spread of the disease (1) from A. to the children in Trinity school, and (2) from B. to the man W. and his family, and from them to the British and other schools, inquiry is concerned with the remaining 16 primary attacks in non-schoolgoers, including eight adults and eight children. In eight instances there was conclusive evidence of direct infection from person to person, three being women who contracted the disease while nursing infected persons, and five being children who were known to have mixed with infected playmates. In the remaining eight cases the channel of infection could not at the date of the inquiry be established, but two of them occurred early in the epidemic in servants who were friends of the nurse girl B., and who had probably been in personal communication with her after her return to Calne.

The subjoined table has been prepared to show the number of males and females respectively at certain specified ages included in the 48 infected families, and the number of attacks and deaths in each class:—

* During B.'s illness her brother came down from London for the day, and three or four days after his return to town he was attacked with diphtheria, narrowly escaping with his life.

TABLE II.

—	Under 3 years.		3 to 12 years.		12 to 15 years.		15 years and upwards.		Total of each sex.		Combined Total.
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	
48 families consisting of	12	24	52	45	17	15	49	49	130	133	263
No. of attacks in each class - -	4	2	26	28	5	2	4	13	39	45	84
Per-centage of attacks -	33·3	8·3	50·0	62·2	29·4	13·3	8·1	26·5	30·0	33·8	31·9
No. of deaths - -	2	—	3	4	—	—	—	1	5	5	10

The striking feature of the above table is the excess of attacks on children from 3 to 12 years of age. This may probably be explained by the fact as taught by experience, that children at this period of life are more prone to contract the disease, and further, from 3 to 12 includes the ages at which children mostly attend school, where they probably run a greater risk of contracting disease through the circumstance that infected and healthy children are unwittingly brought together.

The teaching of this inquiry points:—

(1.) To the necessity of isolation to prevent the spread of diphtheria, for had the Authority possessed a hospital ready for use, and had the servant girl B. (initial case of Group 2) been removed there directly the disease declared itself, instead of being sent to her own home, there can be no doubt that some 70 or 80 cases of severe sickness, and 10 deaths extending over some eight months, would have been avoided.

(2.) To the want of more definite regulations to govern school attendance with a view to guard against children being sent to school when in an infective condition, *i.e.*, when suffering themselves from infectious disease or when such disease is present in their own homes. The question, doubtless, presents some difficulties owing to the disease occasionally escaping detection through the mildness of the attack; and, secondly, from the want of more precise knowledge than we at present possess as to the stage of convalescence that must be arrived at before persons recovering from diphtheria cease to be a danger to others. This inquiry, indeed, shows the disease to have been apparently spread by children when suffering from the paralytic sequelæ of diphtheria. Whether in these cases any other symptoms, such as sore-throat, &c., were present there was no evidence to show. In the face of these difficulties I can but think that great improvement would be effected if school authorities were to make the preservation of the health of the school a consideration antecedent to that of securing large attendances.

To this end the parents should be specially instructed as to the several diseases regarded as infectious, and as to the danger incurred to others in sending their children to school when such diseases are present in their own homes. Further, in cases where parents ascribe absence from school to illness, the school attendance officer should be specially careful to make due inquiry into the matter.

EPIDEMIC OF TYPHOID FEVER.

The outbreak of typhoid fever, with which this town was recently visited, exhibits a marked contrast to the behaviour of diphtheria just considered, seeing that the disease instead of being scattered about the town and its outskirts, was limited to four out of 10 houses (which we will distinguish numerically), in Butcher's Row, situated at the lower end of Church Street. The disease appeared first at house No. 1, a butcher's shop at the upper end of the Row, and subsequently at the three last houses (Nos. 8, 9, and 10). No. 1 was occupied by a young woman, A. G., aged 19, her brother and his partner. No. 8, by Mr. and Mrs. H., No. 9, by a widow and her two daughters. No. 10, (the Post Office) by the postmaster, his wife and daughter, and a servant; supplemented at the time of the fever by a nurse. Besides these there were two young men who attended to the duties of the office but did not reside in the house,

The first sufferer was the young woman A. G., at No. 1, taken ill about September 10th or 12th, with what proved to be typhoid fever. She was removed to her mother's house on the Piece towards the end of the month, where she died on October 23rd. The two next cases occurred on or about September 30th, when Mrs. H., at No. 8, and the widow's younger daughter (aged 14), at No. 9, were simultaneously attacked. Both cases were very severe, the girl's more particularly so, her attack being accompanied by considerable hæmorrhage from the bowels, and she was confined to her bed for 10 weeks or more. After this no fresh case till December 20th, when the postmaster was attacked, but the nature of his illness did not declare itself till the end of the month. Three cases followed at the post office, the persons attacked being the postmaster's daughter, taken ill at the end of January, the nurse at the beginning of February, and the servant on February 23rd. This latter case was removed to the infectious hospital, where I had the opportunity of seeing the sufferer frequently. It was a typical case, and for some days her life was in imminent danger. In all, this local outbreak resulted in seven attacks and one death amongst four families of 15 persons. With regard to the origin of the disease, there had been no previous typhoid fever in the town for a considerable time. The initial case, A. G., having proved fatal, prevented my being able to gain reliable information respecting her movements, beyond the circumstance that she went to certain fêtes in the neighbourhood on August 23rd and 28th, thus suggesting probable exposure to infection on the latter occasion, the interval between the outing and the manifestation of symptoms being in keeping with the usual latent period of typhoid fever, viz., from 10 to 14 or 15 days. As to the subsequent cases. After most careful inquiry I could find nothing to attach suspicion to milk or other article of diet, or indeed to any channel of infection except that of sewer air, and here there was good ground for suspicion. Butcher's Row (it will be remembered) has already been mentioned in the former part of this report as situated on the section of the sewer that receives the drainage (including a considerable quantity of hot water) from the two large slaughter establishments; the post office being specially referred to as having suffered considerably from the escape of sewer air from the ventilating grate near the man-hole, at the junction of the New Road sewer, until complaints grew so loud that the grate was closed, a step which so far remedied the evil that the escape of foul air at that particular spot was prevented. At the same time the consequent increased pressure of sewer air must have the effect of driving it up the drains, and so out at the inlets, to the imminent risk of danger to the health of the occupants of the houses concerned. Further, the two houses (Nos. 8 and 9) simultaneously attacked, had drains from the interior in direct communication with the sewer, the sewer air escaping freely into the dwellings, insomuch that at times the stench was said to be unbearable. Moreover, the drinking water of these two houses, which was fetched from the Lansdown pump (a source in general use) usually stood in the washhouses near the drain inlets, thus exposing it to risk of contamination from sewer exhalations. Mrs. H., the sufferer at No. 8, said she did not drink it except when boiled, but the young girl at No. 9 partook of it freely. As regards the post office, one drain, or more properly sewer, serves for this and the adjoining house (No. 9) for the removal of slop and waste water, and the contents of the two closets which stand in the respective yards at the head of the drain, and are unprovided with means of flushing. There are three drain inlets in the post office yard, which is small, and is confined by high walls. After the occurrence of fever in No. 9 an air shaft was inserted at the upper part of the drain below the closets and carried up the side of the post office, but no trap or surface opening has been placed at the opposite end of the drain, at its junction with the sewer. Thus the proper ventilation of the drain was not secured. As evidence of the escape of air from the drain, the postmaster's daughter told me that she had observed steam issuing from the inlets in the yard. Now the evacuations passed by the first sufferer, A. G., were disposed of in the closet, and so passed into the sewer, thereby adding specific poison of typhoid fever to the already highly polluted air in the sewer, and to the escape of this infected air in and around the dwellings the simultaneous occurrence of cases of typhoid fever at Nos. 8 and 9, may be ascribed. The cases at the post office may be regarded as referable to the further specific contamination of the joint drain and sewer. That took place during the protracted illness of the girl at No. 9, the infection being kept up by the sequence of cases in the postmaster's family, the bowel discharges of all the sufferers passing into the drain, and so to the sewer. In connexion with this specific contamination of the sewer, it is a significant fact that on my causing examination to be made at the man-hole of the Butcher's Row sewer a deposit of fœcal matter was found.

As favouring the view that the sewer air was the channel of infection in these cases, six out of the seven attacks occurred in women, who, from their domestic duties, would

be employed in the washhouses and other parts of the house and premises, and thus be more continuously exposed to inhaling the infected air; while the postmaster (the only male that suffered) was in the habit of spending some time daily in his yard.

With regard to the remaining six houses in the row that escaped, one or two presented grave drainage defects, but this does not necessarily invalidate the conclusions arrived at with respect to the fever in the other houses, experience teaching that persons, although apparently exposed to like conditions, of disease are not equally liable to suffer from them.

By my advice the sewers and drains were frequently and systematically disinfected by chloride of lime emptied into the various flushing chambers and closets, and I have heard of no further appearance of typhoid fever.

With regard to other diseases:—

It is shown by the reports of the Medical Officer of Health that in 1881 the town suffered severely from an epidemic of scarlet fever, which commenced in February of that year, and extended into 1882, causing 18 deaths; that in 1882 a very severe epidemic of measles prevailed, the dissemination of infection on each occasion being ascribed by the Medical Officer of Health to the agency of the schools, the disease spreading rapidly so long as they were open, but declining in a marked degree directly they were closed, and scarlet fever reappearing on the reopening of the schools, thus necessitating their closure for the second time.

This feature of spread by means of schools is the counterpart of that observed in respect of the behaviour of diphtheria during this as well as other inquiries.

In concluding this report, I would state that I am greatly indebted to Dr. Campbell, Medical Officer of Health, for the valuable information and ready assistance he afforded me throughout this inquiry.

F. H. BLAXALL.

April 1884.

RECOMMENDATIONS.

(1.) As to the Sewers and Drains.

Immediate steps should be taken to remedy defects in the sewerage and drainage. The measures adopted should include:—

(*a.*) The protection of the sewer outlet by means of a valve-flap.

(*b.*) An increase in the means of sewer ventilation; especially of the outlet sewer and of the New Road sewer.

(*c.*) The prevention as far as practicable, of deposit in the sewers, by the removal of such structural defects as conduce to it, as also by frequent flushing.

(*d.*) The efficient ventilation and trapping of house drains. Whenever nuisance or danger to health arises from the direct communication existing between the house drains and the interior of dwellings, the communication should be at once severed. The Sanitary Authority should also lose no opportunity of securing such disconnection whenever opportunity offers. As regards any new buildings the matter should be dealt with under byelaws.

(2.) As to the Water supply.

The Authority should take steps to promote the use of the Calstone water throughout their district; and under the Public Health Act, 1875, s. 70, should take action to secure the closing of such wells as come within the meaning of that section.

(3.) As to Excrement Removal and Disposal.

All waterclosets should be provided with adequate means for flushing. Cesspit privies should as far as possible be abolished and waterclosets be substituted. Strict supervision should be exercised by the Inspector of Nuisances to ensure closets being kept in a wholesome condition.

(4.) As to Refuse removal, &c.

The Authority should provide for the systematic removal of house refuse and manure from the vicinity of dwellings. Pigs should not be allowed to be kept in the near vicinity of dwellings so as to produce nuisance.

The Authority should adopt bye-laws compiled on the basis of the Model clauses issued by the Local Government Board :—(*a.*) for the prevention of nuisances arising from filth, refuse, &c.; (*b.*) for the prevention of the keeping of animals on any premises so as to be injurious to health; (*c.*) for the regulation of slaughter-houses; and (*d.*) for the regulation of matters relating to new streets and buildings.

(5.) As to Infectious Hospital Provision.

The hospital should be kept in such a state as to be at any time in readiness for the reception of patients. To this end it should be provided with bedding and furniture; the ventilation of the attic should be improved; an earth closet should be provided in lieu of the present cess-pit privy; and a wall or other suitable close fence, not less than 6 ft. 6 in. in height, should be erected to shut off the hospital premises from the public road.