

**Dr. F. St. George Mivart's report to the Local Government Board on an outbreak of enteric fever at King's Lynn / [F. St. George Mivart].**

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**Dr. F. St. George Mivart's Report to the Local Government Board on an outbreak of Enteric Fever at King's Lynn.**

RICHARD T. THORNE,  
Medical Officer,  
January 18th, 1898.

On the 20th of October, 1897, Mr. S. M. W. Wilson, Medical Officer of Health for the Borough of King's Lynn, reported to the Board that enteric fever had broken out in the Borough. He stated that since the 1st of October 22 cases had occurred, with two deaths. Three days later Dr. C. B. Plowright, Medical Officer of Health for the Rural District of Freebridge Lynn, reported an outbreak of enteric fever in the village of Gaywood, which is continuous with the Borough of King's Lynn. In Gaywood seven cases had so far occurred. In consequence of these communications, the Board requested that the Town Council of King's Lynn would instruct their Medical Officer of Health to prepare a detailed report upon the subject of the fever there. This further report was received by the Board on the 25th of October, 1897, and as it appeared that the number of attacks had amounted to 114, and that the outbreak was extending, I was instructed to forthwith visit the Borough in order to inquire into the circumstances with which the disease was associated. At the same time I was to make similar inquiries respecting the outbreak in the village of Gaywood.

In June, 1892, Dr. Bruce Low investigated an extensive outbreak of enteric fever in the Borough of King's Lynn and the neighbouring village of Gaywood. He reported that from January to June, 1892, 135 recognized cases of that disease had occurred in the town and suburb, with 15 deaths; and that the fever had been undoubtedly disseminated by means of the King's Lynn public water service, which was common to both places. He advised that until a pure supply of drinking water had been obtained, the inhabitants should boil the water before using the same for drinking purposes.

Since the date of Dr. Low's report in no single year have both King's Lynn and Gaywood been free from enteric fever, as is indicated by the following table:—

	1892.		1893.		1894.		1895.		1896.	
	Fever cases.	Fever deaths.	Fever cases.	Fever deaths.	Fever cases.	Fever deaths.	Fever cases.	Fever deaths.	Fever cases.	Fever deaths.
Borough of Lynn (Population*) 18,360 ... ..	131	19	50	3	34	4	27	4	26	6
Parish of Gaywood (Population*) 952	14	1	2	0	2	0	0	0	1	0

\* 1891 Census.

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The general sanitary circumstances of King's Lynn and Gaywood were fully dealt with by Dr. Bruce Low in his report of 1892. In view of the recent date of that report, and of the fact that the conditions in the above respect are substantially the same as when he visited the place, I do not propose to deal with the sanitary circumstances of the localities, except in so far as is necessary in considering the causation of the present outbreak.

### THE HISTORY OF THE EPIDEMIC OF 1897.

Unlike the outbreak of 1892 the recent enteric fever in Lynn and Gaywood does not seem to have been preceded by any notable prevalence of diarrhœa. The various medical practitioners of Lynn with whom I conferred were unanimous on this point. They consider the general health of the town to have been especially good this year up to and during September, in which month the number of cases of enteric fever for the first time exceeded the monthly average for the preceding three years.

The following table shows month by month, from January 1st to November 30th, 1897, the ascertained number of houses in Lynn and Gaywood invaded by enteric fever, with the total known attacks, and the deaths in such houses.

1897.	Houses invaded by enteric fever.	Total attacks in such houses.	Deaths from enteric fever.	—
January and February ...	2	3*	—	* Two other cases of enteric fever were treated in the Borough, viz., two men who were landed from the S.S. "Alf."
March ... ..	2	2	1	
April ... ..	3	3	—	
May ... ..	2	2	—	
June ... ..	2	2	—	
July ... ..	4	5	1	
August ... ..	2	2	—	
September ... ..	9†	9†	1	
October ... ..	255*	303‡	9	
November ... ..	96‡	141§	34	

† 1 in Gaywood. \* 10 in Gaywood. ‡ 4 in Gaywood. § 11 in Gaywood. ¶ 7 in Gaywood.

The next table gives in successive periods from September 1st, 1897, to the 30th November, 1897, the number of houses invaded by the fever in Lynn and Gaywood, with the number of cases in such houses.

—	Successive fortnights ended on						Week ended
	Sept. 14.	Sept. 28.	Oct. 12.	Oct. 26.	Nov. 9.	Nov. 23.	Nov. 30.
Houses invaded	4	4	5	183	139	23	2
Cases ... ..	4	4	9	214	172	42	8

The above tables serve to exhibit the suddenness of the epidemic. In 1897 to the end of August, Lynn and its neighbourhood suffered no more than the customary amount of enteric fever. Next, during successive fortnights of September, and in early October, this disease became twice to three times as prevalent as in any previous month of the year. Then occurred an extraordinary outbreak of enteric fever. In the fortnight ending the 26th of October, fever in Lynn and Gaywood increased 30—40 fold, and maintained during the next succeeding fortnight a nearly equal degree of prevalence. Afterwards it quickly declined; so that by the beginning of December the epidemic as such was practically at an end. In all, there occurred in Lynn and its neighbourhood between 1st September and 30th November, 453 cases and 44 deaths referred to enteric fever; an attack rate by the disease of 23·45, and a death rate of 2·28 per 1,000 of the census population.



And not less remarkable than the suddenness of this epidemic was the indifferent distribution of the fever throughout the place. As to this, the behaviour of the disease has been very carefully studied. There has been plotted, month by month, from January to August, later on fortnight by fortnight, on separate large scale maps, each reported case of enteric fever; and as a result, it has been found that not until the disease had become fully established as an epidemic was there the least tendency to grouping of cases. As in the first eight months of the year such fever as occurred had been widely distributed over the place, so also through September and the greater part of October, inclusive of the great outburst in the second fortnight of that month, the disease was, so to speak, broadcast over the whole district; spread abroad, that is, in a fashion inconsistent with the operation, before late October, of any agent of fever dissemination that had not a range co-extensive and co-terminous with the total area of combined Lynn and Gaywood.

#### *Age Incidence.*

I have constructed the following table setting forth the incidence of the fever, in so far as could be ascertained, upon various age-groups during the present outbreak.

Age group.	Number of persons attacked by enteric fever.	Number of deaths from enteric fever.	Number of deaths per cent. of attacks.
Under 5 ... ..	42	2	4.8
5—10 ... ..	79	3	3.8
10—15 ... ..	100	5	5.0
15—25 ... ..	118	12	10.2
25—35 ... ..	37	3	8.1
35 and upwards ... ..	29	6	2.1
At all ages ... ..	405	31	7.7

#### *Cases Regarded as Doubtful.*

As in all epidemics of enteric fever certain cases of a mild character were brought to the notice of the Medical Officer of Health, and locally suspicions were entertained that many cases had been notified which were not enteric fever at all, but "influenza." I have, however, satisfied myself that there was no sufficient ground for such belief. I should be disposed on the other hand to think, having regard to the number of instances in which no medical aid was sought until the illness of the person was far advanced and the gravest symptoms were apparent, that not a few cases of mild enteric fever escaped notice altogether. Reluctance to admit the presence in their houses of illness was especially manifested by persons engaged in trade and business.

#### CAUSATION OF THE EPIDEMIC.

In seeking explanation of the epidemic, it has to be borne in mind that the outbreak occurred suddenly; that it appeared simultaneously in the town of Lynn and its suburb Gaywood; and that from first to last (especially in the fortnight of its chief incidence) the fever was distributed throughout the length and breadth of both places. Outbursts of enteric fever such as this—so sudden and so widespread throughout a large and populous area—have again and again been referred on incontestable evidence to specific pollution of public water supplies. In the particular instance, the past history of Lynn and Gaywood, along with the facts respecting their present fever and their circumstances at the date of my arrival in the place, afforded a strong presumption that the epidemic was due to the faulty character of the public water service. I did not, however, accept such presumption, preferring rather to examine, as matter of first instance, other accredited agents of enteric fever, some of which had been thought of locally as quite as likely as the water supply to be responsible for

the fever which was occurring. In this way I came to be concerned with (1) sewerage and drainage, (2) general sanitary circumstances, and (3) milk supply, as possible causes of the outbreak.

#### *Sewerage and Drainage.*

Dr. Bruce Low in his report on an outbreak of enteric fever, of a very similar though less extensive character at King's Lynn in 1892, thus describes the sewerage of Lynn :—

“The public drainage consists, in the older parts of King's Lynn, of short sections of brick sewers, constructed some years ago and discharging by different outfalls directly into the Ouse or into one or other of the fleets. For the northern and eastern part of the town a long length of sewer was, a few years ago, laid down. This sewer, which receives the sewage of more than half of the houses in the town, has an outfall near the old dock, and is generally known as the “dock culvert.” For a considerable distance it is an egg-shaped brick sewer, and throughout it is ventilated at intervals by openings at the street level. Here and there shafts have been carried up above the level of the house roofs. There are several automatic flushing tanks at the ends of branch sewers. Few of the sewers appear to be self-cleansing. Deposit takes place in nearly all of them. The tide dams up the sewage in all for several hours daily. Private drainage is effected by ordinary pipe drains. Gullies in yards are mostly trapped. Rainfall pipes usually pass directly into the drains. In some cases sink pipes are not disconnected, but the majority of houses have no sinks indoors. Soil pipes in some cases are ventilated ; much improvement in this respect has been effected of late.”

And as regards Gaywood he says :

“The sewers of King's Lynn extend into the village of Gaywood. There are roadway ventilators along the main sewer, and a flushing tank is situated at a point where the sewer from Gaywood joins the borough main sewer.”

As regards sewerage, the above description may be taken as describing to a very large extent the present condition of Lynn. Certain lengths of brick culvert sewer which were especially defective, have been replaced by pipe sewers, but the general arrangement remains the same, and the sewage is still tide-locked for several hours daily. When an exceptionally heavy rainfall occurs at the time the sewers are thus closed by the tide, more or less extensive flooding is caused of streets, yards, and even of houses.

Now two most conspicuous instances of flooding in Lynn occurred on the 9th of August and on the 29th of September of the present year. On the former occasion a local rain gauge recorded 3·4 inches of rain in 24 hours, and on the latter 2·25 inches were registered in the same period.\* On both these occasions in several parts of the town extensive flooding occurred, water bursting up from gully and drain openings and gradually invading houses to a depth of several inches. In many instances complaints were afterwards made to me as to the foul smell of this water, which in some cases was almost black and left a deposit of black mud. It was inevitable that this coincidence of heavy rainfall and flooding should be associated locally with the fever epidemic which followed, and, indeed, local opinion was in the right in referring the fever in some sort to exceptional rainfall ; though, as will be seen later on, the latter is not to be thought of as operating through the sewers. Perhaps the worst flooding occurred in the vicinity of the thoroughfare known as Windsor Road. The dwellings here are of a poor class, one storied cottages. I was, however, unable to detect any special incidence of the outburst of fever on this neighbourhood. Not until the epidemic had become fully established did the cases notified in this locality appear to be, on the

\* Both the above observations were made in Lynn itself, and surprising though the records (especially that relating to 9th August) may seem, there is no reason to doubt their substantial accuracy. From independent evidence, however, it appears that the rainfall of 9th August was, so far as its very exceptional amount is concerned, limited practically to Lynn, whereas the exceptionally heavy rainfall of 29th September was widespread, affecting a very large tract of country on all sides of the town.

whole, more numerous than greater density of the population hereabouts could fully account for ; and very possibly the unsanitary conditions of the area in question, enhanced as they must have been by the flooding to which it was subjected, may have conduced to exceptional spread of fever in this neighbourhood after the disease was implanted there on the occasion of the initial outburst in mid-October. However this may be, similar floodings occurred in other localities, in which there was no noticeable excess of fever over that observed in other parts where no flooding whatever had occurred. Moreover, I was unable, after careful examination, to discover that there was any special grouping of cases upon the course of any particular sewer or sewers. Further, the incidence of fever on houses draining to the old type of brick culvert sewers was in no way different from that observed on houses draining to the recently laid pipe sewers. The conclusion cannot therefore be avoided that faulty sewerage and drainage are not responsible for the sudden outburst of enteric fever.

#### *General Sanitary Circumstances.*

Mr. W. Whitaker, F.R.S., the eminent geologist, in a report dated 15th October, 1892, to the Waterworks Committee of the Lynn Town Council on a proposed new source of water supply, thus describes the subsoil of the borough and its immediate neighbourhood :—

“ A thick mass of clay underlies the marsh silt that forms the surface, not only in the town itself, but also in the greater part of the neighbourhood, where this (and other alluvial beds) have a wide spread along the main valley, with comparatively narrow inlets up the tributary valleys. These clays have been proved by a boring in the northern part of the town to go down to a depth of 680 ft., and then without reaching the bottom, leaving it uncertain how much deeper clay may go.”

Dr. Bruce Low, in his report, thus refers to the dwellings in the borough :—

“ Many of the streets in Lynn are narrow, and in certain quarters there are courts or yards thickly populated and entered by narrow passages. These courts or yards, many of which are unpaved, are frequently surrounded by high walls which exclude sunlight and prevent free circulation of air. Dwellings in these courts are not unfrequently in bad repair, and they tend to be overcrowded. In business quarters of the town, for instance, in King Street, parallel with the river front, and in the more recently built parts of Lynn, the streets are more open and houses are larger and of a better class.”

There is crowding of houses upon area at certain points, but I met with no instances of overcrowding of persons. There is no doubt that the Sanitary Committee have effected improvements since the last epidemic of enteric fever in 1892. In many of the closest and most crowded courts and alleys I found that water-closets, fitted with flushing-cisterns, had been provided, though, it must be added, not a few were out of order and in a foul condition.

It is also still the fact that, as stated by Dr. Low in his report, in some courts the closet accommodation is inadequate, and the privies are too close to the dwellings. Notable instances of this were seen in the vicinity of Windsor Road. Leading out of this thoroughfare are certain streets of cottage residences, many of which had cesspit privies in a foul condition. Moreover, the backs and sides of the brickwork are not rendered in cement, and in some cases I detected cracks which must allow free soakage from the privy into the adjoining premises.

The arrangements for the emptying of privy pits are very defective. Upon the application of the householder the contents of cesspits are removed in iron tank carts belonging to the Corporation. As Dr. Low observes: “ In the process of emptying some privy pits the contents have to be carried through the houses.”

Nevertheless, I did not find that the incidence of the fever had been heavier upon the inhabitants of the worst class of dwellings, or that the

epidemic outburst in October had specially affected the least wholesome quarters of the town. Up to the date of my last visit I found that not a few of the closest courts and alleys had either altogether escaped the visitation, or that at most single cases, often of a mild type, had occurred in them. On the other hand, on certain residences which could not be classed among those styled poor, the incidence of fever had been very severe. In particular, I visited two dwellings, of the superior type of small house, in each of which five cases and one death had occurred. In neither of these houses were conspicuous sanitary defects to be found. The water-closets were outside the houses, and the only defect worthy of note was that in one case the scullery waste-pipe (which was not trapped) delivered outside the house, too close to the gully hole, the exit of the waste-pipe being actually below the 'grid' covering of the gully. But as this was open to the air, it could not be contended that there was direct communication with the sewer. As I have said, upon the whole there was absence of any evidence that general sanitary circumstances had been responsible for the simultaneous appearance of cases of enteric fever throughout the district.

As illustrating the non-concern of insanitary circumstances with, at any rate, the inception of the epidemic, a table is appended, making comparison of the incidence of the fever on dwellings served by privies and on dwellings served by water-closets.

Months of 1897.	Houses invaded by Enteric Fever.			
	Provided with Privies.	Invaded, per cent. of total.	Provided with Water Closets.	Invaded, per cent. of total.
January and February	2	} .6	Total dwellings served by water-closets, 3,290.	} .6
March ... ..				
April ... ..				
May ... ..				
June ... ..				
July ... ..	1		2	
August ... ..	1		1	
September ... ..			8	
October ... ..	52	} 9.2	193	} 7.9
November ... ..	26		66	
	Total dwellings served by privies, 844.			

#### *Milk Supply.*

A very brief inquiry was sufficient to set aside the suggestion that milk had been the means of conveying the disease. There are 45 dairies and milk shops in King's Lynn and Gaywood. I inquired as to the source of milk supply in respect of 150 households taken haphazard as invaded in the early part of the outbreak. I found that 37 different milk dealers had supplied the households in which these cases occurred. Of these dealers each of two had on his list 13 out of the 150 of invaded households; one dealer had 11 names upon his list; three others had each nine; and two others had each eight. I learnt that the rest of the invaded households had been supplied, in fairly equal proportion, by the other 29 milk dealers. This sufficed to indicate that the milk supply of King's Lynn had not been the principal, or indeed an important, factor in the dissemination of enteric fever in the borough.

#### *The Public Water Supply, in its relation to the Epidemic.*

The above-mentioned possible agencies of fever dissemination having been put aside as in no case having had any important concern in the epidemic, my attention was directed to the water supply.

The Borough Surveyor informs me that of the 4,161 inhabited houses\* in the borough only about 40 have a water supply independent of the Corporation

\* 1891 Census.

works. As at the time of Dr. Bruce Low's visit, the town supply is still derived from the Gaywood river. The sources of this river are thus described by Mr. W. Whitaker in his report to the Waterworks Committee of the Lynn Town Council of October, 1892 :—

“The head-waters of the stream from which Lynn gets its supply are derived from springs that flow out of the base of the Chalk, the water in which formation is held up by the underlying impermeable Gault.

“These streams are the result of the rainfall over the broad Chalk tract rising to the east. Much of the water falling on the Chalk sinks into it, and of this a part finds its way downward, until at some depth the Chalk is saturated and can hold no more. The level of saturation varies roughly with that of the ground, being higher at the hills on the east than at the slope toward the outcrop of the underlying Gault; the reason of the difference of level being the frictional resistance to the flow of the water through the Chalk. The underground water-slope in the Chalk of the immediate neighbourhood being westward, the springs are therefore merely the natural outflow of the water-charged Chalk, the water finding its way out at the lowest available places, the slowness of percolation through the rock making the springs constant, though of course varying in amount, instead of their being very great at one time (after heavy rain) and dry at another, as would be the case if the water flowed through quickly.”

The water of these springs is, no doubt, of satisfactory quality, but it is unfortunately polluted at or near to its sources. Two of the three principal sets of springs rise amidst foul surroundings. The northern set at Grimstone, as Dr. Bruce Low pointed out, rise directly from beneath the churchyard. Another, and perhaps the most important, set of springs rise upon and around the slope whereon stands the farmstead known as Well Hall. The state of affairs at this point was five years ago thus described by Mr. Whitaker :—

“The southern, and apparently the most powerful, set of springs at Well Hall, seems to be looked on as the fit receptacle for all the filth of the farmyard. One building is directly over a spring, the water of which may be seen oozing out from under the outer wall. At the time of my late visit a liberal allowance of muck, of which I did not care to make a minute examination, had been thrown down about as near as possible to others of the many springs here.”

The above description depicts accurately the state of things at Well Hall at the time of my visit. As if these sources of pollution were insufficient, I found at that date an immense heap of refuse and farm manure close to the edge of the stream. The inhabitants of two cottages, situated just below this point, obtain water by “dipping” from the stream, and the enormous quantity of mussel shells thrown upon the very edge of the stream immediately adjacent to this “dipping” place is significant of the indifference of the population of the district to the purity of their water supply.

To describe in detail the various pollutions which by way of divers tributary streams reach the Gaywood river in its course from the spring to within a mile or so of its intake at Gaywood village, would occupy a great deal of space.

The subject is thus dealt with by Dr. Bruce Low, in his report :—

“The feeders of the river receive more or less directly the slop water of Grimstone village, while soakage from privy pits and refuse heaps, as also drainage from farmyards and horse-ponds sooner or later find their way into these tributaries. Two of the springs rise directly from beneath Grimstone churchyard. In addition to the above sources of impurity, the slop waters from the hamlets of Roydon, Bawsey, and Pot Row similarly find their way ultimately into the stream. At Grimstone, and again at Roydon, I saw the overflow pipe of a cesspool, receiving contents of water-closets, discharging into a water-course which flows into the Gaywood River. Similarly, the drains from a slaughter-house, a public-house urinal, and the washings of a laundry empty into watercourses which discharge directly into the stream.”

In this respect matters remain as at the date of Dr. Low's visit in 1892, and

in what follows I do but illustrate the dangers to which the river water is thus exposed. Among the sources of serious contamination of the river is a brook falling into it, about two miles from the intake of the public Water Supply. This brook receives from a ditch the drainage from the farmstead of Waveland. The privy arrangements at the farm are very defective, and the overflow from the privy pit appears to mingle with the drainage from the farmyard and slop-drain. The farmhouse is in the occupation of two families. I was informed that in one of them there had been repeated attacks of diarrhoea during the past summer. Great complaint was made here of stench from the house drain; and as matter of fact at the time of my visit this house drain was being cleared out, whereby the flow of foul liquids into the brook, and thus to the Gaywood river, was being rendered more direct.

Coming now to Gaywood Village, a mile or so above the intake of the town water supply, the river flows by gardens which abut upon the river. Here in the course of my inspection I discovered several privies placed actually upon the brink of the stream. It is true that in several instances these privy structures were provided with pails said to be emptied upon the gardens from time to time; but there can be no doubt that even their presence in such situation conduces to risk of faecal matters being washed out into the stream at seasons of heavy rain.

Adjacent to the village of Gaywood are certain ditches which are only prevented from communicating directly with the river by a thin barrier of clay puddle. These ditches receive drainage from refuse heaps, back yards, a small farmyard, and also the liquid soakage from privies, and in one case the drainage from a patch of kitchen garden upon which previous to the heavy rainfall of September 29th the contents of a large cesspool had been emptied. Though these ditches are in ordinary circumstances prevented by the thin barrier of puddle from communicating with the river, there cannot be the slightest doubt that on the occasion of heavy rainfall they become bank full, and overflowing their dry puddle barriers pour their accumulated foulness into the river.

At the intake of the water works the river water flows through earthenware pipes directly to the settling pond or reservoir known as the Long Pond. Between the river and the pond these pipes are at a varying depth beneath allotment gardens which are largely the property of the Corporation. Having ascertained that these conduit pipes had not been examined for an unknown period of time, variously estimated at from 10-20 years, I had the ground opened over them, close to the intake. The pipes were reached at a depth of a little over three feet, and were found to be leaking so freely at the joints that a pump had to be employed in order to get rid of the escaping water and enable the work to be continued. The pipes are not bedded in concrete but lie in clay, covered by thick heavily manured garden mould. A few feet from this spot the tenant of a garden was in the habit, as he informed me, of emptying every week the contents of a privy pail.

In the Long Pond the water has ample facilities for further pollution from the washing into it of surface refuse and the soakage to it of liquid from the heavily manured allotment gardens which come down almost to its brink. From a refuse heap close to the pond I observed the clearly marked course of a stream which in time of rainfall had flowed into the pond. As there is a public 'right of way' along one side of this pond which gives access to the allotment gardens, it is impossible to exclude children from the locality. And I was informed that in consequence of the habit they had of paddling with their feet in the water a watchman had at certain times to be posted at this spot.

From the Long Pond the water flows—still by gravitation—to the so-called filter beds. These are really only straining tanks, and occupy an area of a little more than 200 square yards. These tanks are still as they were when Dr. Bruce Low saw them. He says:—

“The filtering materials consist of a layer of coarse gravel about 18 inches thick, and a layer of fine gravel about 14 inches thick. The surface of the filtering material is roughly cleansed once a week by stirring it about with strong brushes, and thus detaching accumulated dirt, which is allowed to flow off into the river below the intake.”

From the tanks the water flows into a well below the pumping engines to be pumped direct into the mains, and also into a tank upon the top of a tower, whence, during the temporary cessation of the pumping engines, it flows by gravitation to the town. It thus appears that the water furnished to the inhabitants of the town has now, as at the date of Dr. Bruce Low's report, "multifarious opportunities for becoming polluted by human excrement, not to speak of other impurities directly discharged into it or washed into the stream by heavy rains or melting snow." The opportunities referred to are afforded, firstly, at the source of the river; secondly, in its course to the intake; and, thirdly, at the waterworks themselves.

As was inevitable in the circumstances, the quality of the Gaywood River water has again and again been called in question. Dr. Bruce Low, reporting on it in 1892, states that:—

"Some people in Lynn complain that after heavy rains the water is thick and discoloured, and that if allowed to stand it deposits a sediment, and occasionally 'stinks.' Sometimes a dead eel or a small frog is found stuck fast in the water pipes."

The same complaints as to the water are still freely made. I was informed by several residents of the town, that after heavy rain the water becomes so thick that it is impossible for a person taking a bath to see his own legs in the water, which is of a brown colour. Another resident informed me that quite recently there had been what he called "an epidemic of small leeches in the water." It appears that in the ditches and dykes about Grimstone a great quantity of small leeches are found. Those that are supplied to the inhabitants of the borough in their drinking water are of an average length of half-an-inch.

Chemical testimony, when appealed to, has been almost uniformly hostile to this water. In June, 1892, Dr. Percy Frankland, reporting on a sample of the Gaywood River water collected at a point near the waterworks intake, says, in regard to the organic matter detected by him therein, that it "may be of animal origin, and from your (the borough surveyor's) description of the surroundings of the stream, it is obvious that the latter must be subject to contamination with animal refuse, more especially after heavy rains. The drawbacks of such a supply are sufficiently apparent." Later on in the same year Dr. P. Frankland says, of another sample of the same water, that organic matter and albuminoid ammonia are more than twice as great as in the previous sample from the same source, thus clearly showing how the stream in question is liable to excessive pollution during heavy rains." So, too, Mr. West Knights, the Public Analyst for the counties of Cambridge and Hunts, who, in 1893-94, examined no less than eight samples of the water in question, has condemned it on each occasion as "unfit for drinking purposes." His least unfavourable report as to any one sample is thus expressed: "The water contains organic matter, and is not satisfactory as the source of a public water supply, but I should not go so far as to say that it is absolutely unfit to drink."

Local medical opinion long since utterly condemned the water, as will appear from the following which was published in the Lynn newspapers in 1893:—

"Brought as we are into daily contact with sickness and suffering, we keenly feel how lamentable is the amount of preventible disease which exists amongst the inhabitants of the town. Probably no single cause operates more potently in producing this than our impure water supply. Whilst freely admitting that the improvement of our water supply may entail an addition to the rates, we cannot think, even from a pecuniary point of view, this is for one moment to be compared to the advantages we should derive from an abundant supply of pure and wholesome water.

"To take only one water-spread disease, namely typhoid fever, it is a noteworthy fact that the last epidemic, which unfortunately still lingers amongst us, cost our Board of Guardians £149 16s. 8d., and has left us widows and orphans whose permanent support amounts to £43 15s. 4d. annually. The victims were, however, by no means confined to the recipients of parochial relief. Altogether 131 cases occurred, of whom 21 lost their lives, besides which there were notified 107 cases of continued diarrhœa,

“ considered to have been abortive typhoid. Each case of typhoid fever  
 “ incapacitates the patient from work for a period varying from six weeks to  
 “ three months. Such a prolonged illness entails heavy expenses for nursing,  
 “ extra nourishment, medical attendance and the like, as many families know  
 “ only too well.

“ We have none of us the slightest doubt that the above epidemic arose  
 “ from our polluted water supply, and from it alone.

“ Many diseases are spread by impure water, such as cholera, diarrhoea,  
 “ dysentery, calculus, intestinal worms, and a variety of other less defined  
 “ conditions of ill health.

“ With regard to cholera, we would point out that our present water  
 “ supply is as liable to be contaminated by this disease as it was by typhoid  
 “ fever.

“ We therefore feel it to be our duty earnestly to impress upon our fellow  
 “ townsmen the importance of embracing the present opportunity of improving  
 “ our water supply.

(Signed) FREDK. A. BARRINGTON,  
 G. R. CHADWICK,  
 CHARLES JACKSON,  
 CHARLES B. PLOWRIGHT,  
 R. RHODES REED,  
 WILLIAM WEBSTER,  
 W. B. WEDGWOOD,  
 S. M. W. WILSON,

Medical Men practising in King's Lynn.

“ 4th September 1893.”

Nevertheless, incredible as it may appear, a large and influential section of the inhabitants of Lynn maintain, or at any rate have maintained until now, that this water, manifestly polluted though it be, is of excellent quality. One individual went so far as to exhibit in his window during the height of the epidemic a vessel of water drawn from the town mains, with a placard attached stating that no better water can be obtained.

Having regard to the countless opportunities of pollution from various sources to which the Lynn water supply has been exposed, I have considered it futile to attempt detection of the particular point, or points, of entry to the Gaywood River, and consequently to the public water service, of the specific infection material, dissemination of which along with the Lynn water has caused the disastrous epidemic that has been witnessed. But difficult though it may be to define “where” specific defilement of this water service occurred, there can be no doubt whatever as to “when” infectious material of enteric fever, suddenly and in large amount, gained access to the supply. In this matter also history in Lynn “repeats itself.” As on the occasion of the fever prevalence in Lynn in 1892, reported on by Dr. Bruce Low, so now in 1897 epidemic enteric fever was preceded, at an interval corresponding to the incubation period of the disease, by exceptional meteorological conditions causing sudden flood in the Gaywood river. In 1897 there were two occasions when similar sudden flooding and consequent befoulment of the river took place. On August the 9th and again on September the 29th there occurred in Lynn and its neighbourhood very heavy rainfall, so heavy that, as has already been pointed out, flooding of certain parts of the town resulted through the sewers proving unable to carry off the surplus storm water. On each of these occasions large quantities of foul matters must needs, in the circumstances of the Gaywood river, have been swept into the stream, and in due course have found their way into the Lynn waterworks. Twice, therefore, antecedent to the epidemic, and within the space of a few weeks, these waterworks were delivering to the inhabitants of Lynn and Gaywood, water suddenly and dangerously befouled. Taking a couple of weeks as the average incubation period of enteric fever, and allowing an extra week to cover diagnosis and notification of attack, an interval of three weeks is the period to be thought of as elapsing between either of these two floods, and recognition of a deleterious influence in the causation of enteric fever to be referred to it. Judged by this standard, the downpour of the 9th of August may well have had to do with inception of the recent epidemic in Lynn and Gaywood; for just about three weeks after this

rainstorm, *i.e.*, in September, an increase in current fever was recorded (*see table, page 2.*) The total amount of fever in September and early October, however, was not large; the cases though widely scattered over the town in a fashion consistent with water causation of the disease, being too few in absolute amount at that time to definitely convict the water service of having brought it about.

Not so, however, as regards the exceptional rainfall of the 29th of September. This was followed at an interval of three weeks, by an outburst of the fever on a very large scale indeed. On the 20th and 21st of October the notified cases of enteric fever in Lynn and Gaywood suddenly mounted to 12. Next day they were 26, and in the four succeeding days to the 26th of October no less than 75 additional attacks were notified. And the fever cases of this outburst, be it noted, were distributed from end to end of Lynn and Gaywood, in circumstances which, as I have already stated, left no escape from a conclusion that the outburst had been caused by the water supply. There can be no doubt at all, then, that the epidemic, as such, was due to infection of enteric fever gaining access to the waterworks as a result of the rainstorm of the 29th of September. Why wholesale befoulment of the Lynn public water service effected on one occasion comparatively little mischief, and on the next proved altogether disastrous in the above fashion, is a question which cannot at the present stage of our knowledge be definitely answered. Possibly the storm of 29th September, in that it was as a heavy downpour more widespread than that of the 9th of August, may have (by the floods which it caused) tapped, so to speak, sources of dangerous pollution of the Gaywood river which were not reached and therefore not flushed out into the stream by the even heavier but more localised August rainfall. This, however, is mere surmise. Moreover, we are by way of learning that outside the animal body the microbe of enteric fever is subject to conditions which, within a short space of time, may check altogether its multiplication and annul its virulence, or may greatly enhance its activities in one or both these directions.

#### *Sanitary Administration in regard to the Outbreak.*

On my arrival in King's Lynn on October 29th, 1897, I found that a notice, in the form of a printed handbill signed by Mr. Wilson, the Medical Officer of Health, had already been circulated, urging the inhabitants to boil the town water before using it for drinking purposes. I shortly afterwards conferred with the Sanitary Committee of the Lynn Town Council on the subject of the epidemic.

As regarded water supply, while urging upon them to protect in every possible way the Gaywood river from any further pollution, I recommended that a daily supply of water should be obtained from the mains of some neighbouring district in which the water supply is known to be free from contamination, and distributed by means of water carts throughout the town. Failing this, I suggested that some plan should be devised whereby boiled water should be supplied by the Town Council, at any rate to the inhabitants of the poorer quarters of the town.

As regards infected premises, I recommended that instructions should be given as to the disinfection of excreta, and that the necessary disinfectants should be supplied; care to be taken that the disinfection was regularly and efficiently carried out. Also I urged exercise of definite precaution by the Council in the cleansing of infected privies and closets, pointing out at the same time the powers of the Town Council under Section 13 of the Infectious Disease (Prevention) Act of 1890, to prevent the throwing of any infectious rubbish into any receptacle for refuse without previous disinfection. Finally, I recommended careful inspection of all dairies, milk-shops, stores, or places whence milk is supplied, or in which it is kept for sale, pointing out that powers are given to the Medical Officer of Health and the Town Council by Section 4 of the Infectious Disease (Prevention) Act, 1890, to deal with any source of infection of milk, whether within or without their district. These recommendations were afterwards the subject of various printed handbills, in which the observance of various precautions was urged upon the attention of the inhabitants. "Disinfectants" were freely distributed, and two temporary assistant sanitary inspectors were engaged by the Town Council to explain

the proper method of employing these disinfectants, and, as far as possible, to see that this was carried out. The sewers were flushed daily, large quantities of carbolic acid being employed. Special measures were taken to secure the cleansing of the narrower streets, as well as the courts and alleys, which were visited almost daily for this purpose. During the later period of the epidemic, it was noticeable that the town was clean and free from refuse.

The Borough Isolation Hospital has accommodation for twelve patients only, and little use was made of it in the early part of the outbreak. The West Norfolk and Lynn Hospital received but few cases, and a limited number were accommodated at the workhouse.

A large number of nurses, however, were engaged by the Town Council in view of the circumstance that the greater number of patients were treated at their own houses.

Subsequently to my conference with the Sanitary Committee, water for drinking purposes was brought into the town daily in water carts belonging to the Corporation, from the mains of the Wisbech water supply at Marham. For a while very great difficulty was found in inducing the poorer classes to avail themselves of the safer water thus brought to their doors, but subsequently they made use of it more freely.

In the above ways the best was perhaps done in the circumstances to mitigate disaster that should never have occurred. For it cannot be too strongly insisted on that, so long as the supply of drinking water for the Borough is derived from the Gaywood river, so long will the Borough be at the mercy of waterborne disease. Ever since 1876 the more thoughtful section of the inhabitants have been engaged in a struggle, the bitterness of which only those resident on the spot can realize, to obtain for themselves and their families a wholesome supply of drinking water. In 1875, Mr. Hawksley, being consulted by the Town Council, recommended that the water should be brought in pipes from one of the springs, direct to the town. Since then, until recently, in vain have Medical Officers of Health, and Engineers, and Surveyors protested, and experts like Mr. Whitaker, F.R.S., and Mr. Mansergh, C.E., reported and advised. The party with whom no argument but the one as to the cost had any weight were too strong.

It might certainly be thought that after the severe outbreak in 1892, which was traced in the clearest manner by Dr. Bruce Low to the infection of the public water supply, all opposition to a new source of supply would cease. But such was not the case. In the end, however, a Provisional Order of the Local Government Board enabled the Town Council to carry out a scheme which might otherwise have been frustrated by the opposing section of the inhabitants. The works in connection with the new scheme for bringing water from deep wells in the Chalk near Grimstone are being actively pushed forward, but I am informed that it will be six or eight months before they are completed.

In conclusion, I must express to the Sanitary Committee of the Lynn Town Council and to their Clerk, Mr. Archer, my acknowledgments of the courtesy with which they received me, and the help they afforded me at all stages of my inquiry. To Dr. Plowright, Medical Officer of Health for Freebridge Lynn Rural District, Mr. Wilson, Medical Officer of Health for Kings Lynn, and to Messrs. Allinson, Chadwick, Macauley, Jackson, and Webster, Medical Practitioners of Lynn, I am indebted for much assistance and information. My special thanks are due to Mr. Silcock, Assoc. M.INST.C.E., Borough Surveyor, for much valuable assistance and for the loan of maps and plans.

December 1897.

F. ST. GEORGE MIVART.

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