

Dr. Richard J. Reece's report to the Local Government Board upon the general sanitary circumstances of the borough of Chelmsford.

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Dr. Richard J. Reece's Report to the Local Government Board upon the General Sanitary Circumstances of the Borough of Chelmsford.

R. THORNE THORNE,
Medical Officer,
November 28th, 1896.

The Borough of Chelmsford was incorporated on the 9th November 1888. Previous to this time the administration had been vested in a Local Board, first formed in 1850.

The Borough, which covers an area of 2,309 acres, is partly rural and partly urban in character. It had at the census in 1891 a population of 11,008 persons. The population for the corresponding area in 1881 was 9,793 persons; figures which show an increase of 1,215 persons in ten years, and it is probable that the ratio of increase observed in the ten years 1881-91 has been maintained. The number of inhabited houses increased between 1881 and 1891 from 2,009 to 2,312, and building is still being carried on.

The Borough is situate in the Registration District and Sub-district of Chelmsford. The rateable value is 39,427*l*.

For administrative purposes the Borough is divided into a North Ward and a South Ward, the population of the Borough being nearly equally divided between the two wards.

Industries, &c., of the District.—Chelmsford is a market town, and the centre of an agricultural district. There are several large business premises within the Borough, notably the Arc Works, of the firm of Crompton & Co., Electrical Engineers, where some 500 workmen are employed, and where the electricity for lighting the town is generated. Amongst other trades are to be found agricultural implement makers, fellmongers, tanners, and brickmakers. Within the Borough, and in the districts immediately adjoining it, villa residences are becoming numerous, inhabited for the most part by merchants and professional men whose daily work is in London, Chelmsford being easy of access by rail from the metropolis.

Geology and Topography.—The deep geological formation underlying the whole district is the "London clay." This clay lies at various depths below the surface, from 65' at the Corporation Yard, near the centre of the

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town to 15 feet near Galleywood Common, at the extreme southern extremity of the Borough. It is found at intermediate depths throughout the district. The surface soil is alluvium near the Rivers Chelmer and Cann, and in the remainder of the district consists of boulder clay with beds of gravel in places.

The River Chelmer skirts the north-eastern boundary of the Borough, and is joined at Moulsham Mill by the River Cann, which crosses the northern portion of the district from west to east, separating the North Ward, or old town of Chelmsford, from the South Ward, formerly called the hamlet of Moulsham. These rivers at their confluence are formed by means of locks into a navigable waterway, called the Chelmer Navigation Channel. The works were completed in 1796 by Sir John Rennie. The general slope of the ground is a gentle incline towards the rivers.

GENERAL SANITARY CIRCUMSTANCES.

Roadways.—There are $13\frac{1}{2}$ miles of dedicated roadway in the Borough, as follows:—

Main roads, 6 miles $1\frac{1}{2}$ furlongs.

Other roads, 7 miles $2\frac{1}{2}$ furlongs.

The main roads are macadamized with granite, principally Cherbourg quartzite, the other roads are of gravel. The main roads are, for the most part, well guttered, kerbed, and drained, much attention having been given to these matters of late years. There is about one mile of undedicated roadway, principally formed of gravel. Road cleansing is, on the whole, efficiently performed; some streets, however, were noticed where, apparently, sufficient attention had not been paid to this duty. At the time of my inspection (July) after a long period of drought, the road gullies were noticed to smell offensively in many places. Connected with these gullies are pits to intercept the solid matter, some of them of large size, one at least being capable of holding nearly a cartload. Owing to the scarcity of the public water supply, to be referred to later in this report, the water for road watering is in great part obtained from the River Cann. On one of the days during my inspection this water was stagnant and of a dark green colour, with bubbles of gas rising to the surface, and at the same time emitted a most offensive smell. There are certain mills lower down the River which have the right of damming up the water, and when this is done, the water flowing down the River Chelmer appears at times to flow *up* the River Cann. The River Cann at the point where it reaches the town at the Recreation Ground Bridge is 5 feet deep, further on where it passes under the iron bridge on the London Road, at which point the water is pumped for road watering, the depth is 11 feet. Still further at the stone bridge on the Moulsham Road the depth is 16 feet, beyond which at the back of the saw yards the depth is 4 feet. Thus, at the point between the bridges on the London Road and Moulsham Road the depth of the river is suddenly increased, and between these two bridges a storm water sewer, from the "Friars" district, discharges. This sewer would appear at times to discharge sewage, and I am informed that, at times, fresh fœcal material can be seen floating in the water.

Dwelling-Houses.—The more recently built houses are substantially constructed of brick, and their sanitary arrangements are in conformity with modern requirements. From this class of house, almost every variety of dwelling is represented in the Borough, down to dilapidated ill-ventilated wooden shanties.

These last-named dwellings are to be found principally in the courts opening off the main roads. They are specially animadverted upon in a report on Chelmsford, issued by the Board of Health in 1849, and again condemned by Sir George Buchanan in 1866, as being of the back-to-back type and on account of their insanitary condition. The yards in front of these houses, however, appear to have been improved, and are kept in a better sanitary condition than in 1849. There are many houses of which the ground floor is built of brick and the upper storey of wood; such houses are not confined to the courts, but examples are to be found in the principal streets.



There are many damp houses in the district, and many of the houses in the courts are unprovided with proper eave spouting. In connexion with the dampness of houses, and in view of the reports of previous inspections, it may be of interest to note that during the course of the present inspection attention was directed to a public-house, the cellars of which had recently been filled in on account of water rising in them to the depth of some feet. Towards the outskirts of the town the bulk of the cottages have ample garden space, on which the house refuse is disposed of, as also the slop water when the latter is not needed for use in hand-flushed waterclosets.

Overcrowding.—From time to time the Town Council is called upon to deal with overcrowding of persons in houses. Such cases generally are brought to their notice on the premises being visited by their officers on the outbreak of infectious disease. The demand for house accommodation is great, and the overcrowding principally occurs in the houses of the mechanic and labouring classes. Up to the present time the Town Council have taken no steps under Part III. of the Housing of the Working Classes Act. Should, however, the population continue to increase, the Town Council may find it necessary to consider whether it would be advisable to formulate some scheme for the provision of suitable dwellings for the labouring class.

Water Supply.—The water supply of the District is vested in the Town Council. There are three sources of public supply:—

- (1.) The Mildmay Artesian Well.
- (2.) The Burgess Well Springs.
- (3.) The Admiral Park Springs.

(1.) The Mildmay Artesian Well was constructed in 1853, shortly after the formation of the Local Board, in order to increase and improve the water supply of the district. This well, which is situate near the centre of the town, was dug to a depth of 205 feet, and bored to a depth of several hundred feet, and it is from this borehole that the water is drawn. A section of this well, showing the thickness of the several strata met with and their depth from the surface is given in the Addendum C. to this report. After passing through various superficial strata of clay, gravel, and sand, the London clay was reached at a depth of 65 feet, and was found to be 104 feet in thickness. Beneath this came a succession of clayey, shelly, and sandy beds, apparently belonging chiefly to the Woolwich and Reading series, and extending to a depth of 330 feet, at which point the water is obtained. Below this point is a bed of dark sand, probably the Thanet sand, resting on the chalk. The boring was carried down into the chalk for upwards of 200 feet or to a total depth of 568 feet, but it is stated that the supply of water was not thereby increased. The water indeed appears to be derived from comparatively shallow beds of sand belonging to the Woolwich and Reading or Thanet series, and lying between the lowest layer of the London clay and the upper surface of the chalk. These sandy beds have their nearest out-crops some 16 miles distant on the south over a small area in the South of Essex, about Tilbury and Grays, and to the N.E. in the neighbourhood of Bishop's Stortford. They only reach the surface in small patches, being for the most part covered by boulder clay where they are not by London clay. It follows that the catchment area is limited, and that the supply of water must be small. In a dry season like the present the amount of water available may fall short. At a depth of 110 feet from the surface there are two adits, each 7 feet by 6 feet by 45 feet long. These are built into the London clay and are used as storage reservoirs, the water in the well rising between the intervals of pumping to a height of 90 feet from the surface, and filling the adits.

It is stated that when the well was first bored the water overflowed from its mouth. Now, however, it stands fairly constantly at a distance of 90 feet

from the surface. Since the well was sunk, the borehole has become silted up to a considerable extent with sand. At times the pumps lift a considerable quantity of this sand. The water is raised to the surface by two 25 horse-power beam engines, with high and low pressure cylinders driven by two Galloway's horizontal boilers, capable of working up to 50 horse-power. The water from the well is pumped directly into a reservoir in Mildmay Yard or to Long Stumps Reservoir. The Mildmay Yard Reservoir is built of brick in cement, is covered with a galvanised iron roof, and has a capacity of about 120,000 gallons. From Mildmay Yard, water from the well and from the reservoir is forced to the Long Stumps Reservoir. This second reservoir, which is constructed of brick in cement, has a capacity of 103,125 gallons. It is situate beneath the surface of the ground, on high land near Galleywood towards the southern end of the Borough. The water flows by gravitation from it to supply the South Ward of the town. There is a communication between the water mains of the North and South Wards, so that in emergency, as in the case of fire, the water in the mains of either Ward can be interchanged.

(2.) The Burgess Well Springs.—The chief of these springs rises in a kitchen garden situate to the west of the centre of the town. The spring is enclosed in a covered reservoir, which has a capacity of 34,000 gallons. From the reservoir the water is carried by means of 4-inch iron pipes under the Burgess Well Road to Harrington's Market Garden, where it flows into a tank 3 ft. by 3 ft. by 3 ft. This tank also receives water from two other springs which rise in the garden. The water of these springs is used to irrigate certain watercress beds, after which it passes through a filter of sand, gravel, and charcoal, to enter the tank through earthenware pipes. From the tank in Harrington's Market Garden the water is conveyed in iron pipes to the Mildmay Yard Reservoir already referred to, where it is mixed with the water from the Artesian Well, to be pumped thence to Long Stumps Reservoir. The total yield of the Burgess Well Springs has been estimated at 70,000 gallons per day, but at the time of inspection (July 1896), they were scarcely yielding 20,000 gallons. The water from the Burgess Well Springs is apparently liable to contamination before reaching the Mildmay Reservoir. The source of the principal springs is, as already stated, situate in a kitchen garden, and the proprietors of the garden store a portion of their vegetable refuse against the wall of the reservoir, whilst adjoining the kitchen garden at a higher elevation there is a farm yard, the greater portion of which is undrained. To the north of "Harrington's Garden," and separated from it by the Burgess Well Road, is a row of houses. Here the slop water is thrown on the gardens, when not poured down the hand-flushed waterclosets, and the house refuse and ashes are utilized on the gardens or carried over the road to Harrington's Market Garden. There is another row of houses situate to the north-west and two houses to the south-east of Harrington's Garden where similar sanitary arrangements exist. The late Sir George Buchanan, in his report on Chelmsford, written in 1866, states: "This supplementary source of supply is plainly a bad one, not only from the fluctuating quantity of the yield and its hard quality, but from its being exposed to all the impurities that subsoil water must necessarily encounter, though, indeed, none of these appear to be in very close proximity to the well."

The houses mentioned above appear to have been built about 1869.

(3.) Admiral's Park Springs rise in a reservoir, the sides of which are made of brick in cement, and the roof of galvanised iron. The reservoir is capable of holding 175,000 gallons. At one end of the reservoir, and situated on higher ground, is a water tower and pumping station, at the base of which the engineman and his family reside.

The water tower is substantially built of brick, and supports a tank with a capacity of 86,000 gallons, at a height of 90 feet above the ground level and 111 feet above Ordnance datum. The power used to raise the water from the reservoir to the tank is obtained by means of a 12 horse-power engine, driving pumps in duplicate. Pumping continues until the tank is full

or the water in the reservoir falls very low. The pumping, which lasts about four to six hours, takes place in the morning at the time during which the water is flowing from the tank to supply the town. It flows out at the rate of 11,000 to 12,000 gallons an hour, and the total quantity supplied is calculated to be about 100,000 gallons a day. This water is supplied to the North Ward only, except in cases of emergency, when it can be passed thence into the mains in the South Ward. The money for the construction of the waterworks at Admiral's Park was obtained by loan, after inquiry held on April 24th, 1888, by Mr. Arnold Taylor, one of the Engineer Inspectors of the Local Government Board, the amount of the loan being 10,000*l.*

The water obtained from sources (2) and (3) can only be derived from surface springs, and the yield is liable to fluctuation. Thus in 1895, the total water supply obtained from all sources was estimated in 24 hours to be as follows:—

	Gallons.
The Artesian Well -	75,000
The Burgess Well Spring -	70,000
	<hr/>
	145,000 used entirely in the South Ward.
The Admiral's Park Springs -	100,000 used entirely in the North Ward.
	<hr/>
Total	245,000

Since this estimate was made, the Burgess Well Springs have at times only yielded about 20,000 gallons, and the Admiral's Park Spring about 90,000 gallons, and the total available supply can hardly have exceeded 160,000 gallons in the 24 hours.

A considerable portion of the water is used for trade purposes in the South Ward. The Arc Works alone consume some 15,000 gallons a day. In addition to this, the loss of water from defective mains, taps, and valves, and by direct waste of the inhabitants, has been calculated at 30,000 and 28,000 gallons in the South and North Wards respectively. Thus the water supply per head of the population cannot amount to more than 7·9 gallons in 24 hours, and possibly at times it may be considerably less.

Distribution of the Water.—A certain portion of the South Ward situate on the rising main passing to Long Stumps receives a constant supply, the remaining portion of the ward is supplied for four hours a day only. In the North Ward the supply is turned on for three hours a day. There are certain houses situated on high ground in the district, as at Galleywood, to which no water is supplied, as they are situate above the level at which the water will flow by gravitation. Again, there are other houses outside the Borough to which water is supplied, as the village of Widford. Water is not supplied direct to every house in the district, the better class houses only being so supplied. Many houses are supplied from a single cistern, furnished with a tap and placed in a yard common to the houses, or at some spot accessible to the inhabitants. When these cisterns are empty the people are without water unless they have access to one of the many pumps of which mention will be made hereafter. In many houses that are separately supplied the cistern is placed over the closet, and from this the domestic supply is drawn, as well as the water for flushing the closet. The cisterns supplying a row or batch of houses are often to be found placed in undesirable positions. For instance, in French's Square, a poor neighbourhood of some 15 houses, there is a galvanised iron tank supplied with the borough water, and from which water can be drawn by means of a tap. This tank, which measures about 3 ft. 10 in. by 2 ft. 6 in. by 2 ft. 6 in., is only partly covered by an old zinc or galvanised iron lid laid loosely on the top. It is supported on beams of wood which are laid across and in turn supported by the brick walls of an open ash pit 6 ft. by 4 ft. by 3 ft. 6 in., the unpaved floor of which is below the surface of the ground. This ashpit is the common receptacle of the filth of the houses in the square.

Complaints are numerous throughout the district as to the insufficient quantity of water supplied and occasionally also as to its quality.

Not only has the water supply of Chelmsford decreased, but the demand for water for trade purposes and for domestic use has steadily increased; so that at the present time the Corporation is unable to supply the quantity of water required by the District. The want of water is pressing heavily on the town. The Surveyor is attempting by various means to arrest waste; he has also spent much time in endeavouring to find additional sources of supply. Since the Corporation Artesian Well was sunk other wells have been carried through the London clay. At the present there are inside the Borough boundary artesian wells at Ridley's Mill, Gray's Brewery, Wells and Perry's Brewery, whilst immediately outside the Borough boundary there are artesian wells at Great Baddow Brewery and at the County Gaol. Apparently, all these artesian wells draw their water from the same geological formations immediately above the Chalk; and, as was pointed out early in this report, the amount of water to be obtained from these strata must be limited. It thus seems that there is not much hope of obtaining a largely-increased supply of water from deep borings, unless it should become possible to obtain the water from the chalk. So far, however, such attempts have failed. From the analyses of the Chelmsford public water, made by Mr. Carter, the Medical Officer of Health, in 1892 and 1895, it will be seen that the quality has deteriorated in certain particulars.

WATER ANALYSIS, BOROUGH OF CHELMSFORD.*

Source.	In grains per gallon.					In parts per Million.	
	Nitric Nitrogen.	Nitrates.	Chlorine.	Chloride of Sodium.	Hardness.	Free Ammonia.	Organic Ammonia.
The Deep Well, Mildmay Road, November 14th, 1895	.16	Nil.	21	34.6	3.5	.62	.044
Ditto 1892	.11	Nil.	20.7	32.7	2.0	.48	.038
<i>Remarks.</i> —This is a good drinking water, and good for domestic purposes. The free ammonia varies considerably at times, and is not of much importance. The slight differences between the present analysis and that of 1892 are, no doubt, due to the altered and increased supply of water (from some unknown cause) at the well.							
Burgess Well, October 14th, 1895	.69	Nil.	2.4	3.9	24	.028	.04
Ditto 1892	.69	Nil.	2.1	3.4	21.5	.03	.05
<i>Remarks.</i> —This is a good drinking water, but rather hard for domestic purposes, each 10,000 gallons of water destroying 288 lbs. of the best soap.							
Admiral's Park, October 17th, 1895	.46	Nil.	2.1	3.4	22	.005	.055
Ditto 1892	.28	Nil.	2.1	3.4	21.5	.05	.055

Remarks.—This is a good drinking water, but rather hard for domestic purposes.

In addition to the sources of public supply already referred to there is a public pump which stands in Moulsham at the roadside. The water of this pump is used for watering the roads. From personal observation it was evident that the water was also used for drinking and domestic purposes. It is stated that during the winter of 1894-95 the great majority of the water

* In Addendum B. to this Report will be found a Report on the analysis of these waters by Professor E. Frankland: the samples were taken in July 1896, after a heavy rainfall.

pipes were frozen, and a majority of the people of the neighbourhood resorted to this as the only unfailing supply.

Owing to the scarcity of the public water supply the inhabitants are often driven to obtain their water from private wells, which are invariably shallow, and which are so situate as to be subject to risk of serious contamination.

The Medical Officer of Health analyses the waters of these wells from time to time, and at rare intervals the water of a pump is condemned and the pump "closed." Sometimes the water is still allowed to be used, a notice being placed on the pump to the effect that the water is unfit for domestic use.

The people of Chelmsford form no exception to the rule that not a few persons are strongly prejudiced in favour of local spring or well water, whatever its source, as opposed to a general supply, however excellent it may be. There is in the Market Place of Chelmsford a statue erected to the late Chief Justice Tindal. To the base of this statue the water of a spring was formerly piped, and a certain number of people came every day to fetch the water from the spring for domestic use. It was averred that this water was unsurpassed for the purpose of making tea and very much excelled in good qualities the water supplied by the Corporation. Some time back the present Surveyor, finding that the water of the spring had become contaminated, caused it to be diverted, and replaced by water from the Corporation mains. This change is unknown to the people, and the water is still eagerly sought for, even by people who have the identical water delivered to their houses.

The great frost of the winter 1894-95 played havoc with the water service of the borough, bursting even the largest mains. For some days the district was without water, except in so far as it was supplied by water carried in carts. On the breaking up of the frost in March 1895, the Surveyor found that he could place no dependence on a single main, or service pipe, and much money, time, and trouble were spent in replacing defective pipes. Even at the present time, the damage done by the frost has not been completely repaired; the Surveyor still finding traces of the damage in split pipes, &c. The amount of calculated loss from leakage, &c. (58,000 gallons in 24 hours) would tend to emphasize this fact, as well as the danger of contamination of the water while within the pipes during the periods of intermission of the supply. The sum expended in connexion with the water supply in the year 1895-96 was 1,551*l.* 9*s.* 10*d.*; of which sum 962*l.* was expended in relaying mains and services, and in executing repairs.

The subject of the water supply has been treated of at length, as directly and indirectly many of the insanitary defects of the Borough can be traced to the lack of water.*

Sewerage.—There are two official reports dealing with the sewerage of Chelmsford to which short reference may be of service in explanation of the present condition of affairs.

One, a report of Mr. Creasy, Inspector of the General Board of Health, refers to the state of the town in 1849, before it was put under the operation of the Public Health Act; and the other, a paper on the Results of Works, &c., for Promoting Public Health, from the pen of the late Sir George Buchanan, appeared in the Annual Report for 1866 of the Medical Officer of the Privy Council. In the latter paper, the following brief summary of Mr. Creasy's report is given:—

"The removal of rainfall was effected in the main by mere surface drainage into the river. Such sewers as existed received some little

* Since this report was written, the Surveyor has decreased the number of revolutions per minute of the engines at the Mildmay artesian well, and adopted a system of continual pumping, the result being that he has been enabled to take the water as it rises in the well, and to increase to a great extent the amount that can be raised in 24 hours.

I am informed that the Water Sub-Committee have instructed the Surveyor to prepare plans, specifications, and estimate for sinking a well 160 feet deep with adits near the present deep well, to clean out this well, to reduce the length of the bore pipe, and to lower the pumps, to enlarge the reservoir at Long Stumps, and to provide a second reservoir at the Mildmay Yard.

night soil as well as surface water; some of them appear to have been noteworthy chiefly through their faculty of overflowing cellars. In the report an account of constant cesspools, privy nuisances, foul ditches, and cellars from whence water had to be pumped out, is given. 'The privies and cesspools are generally in bad condition. Surface drains are not infrequently used to carry away the sullage from the overflowing cesspools.' 'The better sort of houses, which have drains to conduct water away, have generally only common privies, emptied frequently, much to the annoyance of the neighbours; and sometimes, this being too long delayed, the soil floats into the yards of the adjoining premises.' The River Cann, since the construction of sewers, had been in dry weather covered with very offensive scum."

Works of sewerage were commenced in Chelmsford in 1853, and were mostly completed in that year. The following account of these works is by Sir George Buchanan:—

"The plan of sewerage separates great part of the storm water from the drainage of houses, the former going off by surface channels and by superficial culverts to the river: the latter being conveyed in pipes to a pumping station in Moulsham at the lowest part of the town. From 1853 to 1858 the sewage was discharged, as well as the surface water, from this station into the river, but it was found to give rise to many complaints, and then filtering tanks were constructed, the liquid part only discharged into the river, and the solid mixed with the town ashes and sold to neighbouring farmers. During 1866 a better use of the sewage has been made; none now enters the river, but the whole is employed in the irrigation of 60 acres of land adjoining the town."

This plan did not answer the expectations of the Local Board, for complaints, which were apparently well founded, were received to the effect that the sewage was not properly dealt with on the land, and that the river was seriously polluted by it. There were also complaints respecting the pollution of the river by sewage from the villages of Widford, Springfield, and Great Baddow, situate in the Rural Sanitary District. A Joint Committee of the Urban and Rural Sanitary Authorities was formed to consider the matter, and they recommended,—

- (1.) That the sewage should be dealt with by gravitation and not by pumping;
- (2.) That the main sewer should be carried down to some portion of the land near Cuton Lock;
- (3.) That the best mode of dealing with the sewage would be by irrigation; and
- (4.) That certain land should be purchased.

This report met with the approval of the two authorities, and an application was made to the Local Government Board in 1879 for a Provisional Order to put in force the compulsory powers of the Lands Clauses Consolidation Acts, and for authority to raise the necessary moneys to carry out the scheme.

Local inquiries were held by the late Mr. S. J. Smith, of the Engineering Department of the Board, on more than one occasion, with the result that the Local Board obtained compulsory powers to purchase 107 acres of land situated at Brook End, Springfield, and sanction to raise loans in 1882 and 1883, for the purpose of carrying out the necessary sewerage works connected with the sewage farm. Subsequently an additional loan was obtained to purchase certain cottages at Brook End.

The sewers laid in 1853 are, with the exception of the outlet culvert, of earthenware pipes, ranging from 12 inches to 6 inches, and in depth below the surface 3 feet to 12 feet. The gradient on the whole is very small, 1 in 1400; in one place there is only one inch fall in 100 yards. In many sewers the sewage is said to flow freely, but in others the solid matter gradually silts up the sewers which require frequent flushing and cleansing. Blockage of sewers has occurred on more than one occasion. Inspection of the sewers is rendered a difficult matter owing to the absence of manholes on the older system, and to the fact that the sewers are not laid in straight

lines from point to point, but carried in curves. There are no ventilators to the sewers at the street level; but rain-water fall pipes occasionally do duty as ventilating shafts.

The sewers are not flushed in any systematic way, the absence of manhole inspection chambers, automatic flushing tanks, and the deficiency of water, all contributing to render flushing a task by no means easy of performance. The more recently laid outfall sewer has manholes at intervals, and it is laid in straight lines.

In the town itself the present Surveyor has endeavoured, by relaying portions of the sewers, to rectify the ill-effects of the curves, and from time to time new manholes have been inserted; but the defects in the system are many and much still requires to be done. Indeed, in 1886 the Board, amongst other things, called the attention of the Local Board to the urgent necessity of providing efficient means of flushing the sewers, additional manholes, and more effectual ventilation.

The population at the Census of 1851 was 7,796, and it was for the removal of the sewage of this number of inhabitants that the first sewers were laid. Owing to the extension of the town certain sewers now receive a greater quantity of sewage than they were originally intended to carry.

The sewage farm at Brook End, in the parish of Springfield, is outside the Borough boundary. Its area is 107 a. 3 r. 17 p. Of this about $12\frac{1}{2}$ acres are pasture land, and the remainder osier bed and arable land. The sewage is received into settling tanks, where the greater portion of the solid matter is deposited, the liquid matter being disposed of by surface irrigation on about $66\frac{1}{2}$ acres available for the purpose. A fairly clear effluent is discharged into the Chelmer Navigation Channel near Cuton Lock. For some years the farm answered its purpose admirably, but now the ground is said to be "sick," and a larger area required. The management of the farm is entrusted, under the supervision of the Surveyor, to a bailiff, who takes an intelligent interest in his work.

House Drainage.—Prior to the formation of the sewerage system, all houses drained directly or indirectly to the river. In 1853 most of the houses were connected to the town sewers by 6 inch pipes. Many cases still remain where sink wastes communicate directly with the house drain, though the sink pipes are now disconnected whenever the attention of the Town Council is directed to a particular case. In the more recently erected houses the waste from the inside sinks discharges into the open air, over or near a gully. There are many instances, however, where the sink pipe is carried under the ground to open under the grating, and directly above the trap of the gully. In many cases a number of cottages use one gully in common, and in the more rural parts, as at Wood Street, there is no drainage at all, slop water being thrown on the gardens. Soil pipes are for the most part unventilated, and even in houses recently erected the ventilating shaft of the soil pipe is not carried up straight to a point above the eaves. Many soil pipes are of galvanized iron, the majority being 4 inches in diameter.

There are many places in the town where the gullies in the yards are liable at times to have sewage flow back through them, and flood the yards, and occasionally even the basements of the houses. This happens during times of heavy rainfall when the sewers become overcharged with storm water, or when a sewer becomes blocked with solid matter.

Excrement disposal is effected for the most part by means of waterclosets. There are a few privies of the worst type in the neighbourhood of Galleywood. Of the waterclosets more than one half are situated outside the houses, and a large proportion are "hand flushed." Of those which are supplied with water, many have no other means of flushing than a two or three gallon "flushing tank," and when the closet is used after the Borough supply of water has ceased for the day it is without water. In some instances the closets are flushed by means of "stool cocks." The closet accommodation is frequently inadequate, and, as a consequence, many closets common to several houses were observed to be in a filthy condition.

Disposal and Removal of Refuse.—House refuse, ashes, &c., are, as a rule, stored in ash-pits, many of which are of large size, with their floors below the

level of the ground, and their contents open to the air. The ash-pits are frequently unpaved, and are often placed close to the back doors of houses, though during recent years attempts have been made to remove them as far as possible from dwellings. The byelaws in force with respect to the construction of ash-pits have not been carried out in their entirety as regards some recently erected. Of late the Sanitary Authority have endeavoured to secure the substitution of galvanized iron pails for fixed ash-pits. A considerable number of these are now in use, and are emptied by the Authority.

The Town Council employ a number of scavengers who are continually engaged in the work of emptying ash-pits in the more populous portions of the town. The work is not systematically performed, and in consequence the various filth receptacles are emptied at irregular intervals. In the more sparsely populated portion of the district, such as towards the neighbourhood of Galleywood Common, the duty of scavenging is imposed upon the occupiers. The refuse when collected is carted to a tip at Long Stumps Road.

The *Common Lodging-Houses* are for the most part cleanly kept, but the byelaws regulating them are in need of revision.

The *Bakehouses*, as far as they were examined, appear to be in fairly good condition.

Slaughter-Houses.—There are 12 registered slaughter-houses in the Borough, of which three appear to be unused. Most of them are situate in the more populous parts of the town. Generally speaking they are kept fairly clean; the floors, however, in several require to be relaid, and the lairs in many instances are only roughly partitioned off by wooden divisions from the slaughter-houses. The drainage in many cases is defective, and the water supply in the majority of instances is derived from wells situate either within or near to the building. The lower parts of the walls are usually of brick, the upper part being of wood; often the side boards have several inches allowed between their edges to permit of free circulation of air. The byelaws in reference to slaughter-houses are somewhat antiquated and require revision.

There appear to be a few pigs kept within the precincts of the Borough. The pig-styes do not appear to be well constructed or drained, and at times must be a source of nuisance.

Dairies, Cowsheds, and Milkshops.—There are 13 dairies and cowsheds and 7 milkshops in the Borough. A considerable quantity of the Borough milk-supply is brought in from the surrounding rural district, and one dairyman living within the urban district sends a considerable quantity of milk to London.

Regulations for the management of dairies, cowsheds, and milkshops came into force on 16th July 1890, but they appear to be very laxly enforced.

As an instance of this laxity in carrying out the regulations, I may give a summary of the sanitary circumstances of one of the largest cowsheds in the district, where milch cows to the number of 58, with six other beasts, are kept in two large sheds. Between the two sheds, limited on two sides by their walls, and on a third side by the walls of a building used for storing the food for the cattle, &c., which joins the two sheds, there is a large space which is used for the deposit of manure. The fluid soaking from this manure necessarily finds its way towards one of the sheds which is situate at a lower level. The general arrangements of one of the sheds was found to be fairly satisfactory, but those of the other were eminently unsatisfactory. The building is old, inefficiently drained and imperfectly ventilated. From the filthy condition of both sheds at the time of inspection it was evident that the regulations with regard to daily cleansing of floors, and the weekly washing of the inner surface of the walls, had not been carried out. Indeed, the employes could not remember when the sheds had been last washed down, but thought it must have been some time between Christmas and Easter, they were not quite sure of the date, but certain such a proceeding had not taken place since Easter. These cowsheds drain to an open pit in the

ground immediately contiguous to the sheds, the overflow from which is discharged on some low-lying pasture land. The water-supply for the cows is pumped from a pond covered with duck weed, to an old boiler, from whence it flows through the drinking trough. Many other examples of defective cowsheds were observed.

SANITARY ADMINISTRATION.

The Town Council have adopted the Infectious Disease (Notification) Act, 1889, the Infectious Disease (Prevention) Act, 1890, Parts II., III., and V. of the Public Health Acts Amendment Act, 1890, and the Private Streets Works Act, 1892.

The Medical Officer of Health, Mr. Edward Hunt Carter, M.R.C.S., L.S.A., was first appointed in February 1872. He receives a salary of 60*l.* per annum, of which, since 1891, a moiety has been paid out of the County Funds. He has, further, an annual grant of 20*l.* to cover fees for water analysis and attendance at the Isolation Hospital. He is in large general practice, and in addition is medical officer to the 1st District of the Chelmsford Union, surgeon to H.M. Prison, Chelmsford, and public vaccinator. He also takes turns with two other medical men in attendance at the Industrial Home, and is surgeon to the Chelmsford Infirmary and Dispensary. He reports every month to the Sanitary Committee of the Town Council on the condition of the town; these reports, however, deal only with the individual cases of disease and with the sanitary circumstances of the houses in which the disease occurs. He appears to have an intimate knowledge of the district, but in his annual reports, of which only those dating from 1892 are in possession of the Board, he does not make his local knowledge apparent, in the sense of rendering well considered advice to his Authority.*

The Borough Surveyor and Chief Sanitary Officer, Mr. George H. Sasse, was first appointed in 1891. This officer has done much to improve the defects in the sewerage system, to devise means to save the waste of water, and to improve the water supply of the district. He was at one time also the inspector of nuisances. He retains the title of "Chief Sanitary Officer" in order that by his general knowledge he may assist or direct the inspector of nuisances in special matters, but it is no part of his many duties to seek for nuisances. Mr. Sasse has also control of the fire brigade, the sewage farm, the cattle market, roads, scavenging, and the water-works. His salary as Surveyor is 250*l.* per annum.

The Inspector of Nuisances, Mr. J. R. Campbell, receives a salary of 75*l.* per annum, with part repayment. At the time of my inspection he had held office for about one year and three months. He has apparently made himself acquainted with the sanitary details of the Borough, but he has failed to turn this knowledge to good account, principally, it would appear, through a lack of method in his daily work. His books are not well kept, and in face of the many nuisances existing in the Borough, the number of notices issued to abate them seems remarkably small.

Considerable difficulty has arisen in Chelmsford in dealing with infectious disease from the fact that notifications of the occurrence of cases have been made from time to time to the Authority by medical practitioners without the patients or even the members of their households being previously informed as to the nature of the illness. Indeed the fact has, on more than one occasion, only been brought to their notice by the official visit of the Medical Officer of Health. As a result the latter has been placed in a false position when, in obedience to his instructions, he, in visiting a house from which a case of infectious disease such as diphtheria has been notified, finds that no knowledge that such notification has been made is possessed by the occupiers, and that the person notified as suffering from diphtheria, has not had intimation from his medical attendant of need for discontinuing his employment and for ceasing to mix with his neighbours.

* News of Mr. Carter's death has reached me just as this report is going to press. R. J. B.

Byelaws.—The byelaws in force in the District are in many respects antiquated and require revision. The subjects and dates of confirmation of these byelaws are given in the following table:—

Byelaws.	Date.
Common lodging-houses - - - - -	27th February 1852.
Nuisances - - - - -	22nd January 1859.
Slaughter-houses - - - - -	28 " " 1880.
Market, sanctioned by the Local Government Board - - - - -	9th November 1886.
Cemetery " " - - - - -	7th May 1894.
New streets and buildings " " - - - - -	26th June 1895.
The recreation ground " " - - - - -	

Isolation Accommodation.—In 1893 the Town Council leased for use as an isolation hospital two cottages on the Galleywood Road, near the confines of the Borough, the neighbourhood being of a distinctly rural character. The cottages are two-storied, built under one roof, and each having four rooms, two on each floor. The two front rooms on the ground floor are used as the caretakers' sitting and bedroom, the two back rooms as kitchens. There is a communication between the kitchens by means of a door. The upper floors of the cottages are kept distinct, and are reached by a staircase from each kitchen. The two front rooms, each having a total cubic capacity of about 920 cubic feet, contain two beds, and the back rooms, cubic space 450 cubic feet, one bed each. Thus the cottages are used for the accommodation of six patients. The walls of the "Wards" are painted. Cases of diphtheria and scarlet fever have been treated in this "hospital" at one and the same time. The cottages are under the care of a man and his wife, the latter acting as nurse. She had no previous experience of nursing before she went to this hospital. On certain occasions, as when there are typhoid patients in the hospital, professional nurses are employed. This necessarily limits the number of beds available for patients. When there is no patient in the hospital the male caretaker works on the recreation ground, and at other times he assists his wife. Behind the cottages are a washhouse and storeroom, and two earth-closets. The excrement is buried in the adjoining field, and the slopwater thrown down a gully in the yard, when it finds its way into a brick chamber in the field and thence by irrigation pipes over the field. The water supply is from a surface well, the pump connected with which is in the washhouse. This "hospital" is totally unsuited for the purpose for which it is employed in every way, except as regards site.

Disinfection.—There are no standing means for disinfection in the District. An old sewage tank, heated by gas, was formerly used for the purpose; but as might be expected, this "apparatus" was found to be useless as a "disinfectant," although it is stated to have been of some service as a "destructor."

Houses in which infectious disease has occurred are fumigated in a perfunctory manner by means of sulphurous acid gas, by the Inspector of Nuisances or by the occupiers. Clothes, &c., are washed in "disinfectants" supplied by the Town Council on the request of the inhabitants.

Ambulance Provision.—The Town Council possess an old brougham which is apparently passing into decay.

There is a *Public Mortuary* situated under a railway arch of the Great Eastern Railway where it passes through the town. The space is divided into two rooms, the floor of the principal room being of cement. Water and gas are laid on, and there are tables and a sink.

There is a building in the Borough known as the *Infirmery*, which serves as the general hospital of the district. Patients suffering from typhoid fever have been received into this institution and treated in the ordinary wards, which are not so arranged as to be suitable for the simultaneous treatment of that disease, and others received into them.

Elementary Schools.—There are in the Borough five voluntary schools, the Chelmsford Grammar School, and about eight private schools. In addition there is the "Essex Industrial School and Home for Destitute Boys," where boys are received between the ages of 6 and 16 years. From inquiries made

at the schools visited, it would appear that the various schoolmasters and schoolmistresses had been asked by the Sanitary Committee of the Town Council to report to the Medical Officer of Health any falling off in the attendance of the children at their schools, and that children should not be received at school from houses in which there were cases of infectious disease. Apparently, however, such information had not been furnished recently, and the schoolmasters and mistresses not being face to face with prevalent diphtheria, had not realised the importance of keeping the Medical Officer of Health informed on these matters. On the other hand, the Schoolmaster of the British Schools considered it the duty of the Sanitary Authority to keep him posted in the prevalence of infectious disease among the scholars attending his School, and that of the School Attendance Officer to ascertain why the children were absent.

RECENT PREVALENCE OF INFECTIOUS DISEASES IN CHELMSFORD.

In 1895, in the South Ward of the Borough, 16 cases of typhoid fever were notified, and a single case in the North Ward. The outbreak occurred in the months of October and November, and was limited in the South Ward to a tolerably well-defined area. The cause of the outbreak was not traced. Six of these fever attacks proved fatal. The total reported cases of infectious disease during the year include 45 cases of diphtheria, of which seven proved fatal. No deaths were attributed to scarlet fever although 17 cases were notified, of which number 15 occurred in the North Ward. The death returns show that measles was fatal in 12 cases. Owing to the prevalence of infectious disease in the fourth quarter of the year certain schools were closed.

In the beginning of the present year (1896) diphtheria was still prevalent in the Borough, 12 cases being notified in January, and 7 in February. Other seven were notified in March, two in April, three in May, two in June, one in July, and one in August. Of these cases five were fatal.

Several deaths have also been notified as due to measles and whooping cough. There have also been a few cases of scarlet fever, three occurring in one house.

In the month of April a case of typhoid fever was notified in the North Ward. No more were notified until the latter end of June, between which time and the third week in August, the date of writing, a series of cases, numbering 27 in all, were notified in the South Ward, 21 houses being invaded. Duplicate cases occurred in three houses, and three cases in one house, the mother and two children being attacked, at a time when the father was recovering after some weeks' illness from "slow fever." One case was brought into the Infirmary from Widford.

The outbreak thus limited in point of time comprised separate groups of cases in different localities of the ward in question, the streets mainly affected being Moulsham Street, New Wittle Street, and George Street.

Of the invaded dwellings, some did not receive water from the public supply, and most of them had outdoor hand-flushed waterclosets. Refuse was disposed of in ashpits often close to the dwelling, and scullery sinks were not always found disconnected from the house drains. Certain of the houses are partly built of wood, and some have damp foundations. Close back-yards were observed in particular instances.

The points to which it becomes necessary to call the attention of the Town Council as a result of my inspection are:—

Water Supply.—The Town Council should endeavour to provide their district with a constant supply of water wholesome in quality and sufficient in quantity, and should take steps to relay such mains as may reasonably be suspected of being in a damaged condition.

If cisterns are retained in the houses, there should be a separate cistern or flushing tank for the watercloset.

Meanwhile the Town Council should see that existing water supplies are protected from becoming fouled, and that polluted wells are closed under section 70 of the Public Health Act, 1875.

Sewerage.—The Town Council should endeavour at the earliest opportunity to remedy the defects in the sewerage system. Means for thorough flushing, ventilation, and inspection should be provided for such sewers as are at present without them, and where circumstances do not permit of such alterations being made in the older sewers they should be taken up and relaid.

Steps should be taken to place the sewage farm in an efficient state.

Isolation Hospital Accommodation.—The Town Council should provide sufficient, and proper hospital accommodation for infectious diseases in place of the inadequate provision they now possess.

Such hospital provision should include :—

- (a.) a properly equipped laundry.
- (b.) a mortuary.
- (c.) a suitable ambulance.

Disinfection of infected premises should be performed in a thorough and efficient manner, and in this connexion the Town Council will do well to provide a trustworthy disinfecting apparatus, and a vehicle for the carriage of infected articles, such as bedding from the infected houses to the disinfecting chamber.

Byelaws.—The byelaws that the Town Council possess should be enforced and the byelaws relating to common lodging-houses, slaughter-houses, and nuisances should be revised.

The regulations for the management of dairies, cowsheds, and milk-shops should be enforced in their entirety.

The Town Council should make byelaws under the Public Health Acts Amendment Act, 1890, concerning new buildings upon the following points :—(a) an adequate water supply to closets; (b) construction of floors, hearths, and staircases; (c) paving of yards and open spaces in connexion with houses; (d) provision of secondary approaches to houses for the purpose of removing refuse.

Byelaws respecting closets and drainage may be made applicable to old as well as new houses. The Town Council may also make byelaws to prevent buildings erected in accordance with byelaws from being altered in such a way that if at first so constructed they would have contravened the byelaws.

Scavenging should be carried out in a systematic manner, at regular periods throughout the district, and additional men and carts should be provided for this purpose.

Nuisances.—Inspection of the district for the discovery of nuisances should be carried out thoroughly and systematically. Nuisances should be sought out, and the provisions of the Public Health Act for their repression should be enforced independently of complaints from inhabitants. Nuisances likely to recur should be specially dealt with under section 92 of the Public Health Act, 1875.

Insanitary Dwellings.—The Town Council should cause all dwellings which from dampness, want of ventilation, dilapidation, and other structural defects are unfit for habitation to be placed in proper repair or permanently closed.

The attention of the Town Council should be especially given to the danger to health arising from the dampness of foundations and walls due to the absence of proper spouting for the conveyance of rainwater from the roofs of houses.

Overcrowding of Persons.—The Town Council should, without further delay, exercise their statutory powers to put a stop to the present overcrowding of persons in houses.

ADDENDUM A.

The late Sir George Buchanan, writing in 1866 on "the results which have hitherto been gained in various parts of England by works and regulations designed to promote the public health," included the town of Chelmsford in his Report, and he drew up an excellent table of vital statistics for the town for ten years (1843-52) *before*, two years (1853-54) *during*, and eleven years (1855-65) *after*, the execution of certain sanitary works.

It has been found possible to continue the Table on the same lines, bringing the information up to the present date. The Table below deals with the deaths from certain diseases occurring in the Registration Sub-District of Chelmsford. This Sub-District includes, in addition to the parish of Chelmsford, the small parish of Widford. The population of Widford has varied between 200 to 300 persons, and, as was pointed out by Sir George Buchanan, the error resulting from the small number of persons thus introduced is manifestly of no amount or consequence. The inhabitants live under the same condition of water supply and sewerage as those of Chelmsford. Correction has been made for persons dying in the Union Workhouse, but not belonging to the parish. Owing, however, to the Workhouse records for a certain period of 1866 having been destroyed in a fire, it has been impossible to account for certain deaths which occurred in the Workhouse during the year in question, and these deaths have been omitted from the Table. Whenever a death has occurred in the Workhouse and the parish from which the deceased person came has not been definitely stated to have been either Chelmsford or Widford, the case has also been omitted from the Table. Moreover, all cases where the death certificate has been in any degree doubtful in the wording have been also omitted. The Table thus understates rather than overstates the death incidence. The death-rate for children under one year of age, from all causes, is probably the rate most affected by these procedures, and it is less than that which would result from a calculation based on the Registrar-General's quarterly returns of deaths in the Sub-District.

TABLE, devised by the late SIR GEORGE BUCHANAN, to show the DEATH-RATE FOR CERTAIN DISEASES in the REGISTRATION SUB-DISTRICT of CHELMSFORD for certain periods, included between the years 1843-65, Before, During, and After the execution of certain Sanitary Works in Chelmsford; and continued by Dr. R. J. Reece, for three decennial periods ended 1895.

Per 10,000 of Total Population Yearly.	Before (10 years 1843-52)	During (2 years 1853-54)	After (11 years 1855-65)	10 years 1866-75.	10 years 1876-85.	10 years 1886-95.
Deaths from all causes, all ages	196½	208	215	204½	174½	157½
All causes under one year	44	43½	42½	42	35½	28½
Males	23·7	20·2	24·0	24·5	21·6	15·4
Females	20·3	23·2	18·8	17·5	13·7	13·0
Epidemic diseases:—						
Small-pox, all ages	2	—	0½	1	0½	0½
Measles	4½	2½	2	2½	2½	2½
Scarlatina	2½	2½	10½	6½	2½	0½
Under 5	1·5	0·0	5·0	5·7	1·7	0·85
Over 5	1·3	2·5	5·5	0·8	1·2	0·85
Diphtheria, all ages	—	—	6½	7½	3½	2½
Whooping Cough, all ages	5	7½	5½	5	6½	2½
Croup	2½	0½	2½	2½	2½	0½
Erysipelas	2	1½	2	1½	1	0½
Rheumatic Fever	0½	1½	0½	1½	—	1½
Acute	0½	—	0½	—	—	—
Continued Fevers, all ages, probably little or no typhus.	12	12½	12½	6	1	2
Under 5	1·7	3·7	1·0	0·84	0·19	0·0
Over 5	10·3	8·6	11·0	5·16	0·85	1·05

Per 10,000 of Total Population Yearly.	Before (10 years 1843-52)	During (2 years 1853-4)	After (11 years 1855-65)	10 years 1866-75.	10 years 1876-85.	10 years 1886-95.
Epidemic diseases—cont.						
Diarrhoea, all ages -	7	8	8	10½	7	6½
Under 5 -	5·3	3·7	6·1	8·7	3·4	4·7
Over 5 -	1·6	4·3	1·8	1·8	1·4	1·7
Cholera, all ages -	(In 1849, 4)	(In 1854, 3½)	(In 1866, 0)	0½	0	0
Dysentery „ -	0½	0½	0½	0½	0½	0
Phthisis, all ages, both sexes -						
	32½	30½	32½	26	27½	20½
Males, 15-55 -	13·1	12·2	11·1	11·6	9·2	7·2
Females, 15-55 -	11·6	11·0	13·1	11·3	6·6	6·9
Lung diseases, all ages, both sexes -						
	23½	25½	29½	27½	25½	21
0-5 both sexes -	9·6	8·0	14·2	10·7	9·5	8·6
15-55 { Males -	2·0	1·8	1·6	2·1	1·7	1·3
{ Females -	1·0	3·1	1·3	0·7	1·1	1·7
Over 55, both sexes -	10·1	11·6	11·6	13·3	11·9	12·9
Brain diseases, all ages, both sexes -						
	28½	26½	30½	27½	22	29
0-5 „ -	15·3	8·0	13·7	11·2	12·0	6·0
5-35 „ -	2·3	3·0	3·4	2·3	2·4	2·1
35-55 „ -	1·9	3·6	2·4	3·1	1·3	3·2
55 and upwards -	8·7	9·8	11·1	14·3	15·9	16·4
Cancer, all ages, both sexes -	—	—	—	0½	9	2½

In the columns added by me in regard of the years 1866-1895 the deaths returned under the heading "croup" have been added to those registered as due to "diphtheria"; though the deaths due to "croup" have also been given separately. The great majority of the deaths, returned as having been caused by "diphtheria" or "croup" occurred during the school attendance period, 3-12 years of age. It is stated locally that "cancer" is on the increase in the neighbourhood, and accordingly the death rates from cancer have been given for the years 1866-95.

On comparing the various columns it will be noticed that, whereas several of the death rates remain about the same, the death rate from "continued fevers" has decreased very considerably, and that the diarrhoea death rate is also lowered. Dysentery is ceasing to be registered as a cause of death; the deaths thus notified in the 30 years, 1866-95, occurred in soldiers who possibly had served abroad.

The most interesting point shown in the Table is the great decrease shown in the phthisis death rate. Sir George Buchanan clearly demonstrated that during the execution of the sanitary works in Chelmsford the death rate from phthisis was lowered, but afterwards the rate rose again and even slightly exceeded the death rate before the execution of the works.

It will be seen from the Table that during the ten years (1866-75) after Sir George Buchanan's Report the phthisis death rate rose still higher, that in the following ten years (1876-85) it dropped below any previously recorded figures, and that in the decennial period which has just elapsed (1886-95) the rate has still further decreased to a marked extent.

The deaths certified as due to lung diseases are somewhat less in number, but the deaths from "brain diseases" remain fairly constant.

Taken as a whole the Table shows that there has been a steady decrease in the diseases which may be classed as "preventible."

I wish to express my cordial acknowledgment to the Registrar General for access to the records of his office and to his officers for much active assistance; to Mr. W. W. Duffield, Clerk to the Guardians of the Chelmsford Union, and to the Master of the Workhouse for time and trouble expended in examining the Workhouse records over a period of many years.

R. J. R.

ADDENDUM B.

CHELMSFORD WATERS.

SIR,

The Yews, Reigate, August 26, 1896.

HEREWITH I enclose results of analysis of four samples of water sent here for examination by Dr. Thorne Thorne.

All these waters were more or less turbid and would require filtration before supply for domestic use.

The samples labelled "Burgess Well" and "Harrington's Garden" are almost identical in composition. They are of very high organic purity, but are derived, in part, from impure sources. They are, consequently, suspicious waters, and I cannot recommend them for dietetic use, unless they came from deep wells (100 feet or more).

They are of the extreme hardness of chalk water.

The sample labelled "Admiral's Park" is slightly softer and contains a much smaller proportion of water from impure sources. It also possesses a very high degree of organic purity; but, if from a shallow well, it is not altogether free from suspicion.

The "water from deep well" evidently comes from beneath a stratum of clay and belongs to the Trafalgar Square category of waters. It contains 40 grains of carbonate of soda per imperial gallon besides a rather large quantity of chloride of sodium. It is almost as soft as distilled water, and exhibits no evidence of previous sewage or animal contamination. Although it is, organically, less pure and contains a rather excessive proportion of saline matters, it is better suited for domestic supply than the other samples.

I am, Sir,

Your obedient servant,

E. FRANKLAND.

The Secretary,
Local Government Board.

RESULTS OF ANALYSIS EXPRESSED IN PARTS PER 100,000.

Number of Sample.	Description.	Total Solid Mat- ters.	Organic Carbon.	Organic Nitro- gen.	Amo- nia.	Nitro- gen as Nitrates and Nitrites.	Total Com- bined Nitro- gen.	Chlo- rine.	Hardness.			Remarks.
									Tem- porary.	Per- manent.	Total.	
	Chelmsford, 11/7/96, G. H. Sasse.											
9917	Burgess Well -	46.16	.066	.019	0	.767	.777	2.7	23.4	4.7	28.1	Turbid.
9918	Water from deep well	103.80	.117	.013	0	.028	.051	32.0	1.4	0	1.4	Slightly turbid.
9919	Admiral's Park -	45.40	.051	.013	.002	.648	.473	2.8	23.2	4.3	27.5	" "
9920	Harrington's Garden -	47.48	.058	.013	0	.746	.759	2.8	23.6	5.4	29.5	" "

E. FRANKLAND,
The Yews,
Reigate,
Surrey.

ADDENDUM C.

MILDMAY ARTESIAN WELL.

The THICKNESS of the SEVERAL STRATA met with in sinking this Well,
with in each instance their depth from the surface.

	Depth.		From Surface.	
	ft.	in.	ft.	in.
Black soil - - - - -	2	6	2	6
Yellow clay - - - - -	2	6	5	0
Gravel - - - - -	12	0	17	0
Quicksand - - - - -	44	0	61	0
Sand with stones - - - - -	4	0	65	0
London clay - - - - -	104	0	169	0
Clay and sand - - - - -	50	0	219	0
Dark sand - - - - -	12	6	231	6
"Clay slate" - - - - -	0	9	232	3
Clay and shells - - - - -	4	0	236	3
"Clay slate," - - - - -	0	3	236	6
Dark sand and clay - - - - -	9	6	246	0
Sand and shells - - - - -	4	0	250	0
Pebbles - - - - -	1	6	251	6
Sand - - - - -	7	0	258	6
Red clay - - - - -	12	0	270	6
Clay and sand - - - - -	64	0	334	6
Dark sand - - - - -	30	0	364	6
Chalk - - - - -	} 204 {	88	452	6
Rubble - - - - -		1	453	6
Chalk - - - - -		115	568	6

APPENDIX D

MILWAUKEE ARTESIAN WELL.

The thickness of the several strata met with in sinking this Well, with the localities from which they were obtained.

Depth	Thickness	Description
0	115	Glauk
15	1	Blue
16	1	Dark sand
17	1	Clay and sand
18	1	Thin clay
19	1	Thin clay
20	1	Thin clay
21	1	Thin clay
22	1	Thin clay
23	1	Thin clay
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96	1	Thin clay
97	1	Thin clay
98	1	Thin clay
99	1	Thin clay
100	1	Thin clay