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For Her Majesty's Stationery Office.

SECOND REPORT

OF

THE COMMISSIONERS

APPOINTED TO INQUIRE INTO

THE BEST MEANS OF PREVENTING THE POLLUTION OF RIVERS.

(RIVER LEE.)

VOL. I.

REPORT AND MAP.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED BY GEORGE EDWARD EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
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COMMISSION.

VICTORIA R.

Victoria, by the Grace of God, of the United Kingdom of Great Britain and Ireland, Queen, Defender of the Faith.

To Our trusty and well-beloved Robert Rawlinson, Esquire, John Thornhill Harrison, Esquire, and John Thomas Way, Esquire, greeting.

Whereas We have deemed it expedient for divers good causes and considerations that a Commission should forthwith issue for the purpose of inquiring how far the present use of rivers or running waters in England for the purpose of carrying off the sewage of towns and populous places, and the refuse arising from industrial processes and manufactures, can be prevented without risk to the public health or serious injury to such processes and manufactures, and how far such sewage and refuse can be utilised or got rid of otherwise than by discharge into rivers or running waters, or rendered harmless before reaching them; and also for the purpose of inquiring into the effect on the drainage of lands and inhabited places of obstructions to the natural flow of rivers or streams caused by mills, weirs, locks, and other navigation works, and into the best means of remedying any evils thence arising.

Now know ye, that We, reposing great confidence in your zeal and ability, have authorised and appointed, and do by these Presents authorize and appoint, you, the said Robert Rawlinson, John Thornhill Harrison, and John Thomas Way, to be Our Commissioners for the purposes aforesaid.

And for the better enabling you to form a sound judgment on the Premises, We do hereby authorize and empower you, or any two or more of you, to call before you, or any two or more of you, all such persons as you may judge most competent by reason of their situation, knowledge, or experience, to afford you correct information on the subject of this inquiry.

And it is Our further Will and Pleasure that you, or any two or more of you, do report to Us in writing, under your hands and seals, your several proceedings by virtue of this Our Commission, together with your opinion on the several matters herein submitted for your consideration.

And We Will and Command that this Our Commission shall continue in full force and virtue, and that you, Our Commissioners, or any two or more of you, may from time to time proceed in the execution thereof, although the same be not continued from time to time by adjournment.

And for your assistance in the due execution of this our Commission, We have made choice of Our trusty and well-beloved Godfrey Lushington, Esquire, Barrister-at-Law, to be Secretary to this Our Commission, whose services and assistance We require you to avail yourselves of from time to time, as occasion may require.

Given at Our Court at Saint James's, the Eighteenth day of May 1865, in the Twenty-eighth Year of Our Reign.

By Her Majesty's Command.

(Signed) G. GREY.

Instructions to the Commissioners.

Whitehall, May 30, 1865.

Gentlemen,

Her Majesty having been pleased to appoint you to be Commissioners for Inquiry into the Pollution of Rivers, I am directed by Secretary Sir George Grey to send you the following instructions for your guidance in the proposed inquiry.

Although it may be taken as proved generally that there is a wide-spread and serious pollution of rivers both from town sewage and the refuse of mines and manufactories, and that town sewage may be turned to profitable account as a manure, there is not sufficient evidence to show that any measure absolutely prohibiting the discharge of such refuse into rivers, or absolutely compelling town authorities to carry it on the lands, might not be remedying one evil at the cost of an evil still more serious, in the shape of injury to health and damage to manufactures. It is, therefore, suggested that your inquiry should include selected river basins, illustrating different classes of employment and population; that these river basins might be:—

1st. The Thames Valley—both as an example of an agricultural river basin, with many navigation works, such as locks and weirs and mills affecting the flow of water, and many towns and some manufactories discharging their sewage and refuse into the stream from which is mainly derived the water supply of the metropolis.

2d. The Mersey Valley—including its feeders, particulary the Irwell, as an example of the river basin, most extensively polluted by all forms of manufacturing refuse, particularly that arising from the cotton manufacture and processes connected therewith.

3d. The Aire and Calder Basin, as an additional example of the same class, particularly in connexion with the woollen and iron manufactories.

4th. The Severn Basin, for the same reason, but in particular connexion with the great seats of the iron trade.

5th. The Taff Valley, in connexion with mining and industry applied to metals.

6th. A river Basin comprising a mining district in Cornwall.

Your special points of inquiry should, it is conceived, be in the Thames Valley. 1. The condition of the river as affected by mills, weirs, and locks, and as affecting the drainage of towns and villages and adjacent lands. 2. The condition of the river, as affected both by the discharge of sewage from towns and villages, and the refuse of manufactories, paper mills, &c., and the possibility of intercepting and rendering useful or innocuous these sources of pollution.

As to the other rivers mentioned, the main object of the inquiry should be how far the use or abuse of the rivers is, under present circumstances, essential to the carrying on the industry of these districts? How far by new arrangements the refuse arising from industrial processes in these districts can be kept out of the streams, or rendered harmless before it reaches them, or utilised or got rid of otherwise than by discharge into running waters? In the course of these investigations you will make inquiry into the effect on health and comfort of the existing system of sewage of towns and populous places in the districts examined, and into the best mode of protecting individual and public interests in the purity of running water.

Secondary questions will, no doubt, arise contingent on these leading points, in which case you will include them, as far as it is necessary, within the scope of your inquiry.

I am, &c.

(Signed) H. Waddington.

R. Rawlinson, Esq.,
J. T. Harrison, Esq.,
J. T. Way, Esq.,
Commissioners to inquire into the
Pollution of Rivers.

Letter from H. Waddington, Esq., to the Commissioners appointed to inquire into the Pollution of Rivers.

Whitehall, July 7, 1865.

Gentlemen,

I am directed by Secretary Sir George Grey to transmit to you an extract of a letter from Mr. Charles Neate, and to state that it will be desirable to include in your inquiry into the Pollution of Rivers, the subject of the water supply suggested by Mr. Neate, provided such extension of your inquiry will not materially impede or delay the completion of the primary object of the Commission.

I am, &c.

(Signed) H. Waddington.

The Commissioners appointed to inquire into the Pollution of Rivers,
2, Victoria Street, S.W.

Letter from Charles Neate, Esq., M.P., to the Right Honorable Sir George Grey, Bart., G.C.B., M.P.

House of Commons, June 27, 1865.

Dear Sir,

I beg to submit to you, with reference to the Commission recently issued to inquire into the means of remedying the pollution of rivers, that as the scope of that Commission has already been enlarged beyond its original and professed object, so as to include an inquiry into the drainage of "lands and inhabited places," it would be right to extend the inquiry still further as to include the great question of the water supply.

Even if the drainage referred to in the Commission is that only which is required for sanitary purposes, it may still be a question whether you might not subject the health of the country to far greater danger by wasting too rapidly the winter supply of water than it now is liable to from the temporary dampness of the soil in certain places.

The effect of drainage, even to the extent it has been already carried out for agricultural purposes, is a subject of serious alarm to many people, and I think it is matter of pressing interest to inquire how far the general level of springs in the country has been lowered, how far it depends upon the height at which the water is maintained in the neighbouring river, and what is the number of springs that have altogether failed, or at least that fail during the summer.

I believe it to be a matter of urgent necessity to provide reservoirs of water throughout the country, to be used for all purposes but drinking, and that the spring water should be habitually confined to that use.

If the Commission, as it stands, is intended to apply to agricultural drainage, the reasons for extending the inquiry are more, still more cogent, for then it is no longer a conflict between one sanitary purpose and another, but between the health of the country and some increase in the productiveness of the soil.

I remain, &c.

(Signed) Charles Neate.

The Right Honorable Sir George Grey,
Bart., G.C.B., M.P., &c., &c., &c.

P.S. I think it would be a great point to inquire whether all the surface drainage of towns might not conveniently be kept out of the service and taken into the rivers.

REPORT.

TO THE QUEEN'S MOST EXCELLENT MAJESTY.

We, Your Majesty's Commissioners appointed by Your Majesty's Commission, dated the 18th day of May 1865, to inquire and report as to the pollution of rivers and running waters, and also as to any remedial measures which may be practicable, having on the 29th March 1866 presented our Report on the main stream of the river Thames, proceeded to examine certain rivers and streams in the manufacturing districts of Yorkshire; but, in consequence of representations made to us upon the subject of an outbreak of cholera in the months of July and August 1866 in Poplar and other parts of the district supplied principally by the East London Waterworks Company, which Company derives its water from the river Lee, we thought it advisable to make earlier inquiry into the pollutions of the river Lee than we otherwise should have done. We commenced to make public inquiry on the 10th December 1866, at the Rivers Commission Offices, No. 2, Victoria Street, Westminster, and we continued such inquiry on the 11th and 15th of the same month, and also on the 4th of February 1867. We also, after due notice in the districts, made public inquiry in the towns of

Luton	on	December	12th 1866.
Bishop Stortford		„	14th „
Tottenham		„	18th „
Hertford		„	19th „
Ware		January	16th 1867.

Information has been given to us by the officials and others connected with the River Lee Trust, the New-River Company and the East London Waterworks Company, and by the several local authorities in the towns and places visited, as also by millers, traders, and others. Tabulated returns are appended to the evidence of several witnesses.

In our Instructions, dated 30th May 1865, we are directed to inspect and report, first, on "the Thames valley, both as an example of an agricultural river basin, with many "navigation works, such as locks and weirs, and mills affecting the flow of water, and "many towns and some manufactories discharging their sewage and refuse into the stream "from which is mainly derived the water supply of the metropolis."

The river Lee is one of the northern tributaries of the lower Thames, rising out of springs in Leegrave Marsh, situated in the county of Bedford, and about three miles above the town of Luton. The upper part of the river and its tributaries drain a considerable area of Hertfordshire. From Waltham Abbey to Blackwall the Lee forms the boundary between the counties of Middlesex and Essex. It is tidal from the Thames to Lee Bridge, a distance of about five miles, and is navigable for barges to Hertford, a total distance of 28 miles. The Stort joins the Lee at Feilde's weir, and is navigable for a distance of 13½ miles.

The area of the entire watershed of the Lee is about 500 square miles, or 320,000 statute acres, the dividing ridges to the west, north, and east, ranging from 450 to 300 feet above medium tide level.

The following is a list of the Tributaries from the north, east, and west into the main River, with the Population (as given in the last census) and number of Mills in the basin of the Lee.

	Boroughs, Towns, Parishes, Hamlets.		No. of Mills.
	No.	Population.	
The Lee proper	54	621,102	31
Tributaries north of Lee:			
Mimram	14	10,269	8
Beane	20	13,265	6
Rib and Quin	16	12,374	6
Ash	9	4,638	3
Tributaries east of Lee:			
Stort and Pincey Brook	27	25,064	12
Cobbins Brook	1	2,105	–
Tributaries west of Lee:			
Turkey Street Brook	4	3,106	–
Salmon Brook	9	21,174	–
Moselle	4	19,975	–
	158	733,072	66

Population in the basin of the Lee above point of abstraction (between Hertford and Ware) of the water by the New River Company, exclusive of Hertford, 73,526.

Population in the basin of the Lee above point of intake (at Ponders End) of the water by the East London Waterworks Company 153,030.

The canals which form junctions with the navigable part of the river are:—

Name of Canal.	Point of Junction with Lee.
Lee Union Canal.	Old Ford.
Limehouse Cut.	Bromley.

Towns and Places on the Banks of the River Lee and the Population as given in the last Census.

Borough, Town, Hamlet.	Population.
Leegrave, Beds	426
Luton, Beds	15,329
Wheathampstead, Herts	1,960
Hertford, Herts	6,769
Ware, Herts	5,002
Great Amwell, Herts	1,660
Stanstead Abbotts, Herts	980
Stanstead St. Margaret's, Herts	93
Hoddesdon, Herts	1,898
Broxbourne, Herts	765
Wormley, Herts	572
Cheshunt, Herts	6,592
Waltham, Essex	5,044
Waltham Cross, Herts	2,029
Enfield, Middlesex	12,424
Edmonton, Middlesex	10,930
Chingford, Essex	1,174
Chapel, Essex	370
Tottenham, Middlesex	13,240
Stamford Hill, Middlesex	5,483
Homerton, Middlesex	8,663
Stratford, Essex	15,994
West Ham, Essex	22,337
Old Ford, Middlessx	7,158
Bow, Middlesex	11,590
Bromley, Essex	24,077
Poplar, Middlesex	43,529
	226,088

The geological character of the river Lee basin is shown on a map appended to this Report. From the watershed on the north down to Hoddesdon the area is mostly chalk; from this point southwards towards the Thames the chalk passes beneath the plastic and London clays; in the several valleys the strata are covered by alluvial sand, gravel, and silt. Although the greater portion of the area is described as a natural filter, it is stated in the evidence that out of an average rainfall of 25 inches four-fifths or 20 inches are evaporated. The dry weather flow of the river Lee and its tributaries is described as, for the most part, spring water. The upper portions of the area are seldom flooded; there are, however, heavy floodings in the lower portion. There are also considerable areas of marshy land which arterial and land draining would improve.

The average annual fall of rain is about 25 inches, so that as compared with parts of England on the south and west coasts of Devonshire and Cornwall, or with the northern districts in the neighbourhood of the Solway, where the average fall of rain ranges from 36 up to 60 inches, the climate of the valley of the Lee is comparatively dry.

Mr. Beardmore, Mr. Greaves, and Mr. Muir furnish tabulated returns of local rainfall, which will be found appended to their evidence. It will be seen in these tables that there is considerable variation as to the total volume of rain falling in any one year. An average serves to contrast one district with another district, but taken alone is not a trustworthy guide either for navigation purposes or for water-supply. The test in both cases is the rainfall of the driest years. The wide variation of rainfall is shown in the following extracts from the several tabulated returns.

East London Waterworks.—Mr. Greaves.

Rainfall.

1860.	Total depth from January to December	-	32·558
1864.	Ditto ditto	-	15·891

River Lee Navigation.—Mr. Beardmore.

Feilde's Weir, Herts, 90 feet above sea.

Rainfall.

1852.	Total depth of rain, January to December	-	39·500
1854.	Ditto ditto	-	17·900
1860.	Ditto ditto	-	33·750
1864.	Ditto ditto	-	17·880

New River Waterworks.—Mr. Muir.

Hoddesdon.

Rainfall.

1860.	Total depth of rain, January to December	-	32·358
1864.	Ditto ditto	-	16·405

Enfield.

Rainfall.

1860.	Total depth of rain, January to December	-	37·125
1864.	Ditto ditto	-	18·490

These returns show as regards the valley of the Lee that in a dry year not quite one-half the depth of rain falls as in a wet year; during dry years much less water flows off the surface of the ground, and spring water is very much reduced in volume. The permanent water capacity of the Lee valley must therefore be measured by the *minimum* volume of rain falling on its surface rather than by the average.

Like the river Thames, the river Lee has been navigable from time immemorial; but whilst on the Thames the navigation works had fallen into ruin, through the abstraction of trade by railways and through neglect, on the Lee the weirs, locks, and other works are at this time in better order, the navigation is more efficient, and the trade is greater, than at any former period. The drainage area of the river Lee, as stated previously, is in round numbers about 500 square miles, the area of the Thames, including the Lee, is about 5,000 square miles, so that the relative areas of the two rivers are as nine to one; but the areas from which water is drawn from the Thames and the Lee respectively for the supply of London are as about eight to one. Five great water companies draw water from the Thames for the west and south of the metropolis, and two great water companies abstract water from the Lee for the supply of the eastern and northern parts of the metropolis. The minimum dry weather flow of the Thames at Teddington lock

is about 350,000,000 gallons of water in each 24 hours, the extreme dry weather flow of water down the Lee at Lee Bridge is little above 40,000,000 gallons in each day of 24 hours. About one-half of the population of the metropolis receive their water supply (some 48,000,000 gallons per day) from the Thames, whilst the other half of the population is supplied with about 38,000,000 gallons from the Lee (as distinct from springs in the valley of the Lee), the New River Company supplying a population of 840,000 persons, and the East London Waterworks Company a population of 675,000 persons; the two companies together supplying 1,515,000 persons out of 3,037,991, the entire population within the metropolitan area. In each case the Water Companies possess statutory powers to draw larger volumes of water than those named, but want of pumping power on the Thames and deficiency of water in the Lee during dry periods have limited the daily volume given in each case up to the present time.

In our first report on the Thames we show that pollution is general from the estuary to the highest point of the main stream. The great intercepting sewers of the metropolis intercept sewage from Hammersmith to Barking Creek on the north side, and from Putney to Crossness Point in Erith Marsh on the southern side, where it is passed into the ebbing tide; the Metropolitan Board of Works has entered into arrangements for the utilization of the sewage on the northern side, and are about to make arrangements for utilizing the sewage on the southern side. By an Act (29 & 30 Vict. c. 89) passed in the last session of Parliament, the Conservators of the Thames received powers to prevent pollution on the main stream of the Thames and of its tributaries for three miles on both sides above Staines, and this session the Conservators have before Parliament a supplemental Thames Navigation Bill, to prevent pollution by sewage from the towns of Richmond, Kingston, Surbiton, East and West Moulsey, New Malden, and Hampton Wick. As in the case of the Thames, so in the case of the Lee, we have found, on inquiry, that pollution of the waters by sewage is general. Details as to this pollution are given in a subsequent part of this Report.

The tidal portion of the Lee and the marshes on both sides of the River Thames were embanked at some early period, beyond any known written or reliable history. The oldest works on the river were the lower embankments, and the earliest works above the tidal flow were no doubt connected with the navigation. Milldams would be constructed at an early date to obtain water-power for grinding corn, and rights of fishing may probaby be as old as any other interest on the river. The earliest population would use and pollute the water to some extent; and as no Conservancy Board has ever had jurisdiction over the entire river-basin, all those portions of the river and of its tributaries not required for navigation or for mill purposes remain, for the most part, in a state of nature; that is, neither embanked nor controlled in any useful way; hence the large areas of neglected marsh-land to be found on both sides of the river down to Lee Bridge. The rapid growth of the metropolis during the last half-century has caused a large increase in the population of the lower part of the valley of the Lee; and as no effective means have been taken to prevent pollution, this has also increased with the growth of population and extension of trade and manufactures. Formerly comparatively little of the water was used for domestic purposes; at present, the entire dry weather volume of the river over and above that required for navigation is taken for domestic and trade purposes.

The lower portion of the Lee valley, where the river forms the eastern boundary of the metropolis, is partially occupied by commerce and trade, but by far the largest area of the watershed above Lee Bridge is agricultural. Luton and the district around have the largest straw-plait trade in the world, and malting is extensively carried on in the towns of Ware and Bishop-Stortford, but in each case the manufacture and trade are principally connected with and contingent upon agriculture. There are water mills on the several streams in the area, but principally on the Stort and on the Lee. These mills are chiefly used for grinding flour; some for crushing out oil. Water-power is used at the Government gunpowder mills near Enfield, and also at the Small Arms Manufactory. There is one small paper mill near Luton. All the water mills on the river Lee, between Ware and Lee Bridge (except the Government mills at and near Enfield, and one at Broxbourne), belong either to the river Lee trustees or to the New River and East London Waterworks Companies. The mills situated on the Stort are private property.

Pollution.—In following the course of the river Lee, in order to estimate its pollution, it may be convenient to consider separately:—

1st. The upper district above the intake of the New River Company at Hertford. 2dly. The middle district included between that point and the intake of the East London Waterworks Company at Ponders End. 3rdly. The lower district to the junction with the Thames at Blackwall.

The upper district contains a population of about 73,000.

The Lee begins to be polluted close to its rise and while yet a slender stream. The first great source of pollution is the sewage and manufacturing refuse of Luton; the largest town in the upper valley, numbering now upwards of 20,000 inhabitants. The town is sewered, and most of the houses in it are drained; and there are at present from 1,000 to 1,500 waterclosets in use. As the result of a compromised litigation with a large landed proprietor in the neighbourhood, the sewage and other refuse, before being cast into the river, are clarified by a liming process. The fresh sewage is mixed with a proper proportion of lime, and the semi-fluid after being so treated is passed into tanks of three or four feet in depth, where a separation of the solids and flocculent matters mechanically suspended takes place; the effluent water more or less clarified flows direct into the stream of the Lee, and downwards to the waterworks and navigation. This process of clarifying sewage improves it in so far as the solids are removed, but the fluid remains sewage, and if allowed to stagnate will become putrid and offensive; mixed with a much larger volume of water and continued in motion it seems to become purer as well as more clarified by the effects of the subsoil, air, and light, and after flowing a few miles the water loses a further portion of the sewage ingredients.

The bleaching and dyeing of straw-plait, the manufacture of which is the staple trade of the town, is undoubtedly a source of very considerable pollution of the water of the river Lee. Large quantities of various metallic salts, dye-stuffs, brimstone, and other objectionable and, in some cases, poisonous materials are, after use in the processes of cleansing, bleaching, and dyeing of the goods, discharged into the stream from which water for the domestic use of a large portion of London is drawn. It is true that the substances so finding their way into the river Lee, though large in quantity in the aggregate, are diluted in the much larger volume of water, and that there are natural influences at work which serve greatly to modify their noxious properties. We learn, indeed, with something approaching to dismay in the first instance, that one manufacturer alone employs from one to two tons of oxalic acid in bleaching straw-plaits, but are somewhat re-assured upon consideration that the poisonous character of this substance is entirely destroyed by admixture with the carbonate and sulphate of lime contained in the water of the river. But the answer to this as to other like pleas for pollution of rivers founded upon the counteracting influences of natural causes is, that we ought not to be dependent upon any such fortuitous protection. No justification of the discharge of these refuse-matters into the river can be offered. There is no reason to believe that they would in any way be injurious to vegetation when mixed with sewage, and although it is shown in evidence that the bleaching, and more especially the dyeing, of straw-plait is to a great extent carried out in detail, and on so small a scale as to preclude separate purification of the refuse, there can be no reason why it should not pass into the sewage, and with the sewage on to land.

The town next in importance to Luton is Hatfield, which contains a population of about 4,300. The plan for disposal of the sewage was adopted with a view to its complete exclusion from the river. But it is essentially a "*dumb-well*" system, and the effect must be more or less to pollute the subsoil water, which after passing through the chalk or gravel subsequently finds its way to the river.

Except at Luton and Hatfield, the sewage of the upper district is not dealt with remedially in any manner. Villages and houses situated immediately on the banks of the stream, no doubt pollute the river; thus we were informed that "Whitwell is a place "where privies hang over the water, and in Welwyn the whole of the sewage runs in." To a certain extent also the river is polluted by sheep-washing, which is carried on upon a large scale. The preparation used for dipping sheep contains arsenic; and when sheep come to be washed months after they have been dipped, the poisonous ingredients, it would appear, remain in the wool sufficient to make the water for the time unwholesome for fish to live in. But from the general district (exclusive of towns on the river and tributaries) the pollution is insignificant, the population being chiefly agricultural. Almost all the water falling upon this part of the Lee basin is absorbed or evaporated. The Lee and its tributaries above Hertford are consequently rarely flooded, and but slight abrasion of the surface takes place, so that scarcely any refuse is washed into the streams.

The middle district, lying between the commencement of the New River at Hertford and the intake of the East London Waterworks at Ponders End, comprises a population of 79,000 persons.

Hertford might seem to be more properly placed in the upper district, because it is a short distance above the point of the commencement of the New River, and formerly

its sewers delivered into the Lee above the same point. But by an Act passed in 1854 the New River Company obtained powers to lay down intercepting main sewers through the town; to construct works for treating the sewage by the liming process; and to convey the effluent water past the New River head into the Lee above the town of Ware. The New River Company have completed these sewerage and outlet works at an outlay of about 22,000*l.* and maintain them; they also subject the sewage to a liming process at a further cost of about 700*l.* per annum, sparing neither trouble nor money. The effluent water usually passes away clear, but being, as it is, the sewage of nearly 7,000 persons, it cannot be otherwise than a nuisance, and it is, according to the evidence, a constant cause of complaint to the people of Ware.

Ware, in its turn, in the disposal of its sewage, shows no consideration for towns below. It is a town numbering some 6,000 inhabitants, and its sewers receive the discharge from upwards of 220 waterclosets, as well as household drainage. This sewage, without any liming or other sort of treatment, is passed direct into the river by several outlets, an arrangement which tends to diminish the local nuisance, but does not diminish the total amount of pollution caused to the river. In addition, the authorities of the town of Ware cause putrid refuse from cesspools to be conveyed beyond the town and there thrown into gravel-pits. The soakage from these masses of refuse must in some degree pollute water in adjoining wells, and also the subsoil water which eventually reaches the river.

Below the town of Ware the Lee is joined by the river Stort. In time of flood the Stort brings down large accumulations of sewage and mud from the towns on the banks above. The chief of these is Bishop-Stortford, a town of upwards of 5,000 inhabitants. Drains are general throughout this town, though main sewers have not been laid down on any proper system; these drains receive and discharge into the river the sewage refuse of the streets, houses, and other places, as also the contents of upwards of 300 waterclosets. The effects of this pollution are very sensible at the lower part of the Stort. Mr. Garratt, of Hunsdon-Mill, which is about eight miles below Bishop-Stortford, describes the river as becoming yearly fouler and fouler; every house on the river drains into it; farm-yards also; carcases float on the surface, and the bed becomes silted up with refuse.

At Ware, Bishop-Stortford, and other places on the river Lee and its tributaries, the process of malting barley is largely carried on, and gives rise to a pollution of the streams which is objectionable rather in a local than a general sense. The liquid which results from the steeping of barley to cause it to germinate, is a solution of various vegetable substances, not in themselves injurious, but liable to become offensive by fermentation. The evidence tends to show that this result does frequently occur, and the discharge of the liquid into the rivers is, under any circumstances, to be deprecated. On the other hand this refuse, which is objectionable in the river, would be beneficial to land; and as in most instances the maltsters' operations are carried on in the towns or in close proximity to them, the obvious method of disposal of the steep-liquid is through the sewers on to the land.

Below the junction of the Stort, the towns of Hoddesdon, Broxbourne, Cheshunt, Waltham-Abbey, Waltham-Cross, and Enfield-Highway, discharge sewage into the Lee.

The Lower District commences from the intake of the East London Waterworks Company at Ponders End. From this point the river ceases to be a source of water supply, and becomes, in a great degree, like an open common sewer. At the foot of Tottenham Lock is the outfall of Catchwater-Dyke, an open ditch which the East London Waterworks Company under their Act of 1853 have constructed to intercept the sewage of the towns on the west of the Lee for some miles above the reservoirs of the company, and to discharge it below. From this single outlet the Lee receives the sewage of Enfield, Edmonton, Hornsey, Chipping-Barnet, East-Barnet, and Hadley, in its original condition, unmitigated by any process, except so far as it has undergone oxidation in its course along the open ditch. The outlet itself is very offensive in summer. Immediately below are situated the Tottenham sewage works with an outlet into the river Lee. Tottenham is at present a town of some 16,000 inhabitants, having upwards of 2,000 waterclosets, and a water supply of 400,000 gallons per day. The subsoil and open ditches bring the volume of water discharged from the district up to 700,000 gallons each day. The sewage at Tottenham is limed and the solids precipitated, but the effluent water retains so much sewage matter that the Lee Trustees, as protectors of the navigation, and of the health of those employed upon it, have recently obtained from the Court of Chancery an injunction to prevent the Local Board of Tottenham from casting their sewage into the river, so as to create a nuisance.

Leyton, Leytonstone, and Walthamstowe, from the Essex side add, as stated in the evidence, considerable pollution to the Lee.

West Ham, a large and now populous parish, with four-fifths of its houses provided with waterclosets, throws the whole of its sewage into the receding tidal water of the Lee near to its junction with the Thames. The pumping of this sewage costs the locality at present 1,000*l.* per annum. A large volume of sewage at each low water is also discharged by gravitation; but so foul is the river Lee here that we were told by the engineer to the Local Board that this enormous volume of sewage makes absolutely no visible alteration in the river. It should be stated that the discharge at this point into the Lee of the West Ham sewage, is only a temporary arrangement, and an alteration is now under consideration.

Pollution from sewage and refuse of manufactories, notwithstanding the efforts of the Lee Trustees to prevent it, is much on the increase. Large sums of money are spent in dredging out sewage-mud which has accumulated in the bed of the river. The river at Old Ford is rendered very pestiferous during hot weather from the discharge of impurities from large chemical and other works on the banks. The Limehouse cut in summer is also very foul. The district immediately bordering the tidal portion of the Lee has become a nuisance district, the seat of trades expelled beyond the limits of the better parts of the metropolis.

The evils of this pollution are greatly aggravated by two causes, shortness of fresh water in the river Lee and the action (rising and falling) of the tide. The Water Companies now draw direct from the Lee about 38,000,000 gallons of water daily and in consequence, during the extreme droughts of summer, the volume of the river below the intake of the East London Waterworks Company probably would not much exceed the 5,500,000 gallons to which the Lee Trustees are entitled above Old Ford Lock. Thus whilst the pollutions tend to multiply, the water wherewith they might be diluted tends to fail. At neap tides the river is reduced to a small foul stream, oscillating at the bottom of a muddy creek, and there exposes an area of eight acres of oozy mud and sewage deposit, verging into a state of putridity. During the last two summers the engineer to the Lee Trust has thought it advisable not to open the gates at Bow Locks for the receding tide. The flood tide flows through, bringing up vast quantities of refuse from the Thames and the Lee, and being locked in at Limehouse and Bow, deposits the sewage. Thus the evil is ever accumulating.

Sewage of Towns on the Lee.—The variety of systems now in operation and which have been attempted by towns situated within the Lee basin to get rid of their sewage, shows the difficulty that is experienced in dealing with it.

Luton, Hertford, Enfield, and Tottenham have sewage works. At Enfield the solid part of the sewage is separated and the fluid goes to the river; at the other towns the lime process is adopted. Ware, Bishop-Stortford, Edmonton, and other towns pass sewage into the Lee and its tributaries without any attempt at clarification. The visiting justices at Colney-Hatch tried irrigation by hydrants, but it was considered unsatisfactory, though the crops were reported to be good. The British Land Company tried filtration through burnt gravel at East-Barnet; at present the sewage is passed into dumb-wells, but the attempt to get rid of it in this manner is said to be a failure at both these places. At Hatfield the solid matter is first separated and the liquid is allowed to soak into the chalk. The sewage of Hornsey and Wood-Green passes into the Tottenham ditches, there stagnates and creates a great nuisance; that of Chipping-Barnet produces a similar nuisance at East-Barnet.

Cesspools exist to some extent in every town situated within the area; the contents are usually carted on to the land, but the Board of Health of Ware cart much refuse into gravel-pits beyond the town, where it wastes away in the subsoil on the dumb-well system.

Every plan hitherto adopted is unsatisfactory. The lime process does not purify the sewage even when carried out most carefully by the New River Water Company as at Hertford. The discharge of effluent water from these works and *à fortiori* sewage direct from towns into the Lee and its tributaries should be strictly prohibited. The practice of passing sewage into dumb-wells cannot be justified, it must contaminate water to some extent, though it would be difficult to prove it in many cases. The water percolating to the subsoil of the Lee basin liable to this pollution may be used subsequently for domestic purposes. The nuisances occasioned by passing sewage into open ditches shows that any general prohibition against sewage being carried into rivers or running streams should extend to its discharge into ditches and watercourses of all descriptions, although they may be occasionally dry. Open cesspools too frequently partake of the character of dumb-wells, with this important aggravation that they poison the shallow wells near them instead of the water of deep-seated springs. The mischievous

effects of these cesspools on the health of the inhabitants were clearly proved at Luton, Ware, and Mile End Old Town, and such cesspools should be compulsorily closed.

Closets or privies supplied with dry earth or ashes may be adopted where the water-closet system is not introduced; they should be built at least 10 feet from any house, be properly managed, and frequently cleaned out, under vigilant inspection from the local authorities. When these conditions are complied with, they do not injuriously affect the health of the people.

All nightsoil and sewage should be conveyed rapidly and regularly to the land in some way or other; it is a manure too valuable to be wasted as at present; if allowed to remain and ferment among the persons producing it, it is sure to cause disease; on the other hand, nothing can justify the common practice of merely getting rid of it irrespective of the injury and annoyance it may cause to others.

All main sewers and house-drains should be fully ventilated; at Luton, and other towns where a system of sewerage has been carried out without proper ventilation, sickness has invariably resulted from gases entering the houses.

We have received very conclusive evidence as to the success of waterclosets for the poor where they are properly looked after, as at West-Ham and Mile-End Old-Town.

Litigation.—The Lee exemplifies the evils inevitably entailed by absence of river government. Left without control, towns naturally take advantage of running water to get rid of their sewage, regardless of the fact that the process is simply a transfer of the nuisance from themselves to their neighbours lower down the stream; litigation follows; but litigation besides being expensive and breeding ill-will is unsatisfactory. Courts of law are in fact incompetent to deal with the difficulty, and too frequently the party proceeded against may not possess either the legal power or the pecuniary means to provide by permanent works a good and sufficient remedy. The town authorities of Luton are under a perpetual injunction obtained against them by a wealthy landed proprietor in the neighbourhood, which prohibits them from casting their sewage into the river unless it has been first treated by lime. The people of Luton have carried out the injunction strictly, and have remained safe. The New River Company which, as already stated, subjects the Hertford sewage to the same process, and in a still more careful manner, is nevertheless complained of and threatened with litigation by the authorities of Ware. But in both cases the result is the same; the large sums are annually spent in vain, the effluent water remains to all purposes sewage, and, except to the eye, the Lee receives both from Luton and Hertford almost as much sewage pollution as if that process had never been performed. In point of fact, if a river is really foul, it is safer that it should look so.

The authorities of Bishop Stortford resort to singular operations to deliver themselves from their sewage, which the clerk to the Board of Guardians thus describes:

"The nuisance of which the inhabitants have complained from the smell of the river was during last "summer and the summer before, but it was very much abated in consequence of our having wet seasons, "and a plan was adopted that succeeded remarkably well, and that was this: during the summer, when "the water is very short, the filth will sometimes almost crop up to the mouth of the drains, and when "there has been a flood in the winter this accumulation has been stirred up by a barge and a heavy rake "behind, so that we have passed it on to our neighbours to some extent. We thought we had kept it long "enough, and by use of the flood water relieved ourselves from a considerable quantity of stink by that means."

Bishop Stortford has hitherto escaped litigation, but the same witness informed us,—

"We have been threatened by several parties. Our neighbours at Sawbridgeworth have told us that we "have been poisoning them. We have said that we are sorry for it, but we think that they contribute to the "nuisance to some extent themselves, and we have therefore not heeded what they had to say."

Millers on the same stream are almost obliged to resort to similar practices by way of self-defence. Mr. Garratt, of Hunsdon Mill, who has been much troubled with accumulation of mud, says,—

"I find that other people send the mud to me; and I had a large hoe constructed, and I put four horses to "it, and I sent the mud down again into the navigation. It is cheaper than throwing it out."

The condition of the lower end of the valley, where the population is much denser, and adoption of the watercloset system is more general, is of course much worse. Various towns on the Lee, and local authorities on the outskirts of London, have been or are at litigation one with another. To preserve the purity of Edmonton Brook, Edmonton has obtained an injunction against Enfield, and is applying for an injunction against the Trustees of Colney Hatch Lunatic Asylum. Tottenham last year instituted proceedings against Hornsey for fouling Moselle Stream, but although both the fact of the nuisance and the right of Tottenham to relief were equally undoubted, no relief could be given by the law, because there was no public body at Hornsey to be made amenable. The Lee Trustees a few years ago obtained an injunction against the Metropolitan Board of Works, and 820*l.* damages in respect of injury done to the navigation by discharge of sewage from storm-water outlets belonging to the Board. The Lee Trustees also

recently filed a bill against the authorities of Tottenham, to put an end to the nuisance from their sewage works, and especially to prevent the sewage of Wood-Green and West-Green, which are districts within Tottenham parish, being added to the sewage of the rest of the parish, which is now discharged into the Lee. An injunction with costs has been granted, and the consequence will be that the sewerage works of Wood Green and West Green, which the Tottenham Board of Health have just completed at a cost of 9,000*l.*, will be rendered useless; that the population of the two districts will be condemned to fall back on the noxious system of cesspools, already temporarily made; and lastly, that the overflow from these cesspools will be a nuisance not only to the parish, but also to its neighbours; and so perhaps Tottenham may escape from its litigation with the Lee Trustees only to find itself involved in litigation with Edmonton. The only means of putting an end to this litigation is for the Legislature to prohibit throughout the valley the casting of sewage into flowing water, and to create a Conservancy Board whose duty it shall be to see the prohibition carried into effect.

Sewage can very generally throughout the Lee basin be applied to land without difficulty, by gravitation. When pumping is required, towns may fairly be required to adopt it. The purification of the watershed of the river Lee from sewage may involve separate sewerage systems, and also the application of sewage to land for agricultural uses at several points, as at Dunstable, Luton, Stevenage, Buntingford, Bishop-Stortford, Harlow, and several towns and villages in the lower valley, from Hertford and Ware downwards. Schemes to drain all the towns and villages below Hertford would probably be very costly in the first outlay, because the subsoil is so full of water that large volumes of spring and subsoil water would enter sewers and drains in process of formation. On the other hand, under proper control, this abundance of water would eventually be an advantage, as sewage largely diluted is moved to the outlet more quickly and steadily and in a fresher state than when sewers and subsoil are dryer. Combination of the sewerage of towns situated in the higher or middle districts of the valley would involve large and long expensive culverts, whereas small sewage farms would find a readier market for the produce than large farms removed from the population. In the lower valley it may be difficult or impossible to obtain land for sewage irrigation, and it may be expedient, and it is certainly possible, for such towns as Enfield, Edmonton, Tottenham, and other districts, to combine and carry their sewage by continuous sewers either to the Metropolitan outlet or to land in the lower valley of the Thames.

Application of Sewage for Purposes of Irrigation.—In our Report on the Thames, (pages 12 to 15,) we have described at some length the modes of sewage irrigation as practised at Croydon, Norwood, Worthing, Carlisle, and Edinburgh; we have little to add to this account other than that experience confirms the practice of this mode of disposing of sewage. In the course of our inquiry we have received evidence as to its advantage. At this time, April 18th, there are crops of Italian rye-grass at Worthing grown under sewage irrigation, which are being cut at the rate of from five to eight tons to the acre, whilst adjoining pasture-lands are almost bare. A small dairy has been established, the cows being stall-fed on the cut grass; the milk produced, from its richness and superior quality, commanding a preference in the town. A sewage farm requires special and peculiar management; the operations should be specially adapted to this mode of culture, and then it will be found that any land may be improved. The operations do not turn clay lands into swamps, although 60 inches in depth of sewage are added by irrigation to the rainfall. The dressings with sewage must be even and at regulated intervals. In all cases sewage should be used fresh, that is before putrescence has set in, so as to prevent any effluvium arising from the irrigated land. Where this is the case there cannot be any just grounds for complaint. Where clay lands are irrigated, and the contour of the land will admit of the operation, a second and even a third use of the water may be made with advantage.

Sewage irrigation works cannot be too simple in their character; the application should be by surface carriers, not by underground piping and hose and jet. Land which has been worked in ridge and furrow will require levelling, that is the soil should be stripped or the ground be broken up so as to bring the surface even. Main carriers should be laid in nearly level lines so as to command the area below, and secondary carriers at from half a chain to one chain apart should contour the entire surface. The main carriers may be covered in, having valves or sluice-boards of an inexpensive and simple kind to retain and let out sewage as required. The main carriers will be of brick or of earthenware pipes in size proportioned to the volume of sewage to be distributed. Conduits below 18 inches in diameter may be made most cheaply of earthenware pipes: brickwork may be cheaper for conduits of larger cross-sections. Small carriers may be formed with common agricultural tiles, but jointed and laid only three parts in the soil,

so that one tile or more than one tile can be removed temporarily at any point to allow of surface overflowing at such points when the tiles are removed for this purpose. All ordinary conduits may be open trenches, readily formed by hand labour or by the plough. These subsidiary contour gutters must not necessarily be looked upon as permanent. After one sowing of Italian grass has run its course (this should not exceed two years) these minor conduits may be ploughed up with the rest of the land. Some farmers will probably clean the land by taking a root crop off it, and then lay it down again for a second course of Italian rye-grass, and so on. Proper irrigation and cultivation neither fouls the land nor exhausts it. Where sewage irrigation is the cause of a nuisance it will be found to proceed either from use of old and putrid sewage in large and foul open ditch-like carriers, or from open tanks and large carriers being allowed to become foul.

A sewage farm not only requires a peculiar mode of cultivation, but also special management in dealing with the produce. Tolerably good land under sewage will produce from five to seven crops of Italian grass per annum, weighing in the aggregate when green from 50 to 60 tons per acre. A first cutting at Worthing, in May 1865, was from 20 to 25 tons per acre. The grass is used to the best advantage on the day it is cut and is most profitably applied to stall-feeding dairy cows. With such rapid growth and weight of grass a special market for the produce of the land must be provided to prevent waste, failure, and disappointment; but as milk and butter are a necessity, and as good milk and butter will command a preference in the market, there need not be any difficulty with a sewage farm because of its great productiveness. This has been, however, a complaint made against sewage irrigation in some places—a market did not offer means for immediate sale, the grass spoiled in keeping, and therefore the experiment was pronounced a failure. In course of time sewage farming will become a special business, and when it is found that there is more profit in a sewage farm than in an ordinary farm, the system of sewage irrigation will have been solved. Where there is sewage there must be population. Milk, butter, and beef will therefore necessarily be in proportionate demand; so that, when the true use of sewage is understood, that which is the cause of nuisance by being wasted will be turned to profit on the land.

Floods.—The valleys above Hertford are seldom injuriously flooded, as the chalk subsoil is absorbent, and the gradients are tolerably steep. When floods do occur, the water, though turbid for the time, subsides rapidly and soon becomes clear again. Below Hertford, floods are liable to act injuriously, the water remaining longer on the adjoining marsh lands. Mr. Beardmore stated that heavy floodings had taken place in May 1824, in November 1852, and in October 1857, and that at such times large areas of land were laid under water for several days.

The marsh-lands on both sides of the lower Thames are not subject to such flooding, as the embankments are found to be sufficient to shut out the tides, and the primitive sewers, marsh-ditches, and tidal outlet-sluices regulate the delivery of flood waters so as to prevent injury to land. The marsh districts on both sides of the lower Lee are now subject to the double evil of flooding and droughts; during long continued dry weather the surface cracks until there are fissures several feet in depth. Flood water is passed much more rapidly down the valley of the Lee in consequence of the improvements made of late years in the navigation by dredging the channels. Much, however, remains to be done which would improve the conditions of the marsh-land and the health of the people.

The evidence as to the water-mills proves that in many instances the dams and ponds act injuriously by preventing land drainage and impeding floods. However useful water-power may have been in former times, when these mills were first established, that use has now been greatly reduced in relative value, and, wherever there is sufficient trade to make grinding corn a profitable occupation, steam-power has to be brought in as an auxiliary, the improved navigation and railway accommodation facilitating the delivery of coals so as to give an advantage to steam over the constantly alternating and uncertain flow of water. Water-power having diminished in commercial value, and land for agricultural purposes having greatly increased in value, injury to the adjoining lands may be shown to cause an annual money loss to the district. To this money loss must be added injury to health by the retention of large areas of undrained land. Water-mills and mill-dams are proved to be injurious to local properties, but we have no evidence as to any serious pollutions being caused by these mills, other than so far as they cause a partial stagnation in the water and accumulations of mud by ponding. The rivers are not abused as in the manufacturing districts, by being made the receptacle of solids. Furnace-ashes are too valuable to be so injuriously wasted,

and the River Lee trust is active in preventing abuse and pollution within the extent of its jurisdiction.

Rights of Lee Trust and Water Companies.—The right of appropriation of the water in the Lee is determined by Statute 18 & 19 Vict. c. 196. The general result of these provisions is that the Lee Trust has a paramount right to water required for the purposes of the navigation, and that the remainder of the water is divided between the two Water Companies, practically in equal shares. The priorities are fixed in the following order:—

1. Right of the Lee Trust to pass through their locks,
   - *α.* For the Upper Reach, extending from the highest point where water is drawn by either of the Companies down to and including the first lock above Feilde's weir, a volume of water not exceeding in any 24 hours 576,000 cubic feet.
   - *β.* For the Middle Reach, extending from the first lock above Feilde's weir down to and including Waltham Town lock, a volume not exceeding in any 24 hours 720,000 cubic feet.
   - *γ.* For the Lower Reach, extending from Waltham Town lock down to and including Old Ford lock, a volume not exceeding in any 24 hours 864,000 cubic feet.
2. Right of the Lee Trust to draw such further quantity as shall be necessary, in each pond of the navigation, to maintain the water on a level with the customary head level of that pond.
3. Right of the New River Company to take 2,500 cubic feet a minute.
4. Right of the East London Waterworks Company to take 2,500 cubic feet a minute.
5. Right of each Waterworks Company to take *pari passu* 500 cubic feet a minute.
6. Right of each Company after notice to take *pari passu* any additional quantity.
7. Right of Lee Trust to whole of water below Tottenham mill.

The Lee Trust receives annual payments from each of the two Companies, viz., 1,500*l.* from the New River Company and 2,000*l.* from the East London Waterworks Company.

The New River Company has also contributed 42,000*l.* to the Lee Trust for construction of navigation works.

River Lee Trust.—The navigation of the river Lee, as we have previously stated, is the oldest interest connected with the river. King Alfred is known to have visited Ware by water. Parliament legislated for the Lee in the reign of Queen Elizabeth. The incorporation of the River Lee Trust took place, however, in the session of 1850. On the lower tidal portion from the Thames to Bow Locks, there is a mixed jurisdiction of the Conservators of the Thames, the Essex Sewer Commissioners, and the River Lee Trustees. The total length of the navigable portion, from Blackwall to Hertford, is about 28 miles; the total rise in this distance is 110 feet; there are 20 locks, besides extra locks for flood overflows and minor purposes; up to Enfield the river is deeper and the locks are wider than above—96 feet in length, and 18 feet 6 inches wide—on this part of the navigation barges drawing 6 feet of water and bearing 110 tons can travel. From Enfield to Hertford the locks are also 96 feet in length, some are 16, others only 13 feet wide, and the depth of water is reduced to 4 feet: barges bearing more than 85 tons cannot navigate this upper portion. The oldest locks and weirs were, like those described on the Thames, of a primitive and rude character. Betwixt the years 1770 and 1780, Smeaton improved the navigation, under powers contained in an Act 7 George 3. cap. 57. It was at this period that locks partially constructed of masonry were first introduced. Nearly all these early and comparatively rude works have now been superseded; the existing improved and efficient works having for the most part been designed and executed by Nathaniel Beardmore, Esq., C.E, the present Engineer-in-Chief of the River Lee Navigation.

The navigation is of the utmost importance to the district, as is abundantly shown by its active condition, railway rivalry having failed to injure the river trade as in the case of the upper Thames. We have no hesitation in coming to the conclusion that the navigation of the river Lee must be maintained, as it confers a local value on land, on trade, and on all other property, far greater than the cost of maintaining the existing works. The two great Water Companies, which are now rival claimants for the water, have both come in upon the navigation long subsequent to its establishment

The navigation requires a steady, regulated depth and volume of water, sufficient to supply the locks. The river betwixt lock and lock has in some parts more the character of a canal than the wide open reaches on the upper Thames.

The Lee Trust is an unpaid body, the constitution of which is herein-after described. Particulars as to the state of traffic will be found in the evidence of the Marquis of Salisbury, Mr. Marchant, and Mr. Glass, who are respectively the Chairman, Clerk, and Traffic Manager of the Trust. The Trustees are empowered to raise 230,000*l.* upon the credit of the Trust, of which they have already raised 174,287*l.* The Trust derives its income from tolls, from the annual payments of the water companies, and from the rentals of mills and other property. The whole revenue of the Trust is vested in the Trustees and is applicable to payment of charges and to maintenance of the navigation.

The river Lee Trustees dredge the river, cut weeds, cleanse the channel, and cause floating carcases to be removed from the water—these are seldom, however, seen above Tottenham. There are no rigid rules to prevent or to regulate bathing: the trustees, in fact, act as conservators for the navigable portion of the river as regards its trade only, but not as special conservators for any other purposes. The soil of the bed of the Lee is vested in the Trust, but their legal powers are limited to the navigable portions of the river and to navigation purposes.

Stort Navigation.—The navigation upon the Stort was established in 1769, and is regulated by the provisions of 6 Geo. III. c. 78. The Act empowered the Undertakers to construct the works, and to take certain tolls for the use of the navigation. It also appointed a large number of noblemen and gentlemen as Commissioners, to protect the various interests of land owners, millowners, and others that might be affected. Vacancies amongst the Commissioners were to be filled up by the election of the survivors; the qualification required being the possession of a life interest in land to the amount of 40*l.* per annum, or of personal property to the extent of 800*l.*

The navigation extends from Feilde's Weir near Rye House on the Lee to Stortford, a length of 13½ miles, and is constructed for vessels capable of carrying from 40 to 50 tons each. The annual traffic amounts to about 60,000 tons weight of goods. The navigation has passed into the hands of a private firm, which became entitled to it by foreclosure under a mortgage for 40,000*l.* The body of Commissioners, from the omission to supply the places of defunct members, has become extinct. Great inconvenience ensues. Millers complain of the navigation and the owners of the navigation complain of the millers, and there are no means of redress from the absence of Commissioners authorized to settle such disputes.

The present owners of the navigation have power to dredge, and the expenses of dredging have been greatly increased by sewage thrown into the river at Bishop-Stortford, and at other places. This pollution the owners of the navigation, with their limited statutory rights and in the present condition of the law, are powerless to prevent.

New River Company.—The New River conduit was commenced by Sir Hugh Myddelton in the reign of James I. The source of the New River is in Chadwell springs, but water is now also derived from the River Lee direct, at a point between Hertford and Ware. The drainage area above this point is almost entirely chalk, and in dry seasons the entire volume of water is due to springs. The Chadwell springs vary in volume from 290 to 700 cubic feet per minute. By the River Lee Act of 1855 the volume of water which the company is empowered to take from the Lee is defined, as already explained; this volume has not, however, been taken. The average volume drawn appears to have been about 18,000,000 gallons per diem. The minimum flow at the point of abstraction is stated to be about 27,000,000 gallons. The extent of pollution of the River above the intake of the Company has been already considered under the head of Pollution. Besides the water from Chadwell springs and the river Lee, the New River Company obtain water from wells and borings; one well sunk and bored near the town of Ware has not been used for some time. There are also wells at Amwell Hill, at Cheshunt, and at Hoddesden. There are subsiding reservoirs, 40 acres in extent, at Stoke-Newington, and about 8 acres at Hornsey, or 48 acres in the whole. The engineer, Mr. Muir, stated that the amount of sediment in the water was small, as also that the filtering was simply through sand-filter beds, which have been in use since 1856, situated as under:—

Hornsey	2 acres in extent.
Stoke Newington	5 „
New River Head	2½ „
Total	9½ „

New filter-beds of about two acres in extent are in course of construction. Charcoal-filtration has been tried experimentally, but, supposing it to be practically successful, the Engineer estimated that it would cost the company not less than 94,000*l.* if permanently adopted, and that this would be too great an outlay. The Engineer also stated that the New-River Company have, from all sources, a volume of 35,000,000 gallons per day to rely upon, though they have never delivered any such volume. There are at this date upwards of 112,000 houses supplied by the New River Company, having about 7·5 inhabitants to each house, or a total population, in round numbers, of upwards of 840,000, and the demand for water in the locality is increasing. The greater proportion of these houses have waterclosets. The company supply water by meter; at present there are 720 meters in use which register about 2,300,000 gallons per day. The total volume of water delivered per day in December last for all purposes was 22,500,000, which, deducting 2,300,000 used for trade purposes, leaves 20,200,000 as the domestic supply, or about 24 gallons per head of the entire population, or, including water for trade purposes, about 27 gallons each per day. Out of the total number of 112,000 houses supplied, not more than 1,200 or 1,300 are on the constant system; all the rest are supplied intermittently for about 35 minutes, six days in the week; but a large number of the inferior houses have a supply on Sundays. The time the water is turned on seems, however, in some respects to be left to the discretion of the turncock, who is expected to fill the cisterns of ordinary capacity. Some blocks of houses have cisterns, but in many of the poorer parts there are only tubs, pots, and pans, and if from any cause the tenant is not in the way when the water is on, the supply for that day must be begged or stolen. The Company does not hold itself liable for anything but delivering the water; the means of storing the water from day to day, from Saturday to Monday, must be provided and maintained in efficient order by the landlord or tenant; Mr. Muir, the Engineer to the Company, stated that the present arrangements are of a very wretched character. The Company have laid pipes to the doors of the houses, and yet some landlords will not go to any expense in making provision for laying in and storing water. Although, as is shown, the Company pump and pass into the district a daily volume for domestic uses equal to some 24 gallons per head, man, woman, and child, yet by experiments with model lodging-houses, where a constant supply was given for all requirements, the inhabitants, it was found, did not consume more than about 7 gallons per head. At present the eastern part of the metropolis has a daily volume of water poured in, far more than careful experiments prove to be necessary for all purposes, and yet so wretchedly defective are the landlord's arrangements for storing water, that there is a water famine, and the complaints are constant, very loud, and very angry.

The New River, like some other of our oldest waterworks, at first supplied water through pipes of wood. Stone and earthenware were also used for water distribution in these early days: the first cast-iron pipes had flange-joints; now socket-joints are alone used. Some of the cast-iron pipes first laid have been found after 60 years' use perfectly sound. The mains of the New River Company vary in diameter from 36 inches down to 3 inches.

The length of the New River conduit as originally laid out by Sir Hugh Myddelton was about 38 miles, but by cutting off bends, straightening and improving, it is now not more than 28 miles in length. The cross-sectional area is about 75 square feet, and the velocity about four-tenths of a mile per hour; the fall is not more than 1 in 10,000, and the flow is checked by gates and sluices; the bed of the river-conduit is not pitched with masonry or protected by concrete, but is the natural subsoil, with clay-puddle where required.

The New-River conduit is preserved free from pollution. There are fish in it, and all rights to fish are vested in the Company. The soil of the bed of the conduit is vested in the Company, and in some instances the banks also for some distance on both sides.

The present capital of the Company is 3,000,000*l.* sterling, and a dividend a little over six per cent. is paid.

East London Waterworks Company.—The East London Waterworks Company commenced operations by purchasing two old works, one situated at Shadwell, the other situated at West Ham. In 1807 the first Act was obtained, and in 1809 the works were opened, but on a very small scale; the capital, at the outset, being 120,000*l.*; at present the capital is 1,300,000*l.*, consisting of stock, 975,000*l.* receiving 6 per cent., and shares 325,000*l.* receiving 4½ per cent. The dividends in the first instance did not exceed 2 per cent., and from 1820 to 1822 a suspension of dividends took place. The works, when first established, took water from the open river and within tidal influences at Old

Ford. In 1825-26 application was made to Parliament to remove the intake up to Lee Bridge, from which place the water was brought down in an open conduit, and was stored in open reservoirs at Old Ford, from whence it was then pumped for use. The intake is now at a point not far from Ponders End in the parallel of Stonebridge Lock.

The Company have, in station and reservoir area with other land, about 400 statute acres. On a portion of this land a storage reservoir exists capable of containing about 170,000,000 gallons of water or 8½ days' supply, which can be drawn upon during the time the river water is muddy by reason of floods.

In addition to this reservoir the works at present consist of an open conduit from Enfield to Lee Bridge 1¼ mile long, having a cross-sectional area of 100 feet in which the water flows 20 feet per minute; filter beds 12 acres in extent; pure water basin and pumping establishment at Lee Bridge; a cast-iron conduit of 48 inches diameter, capable of conveying 20,000,000 gallons of filtered water per day from Lee Bridge to Old Ford, where there is a covered reservoir, and additional pumping power. There is also water-power for pumping but not on any large scale. There is steam pumping power equal to 1,100 or 1,200 horse-power requiring about 6,000 tons of Newcastle small coal at 12*s.* 6*d.* per ton per annum. The lift is about 112 feet vertical. There are about 500 miles of cast-iron mains, varying from the conduit of 48 inches down to 3 inches in diameter. By the last returns about 90,000 houses are supplied, which at 7·5 per house gives a population of 675,000. The volume of water is about 20,000,000 gallons per day for all purposes, or upwards of 29 gallons per head, or (exclusive of what is taken for trade purposes) about 18½ gallons per head of the population.

The supply is partly constant, but chiefly intermittent. The Company supply water largely for trade purposes, mostly by meters from mains constantly full. Some houses of the better class and some cottage-houses are also supplied on the constant system direct from the mains. Over the greater portion of the district in dwellings above the class of court-houses the inhabitants have tanks or tubs which are filled each day. The supply becomes in part constant in all cases where the Company can treat with landlords willing to make proper storage arrangements in tanks and cisterns, which may be filled each day. The supply of water to house-property of an inferior class is for the most part intermittent, and only on six days in the week, Sunday not being a day of supply. The water is turned on for about half an hour each day; in many of the courts the apparatus is an open wrought-iron stand pipe of about one inch in diameter having no valve upon it, so that the water flows to waste under whatever local pressure there may be when not actually being caught by some one or other of the inhabitants. This defective and unsatisfactory mode of supply leads to great waste of water even during the short period of half an hour. Also the receptacles, where they exist, are often unfit to store the water. Some tanks are placed over the watercloset and dust-bin, and the open tubs stand in small crowded yards, exposed to any dirt, dust, or atmospheric contamination there may be.

Waterclosets are largely used throughout the entire district. At Christmas, 1865, out of 78,710 houses there were 36,214 having waterclosets supplied with water.

With regard to the quality of the water, the water drawn at Ponders End is not of course so pure as that taken by the New River Company higher up the stream, because the river in its course over the intervening space has received additional impurities from towns and places, as already detailed under the head of pollution, but this difference is greatly diminished by the fact that between Hertford and Ponders End the Lee has been reinforced by a large accession of fresh water from the land springs which break out from the chalk into the bed of the river. The result is, as the analyses show, that the East London Waterworks Company are able to obtain a fair wholesome water. The Company have gone to great expense to improve the water before it passes to their filter-beds, by the construction (under statutory powers) of Catchwater Dyke to intercept sewage of certain towns above the intake, and to deliver it at a point below. In a bill now before Parliament the East London Waterworks Company propose an extension of this system of intercepting sewers.

The process of sand-filtration is conducted successfully, though at some seasons under difficulties. A rapid growth of weeds takes place on the sand of the filter-beds, especially during hot weather in summer. The water, as it is delivered from the mains, is proved by the analyses published by the Registrar-General to be equal in quality to the average of the London waters.

Serious charges, however, have been made that the outbreak of the cholera, which in the months of July and August last year took place in the east end of London, is to be attributed to the water furnished by the Company from its reservoirs at Old Ford,

whence the suffering districts drew their supply. We did not consider it incumbent upon this Commission to institute a medical inquiry into all the particulars of this special case, though the evidence we received incidentally bore upon the subject. Suffice it to say that on the one hand the water supplied by the Company at this period from its Old Ford reservoirs had received an admixture of some unfiltered water drawn from an open and partially abandoned reservoir, and that on the other hand there were several local conditions—the low level of the district, the use of polluted wells, the saturation with sewage of the subsoil, and the excessive accumulation of stagnant sewage in ditches and cuts arising in great measure from the storm overflows of the metropolitan sewerage works—the concurrence of which at that season were calculated to produce cholera. Under these circumstances we do not feel justified in attributing the cholera to any one cause exclusively. But the act of the Company in drawing water from the open reservoir for domestic consumption was unquestionably reprehensible. The Company have now entirely cut off all direct means of communication with this source of supply, and we assume that on no future occasion will this water again be resorted to.

Improvement in Water Supply.—With regard to the capability of the river Lee to meet the increasing demand for water supply in the eastern districts of London, the entire volume of water daily drawn direct from the river Lee amounts to 38,000,000 gallons, the New-River Company drawing upon an average 18,000,000 gallons, and the East London Waterworks Company 20,000,000 gallons. In very dry seasons some difficulty is experienced by the latter Company in obtaining their customary volume. It may therefore be taken that no dependence can be placed upon an increase of the supply from the river without the construction of impounding reservoirs on a much larger scale than those now in existence. The construction of such reservoirs has been a matter considered by the Lee Trust and by the Water Companies. The Marquis of Salisbury explained to the Commission a system of impounding reservoirs designed by the late Mr. Rendel for the Lee basin—two to be constructed on the Lee itself, and others on the Ash, Rib, and the Amwell Marsh—capable of holding some 6,212,500,000 gallons of water, a volume sufficient for 140 days' supply at the present rate of delivery from the Lee. It is questionable whether these chalk valleys can afford sites for reservoirs to hold such large volumes of water, unless great expense were incurred in puddling. In Mr. Muir's opinion it would be very difficult to make large reservoirs above Hertford. Extensive reservoirs might with ease be made below the point where the Lee passes from the chalk on to the London clay. The reservoirs of the East London Company, in which there is storage for 170,000,000 gallons of water, cover 120 acres. But reservoirs to hold the volume of water contemplated by the late Mr. Rendel would probably require an area of 2,000 or 3,000 acres; and though large storage reservoirs may be made available to reserve flood waters, yet if, in dependence upon such a store, a corresponding enlargement were made in the area of supply, then, in the event of several dry years following each other, the continued drought would most probably end in the exhaustion of such store, and consequently in temporary failure.

Another question which naturally presents itself is, whether the water of the Lee valley, when its collection and transmission to the metropolis have been surrounded by all practicable safeguards from pollution, will be of such a quality as to satisfy the reasonable wants of the population.

The various streams which contribute water to the river Lee have their sources at considerable distances from each other and flow through very varying soils. Their general characteristic, however, is that given by the chalk, from which the great bulk of the water is derived. That this is so will be seen by the following analyses taken from the different streams during the present month :—

	1 Lee, above Luton.	2 Lee, at Hyde Bridge, above Wheathampstead.	3 Mimram, above Welwyn.	4 Beane, at Watton.	5 Beane, at Stapleford.	6 Mimram, below Hertingfordbury.	7 Lee, below Hertford.	8 Lee, above Hertford.	9 New River, near Ware.	10 Lee, above Ware.	11 Lee, below Ware.	12 Rib and Quin, near Wades Mill.
Solid Residue in grains per gallon:												
Mineral - -	24·28	19·17	21·11	22·15	21·78	20·92	19·94	19·57	21·60	20·24	21·28	23·13
Organic - -	1·04	1·32	0·88	0·88	0·45	0·85	1·09	0·74	0·48	1·18	0·57	0·81
Total -	25·32	20·49	21·99	23·03	22·23	21·77	21·03	20·31	22·08	21·42	21·85	23·94
Hardness, degrees of Clarke:												
Permanent -	5·7	3·4	2·9	3·6	4·1	4·4	3·7	4·2	3·8	4·7	4·3	4·3
Temporary -	11·9	13·2	12·7	12·0	12·8	12·4	12·3	10·8	12·0	11·1	12·5	13·1
Total - -	17·6	16·5	15·6	15·5	16·9	16·8	16·0	15·0	15·8	15·8	16·9	17·4

(*continued.*)

	13 Rib at Hunsdon Park.	14 Quin, near Braughing.	15 Stort, above Bishop Stortford.	16 Stort, near Spellbrook.	17 Stort, at Harlow Mill.	18 Lee below Wheathampstead	19 Ash, above Waterplace.	20 Lea, navigation above Hoddesdon.	21 Cobbins Brook, near Waltham.	22 Turkey Street Brook at Enfield Wash.	23 Lee, at point of diversion from E. L. W. C.
Solid Residue in grains per gallon:											
Mineral - -	24·43	24·05	24·68	26·40	24·68	20·01	22·96	22·05	29·23	18·09	21·82
Organic - -	1·20	0·91	0·72	1·32	1·37	0·95	2·10	1·25	3·54	2·70	0·97
Total -	25·63	24·96	25·40	27·72	26·05	20·96	25·06	23·30	32·77	20·79	22·79
Hardness, degrees of Clarke:											
Permanent -	3·5	5·5	4·8	4·9	5·4	5·1	4·3	3·8	7·6	7·5	4·4
Temporary -	14·6	12·3	12·2	12·5	10·8	9·9	11·5	12·0	5·7	0·6	10·6
Total -	18·1	17·8	17·0	17·4	16·2	15·0	15·7	15·8	13·0	8·1	15·0

The samples were collected during the week ending the 17th of April, in this year, and analyzed in the Laboratory of the Commission.

In the third line which shows the solid residue in each gallon of the water, if we omit No. 21, which is altogether abnormal and derived from a stream of small importance, we find the figures to range from 20½ grains to 27½. The same is true of the hardness which, omitting numbers 21 and 22, varies from 15 degrees (No. 23.) to 18·1 degrees (No. 13).

The water (No. 22) from Turkey Street brook is only about half the hardness of the rest of the samples. This stream is evidently supplied in great part by surface water, and it is liable to great variations in volume from flood and drought. The samples are (in common with all chalk or limestone waters) reduced in hardness by boiling. The line of figures set down as "temporary hardness" shows to what extent this softening result is obtainable.

The general similarity of composition in all these samples is very striking, the only deviations of any importance being in respect of the quantity of organic matter. The effect of the contamination of the tributaries of the Lee, by impurity from external sources, is exhibited by contrast with the water of the New River, which contains

less than half the organic impurity found in some of the other samples. The New River owes this superiority partly to its being to a great extent derived from springs flowing direct from the chalk, and partly to the fact that the aqueduct by which it is brought to the metropolis is devoted to no other purpose than that of a water carrier, and is most jealously guarded from pollution in its course. It may not be possible to raise to the standard of the New River the quality of the water of the lower Lee, which has received the Ash, Stort, and other tributaries, draining large areas of clay and liable to frequent floodings; but it cannot be doubted that, if proper measures be adopted to protect the river from avoidable pollution, a great improvement in its purity will be secured.

Such a system of protection of the water of the river Thames has already been inaugurated by the Act of last Session. We recommend that similar protection be secured to the water of the river Lee by the early action of Parliament. The question whether a navigation should be allowed to continue a proper conduit for water destined for the Metropolitan supply is one which deserves serious consideration.

Water Supply of Towns in Lee Basin.—Water is abundant throughout the valley of the Lee. Notwithstanding this, however, some of the towns are badly supplied, and sickness is distinctly attributed to the use of well-water polluted by cesspools. At Tottenham, Edmonton, and other towns the mains of the New River and East London Waterworks Companies are accessible, and are to a limited degree used; but some dissatisfaction is felt at the rates charged by the Companies, and at the exclusive right of the Companies to use the water of the Lee.

Conservancy.—Hitherto, the management of the Lee, so far as there has been a management, has been vested in the Lee Trustees; but as before mentioned, the jurisdiction of this corporation is confined to the navigable channel, and it is only as incidental to their duty to protect the navigation that they possess any authority to prevent pollution or to regulate the height of water and other matters. In their hands the undertaking has been a commercial success; the navigation is well maintained and it is a valuable convenience to towns on the banks and to districts inaccessible to railways; also the river improvements have been found beneficial to the health and comfort of the inhabitants of the valley. Abuses by mills, which in the Thames valley cause such disastrous floodings, have in a great measure been controlled in the Lee. Nor have the Trustees, in the exercise of such powers as they possess for the protection of navigation, been remiss in restraining the pollution of the lower part of the river. Altogether they seem to have administered their Trust well. The Trustees, we are assured by their chairman (the Marquis of Salisbury), consider that without any other change beyond an extension of power, they (the Trustees) are as a body competent to undertake the Conservancy of the river basin for all purposes, and would regard with disfavour any proposition to vest the duties in other hands. To this view we are unable to assent. In our opinion the present constitution of the Lee Trust is not fitted for that of a Board of Conservators.

The present constitution of the Lee Trust is fixed by the conjoint operation of several statutes. By the 16th section of 12 Geo. II., c. 32, the Lord Mayor, Aldermen, and Recorder of the city of London, the Parliamentary representatives of the counties of Middlesex, Essex, and Hertford, and of the city of Westminster, and the boroughs of Colchester and Rochester, were declared to be *ex officio* Trustees, and with them numerous other gentlemen were personally associated as trustees. To these the Act 7 Geo. III., c. 51, sec. 1, added more than 100 others, and further increased the list of *ex officio* Trustees by the Comptroller of the works and revenues of London Bridge, the Mayor and Recorder of Hertford, and the Governor, Deputy-Governor, and Treasurer of the New River Company; and by the 72nd and 75th sections it was prescribed that future vacancies should be filled up by election—the electors to be the Trustees themselves, or any seven of them, and the qualification to be that the person elected should be residing in the same county as that wherein the person whose vacancy was being filled up had resided, and further should, in his own right or the right of his wife, be in receipt of rents of landed property to the value of 100*l.* per annum. By 13 & 14 Vict. c. 109, the Trustees were incorporated. The vacancies as they have occurred have not been regularly filled up, and there are now, we are informed, 67 Trustees, including the *ex officio* members.

The interests which demand representation in any body having the government of the River Lee are, the navigation; the riparian owners; the towns on the banks of the different streams; the traders and wharfingers using the river; both the great Water Companies; the water consumers; the proprietors of the Stort Navigation; and lastly, the Central Government, whose presence at a Conservancy Board is essential to a due regard

being paid to the various interests, and especially to the public health. Some of these interests are no doubt sufficiently provided for by the present Trust; but there are others which have no direct means of making their wishes known.

To add to the Lee Trust, numbering as it already does 67 persons, new members to represent the above-mentioned interests, would in our opinion be to add to a body already far too large, and to render it incapable of efficient working. Still more impracticable would it be to have two bodies; to retain the Lee Trust (whether in an independent or surbordinate position) for the exercise of their present function of regulating the navigation, and to create a Conservancy to watch over all the interests of the river except navigation. Unity of management, so desirable in all undertakings, is, in river administration, an absolute condition of success.

We recommend that the Lee Trust cease to exist except for the purpose of providing electors as herein-after mentioned; that their powers, rights, and property be transferred to a Conservancy Board which shall have charge of all the interests connected with the rivers, and that on that Board the Lee Trust be largely represented. The present staff of the Lee Trust should be retained, and thus the Conservancy would be enabled to start on its career with a complement of officers of local knowledge, long experience, and tried ability. The present Chairman of the Lee Trust would preside over the Conservancy Board, and the leading members of the Trust would continue to be associated with him. But the multitude of those who are now but nominal members of the Trust and who have no real concern in the undertaking would be superseded for all purposes except that of being electors, and be replaced by a limited number of active governors. In this way there might be established a good working body, compact in its constitution and adequately representing all the interests of the river basin.

We would propose a body not exceeding 15 in number, composed as under:—

5 Members to represent the navigation (the first five to be the present Chairman of the Lee Trust, with four of the existing Trustees to be elected by the existing body; future vacancies to be filled up by election by Members of Lee Trust.)
1 Member to be nominated by proprietors of Stort navigation.
2 Members to represent the New River Company, viz., the Chairman, Deputy Chairman, or Treasurer, for the time being.
2 Members to represent the East London Waterworks Company.
2 Members to be appointed by the Corporation of the City of London.
1 Member to represent and be chosen by Traders on the Lee and the Stort.
1 Member to be nominated by the Home Office.
1 Member to be nominated by the Board of Trade.

—
15

Provision should be made for members to go out by rotation, at fixed intervals.

The exact proportion which in the establishment of the Conservancy Board should be assigned to the various interests represented is not a matter upon which we lay much stress, it is a matter of detail; other arrangements than the one suggested might answer equally well. We contemplate that the need for a representative of the Stort navigation would shortly cease to exist. The Conservancy should have power to purchase the interest of the firm who now own that navigation. In the meantime that interest should nominate a representative to the Conservancy Board, which, in its turn, would not only succeed to the place of the defunct Commissioners of the Stort, but, for the purpose of protecting the river from pollution and the valley from floodings, would receive powers enabling them to control that navigation.

A Conservancy Board, such as we have indicated, would be equal to its duties, and would command the confidence of the public. The interests of the navigation could not suffer in the hands of such a Board, nor would the position of the bondholders of the Lee Trust be injuriously affected; on the contrary it might be improved if, as in our opinion would be just and politic, they received a first charge upon the funds of the Conservancy from whatever source.

In some respects the suggested change of the constitution of the Lee Trust is analogous to the recent change in the management of the Thames. In the case of both rivers the result will be the same, the substitution of a small governing body for a multitudinous collection of nominal governors, and the consolidation into the hands of a single administration of all the powers requisite to be exercised for any purpose throughout the watershed. But the reason for the change is very different in the two cases; in the case of the Lee the motive for change is not past failure of the existing government, but the necessity of wider action for the future; and therefore it is that the modification which we recommend in the Lee Trust is in the nature not so much of an absorption into a new body, as of an establishment on a stronger basis.

The Conservators should be furnished with complete powers. In addition to maintaining the navigable channel and managing the traffic of the navigation, they should be responsible for the due observance throughout the water-shed of statutory prohibitions against the pollution of water which can reach the river, and for keeping the bed and banks both of the river and the navigation in such a condition as to render the channel a fit carrier of pure water to the metropolis. The Conservators should also superintend the execution of works of arterial drainage in the watershed, and would be a guarantee that such works were carried out properly, and not for the benefit of some districts to the injury of others.

With regard to the funds required to meet the cost of the proposed measures, the Lee Trustees have, strictly speaking, no income, the surplus profits of the navigation which remain after defraying the cost of dredging the bed and maintaining the banks of the navigation being applicable to the reduction of the bonded debt of the Trust. However, it is unnecessary to expect that the expenses entailed upon the Conservators would be considerable. The cost of all works of arterial drainage and of works of improvement of the bed or banks of the river in places where it is not navigable would fall not upon the Conservators but exclusively upon the property benefited, the Conservancy being in fact merely a machinery to assist the co-operation of riparian proprietors, and to prevent the opposition of a few being a bar to the execution of works required for the common good of the district. Each town and village would justly be required to bear the cost of all works for the interception of its own sewage from the river, and for the disposal of it by irrigation or otherwise. The chief additional expense created by the institution of the Conservancy would be the maintenance of a staff to see that throughout the watershed the laws and regulations prohibiting the pollution of running water were strictly observed. This expense would rightly fall upon those most interested in the purity of the river, viz., the metropolitan consumers of water derived from the Lee, and these consumers would be most conveniently reached by the charge being in the first instance thrown upon the Water Companies who supply them. The right which the Companies possess to obtain water from the Lee, in such volume and purity as are now attainable, has been purchased by them at large cost. The New River Company has constructed sewers for Hertford at an outlay of 22,000*l.* and maintains the outlet works at a further cost of 700*l.* per annum: and to the Lee Trust it has contributed 42,000*l.* for navigation works, and makes an annual payment of 1,500*l.* In like manner the East London Waterworks Company has constructed the intercepting sewer, called Catchwater Dyke, to protect its intake, and pays to the Lee Trust 2,000*l.* per annum. But this expenditure of the Companies is no objection to a further charge being laid upon them to secure a new gain. To the consumers of water from the Lee—one half of the population of the metropolis—the purer quality of water which the Lee would yield in consequence of the institution of measures to protect it throughout its course, would far more than compensate for the slight addition made to the water rate, which would be required to meet the expense of such measures. Both the Companies, we were informed by their officers, would be not unwilling to make an equitable contribution for this purpose. In fact the East London Waterworks Company are, as appears by their Bill now before Parliament, proposing to protect their intake by constructing additional intercepting sewers —works the expense of which properly belongs to the towns that require them. We therefore recommend that, to meet the expenses of the conservancy, the profits of the Navigation should be supplemented by a charge upon the Water Companies. In adjusting the proportion in which this charge should be borne between the two Companies, regard should be had to the fact that, as compared with the East London Waterworks Company, the New River Company, although they draw a larger volume of water from the Lee valley, draw a smaller volume from the river itself, and that from a higher point in its course, where it is not liable to the greater part of the pollution which it will be the duty of the Conservancy to prevent.

Conclusions.

We now beg most humbly, in this our Second Report, to lay before Your Majesty the main conclusions to which we have been led by our inquiry:—

That the waters of the river Lee and of its tributaries are polluted by town sewage and also by refuse from manufactures.
That there has been much private litigation in consequence of local nuisances, and that the law in respect of pollution of running water is in an unsatisfactory condition.
That portions of the river may be improved by embankments, and that considerable areas of land require arterial drainage.

That there are milldams which injuriously impede the free flow of water, and cause injury to adjoining lands.

That it is expedient that more stringent measures be adopted to protect from pollution that portion of the Metropolitan water supply which is derived from the Lee.

That a Board of Conservancy is required for the river Lee, the Lee trustees having powers confined to the navigable portion of the river, and only for the protection of the navigation.

That the limit of supply of water from the river Lee, available without the construction of extensive storage reservoirs, has been fully reached.

That much of the water now supplied to the metropolis is wasted owing to the absence of proper means of distribution.

Recommendations.

We humbly submit the following recommendations to Your Majesty:—

That the charge of the entire watershed of the river Lee be vested in a Conservancy Board consisting of 15 members, to be appointed as herein-before mentioned.

That the powers and property of the Lee Trust be transferred to the said Conservancy.

That the Conservators receive powers to purchase the Stort Navigation, with a view to consolidate it with the navigation of the Lee.

That after the lapse of a period to be allowed for alteration of existing arrangements it may be made unlawful for any sewage, unless the same has been passed over land so as to become purified, or for any injurious refuse from manufactures or agriculture, to be cast into the river Lee or into any of its tributaries, and that persons offending in this respect be made liable to penalties to be recovered summarily.

That it be incumbent upon the Conservators to see to the enforcement of the prohibitions that may be established against pollution of the river, and that for this purpose power be given to them to visit and inspect works, and, after due notice, to close the outlets of sewers, drains, and discharge-pipes into the river or its tributaries.

That, in the event of the funds derived from the navigation, together with the annual payments now made by the New River and East London Waterworks Companies, proving insufficient to meet the expenses of measures taken by the Conservators for the protection of the river from pollution, the said Companies be called upon to contribute in equitable proportion such further sum as may be necessary, not exceeding a *maximum* to be fixed by Parliament.

That powers be given to the Conservators to make embankments and to drain and improve marsh lands, and carry out arterial drainage operations, the cost of such improvements to be met by a rate upon the properties so improved.

That the Public Works Loan Commissioners be authorized to make advances to the Conservators upon such security as shall seem sufficient.

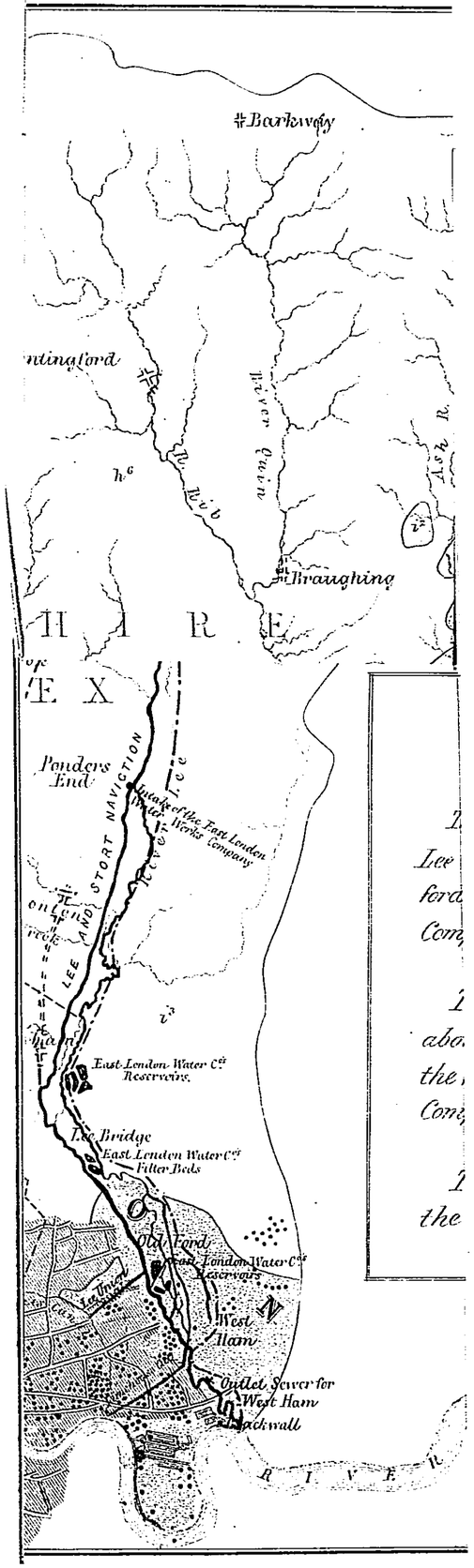
That Legislative measures be passed to render it compulsory upon each Company to supply water upon the "constant system" throughout its district, and upon owners of houses to furnish their houses with proper arrangements to receive such supply.

All which we humbly certify to Your Majesty, under our hands and seals.

(Signed) ROBERT RAWLINSON. (L.S.)
JOHN THORNHILL HARRISON. (L.S.)
J. THOMAS WAY. (L.S.)

Godfrey Lushington,
Secretary.

May 6, 1867.



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our hands and seals.

WLINSON. (L.S.)
RNHILL HARRISON. (L.S.)
WAY. (L.S.)

GEOLOGICAL MAP

OF THE BASIN

OF

THE RIVER LEE

from Greenoughs England

SCALE OF STATUTE MILES

0 1 2 3 4 5

GEOLOGICAL REFERENCE.

London Clay ..... i^3 — Covered with Brick Earth, Red Gravel and Sands on the uplands and Red Surface Clay, Peat, Sandy Clay and from 12 to 20 feet of washed Flint Gravel and Sands in the valley flats

Plastic Clay ..... i^2

Chalk ..... h^e — Covered with Gravel and beds of Fine Sand reposing on the Chalk, the surface being Brick Earth in the Flanks and occasional patches of Drift Clay on the summits

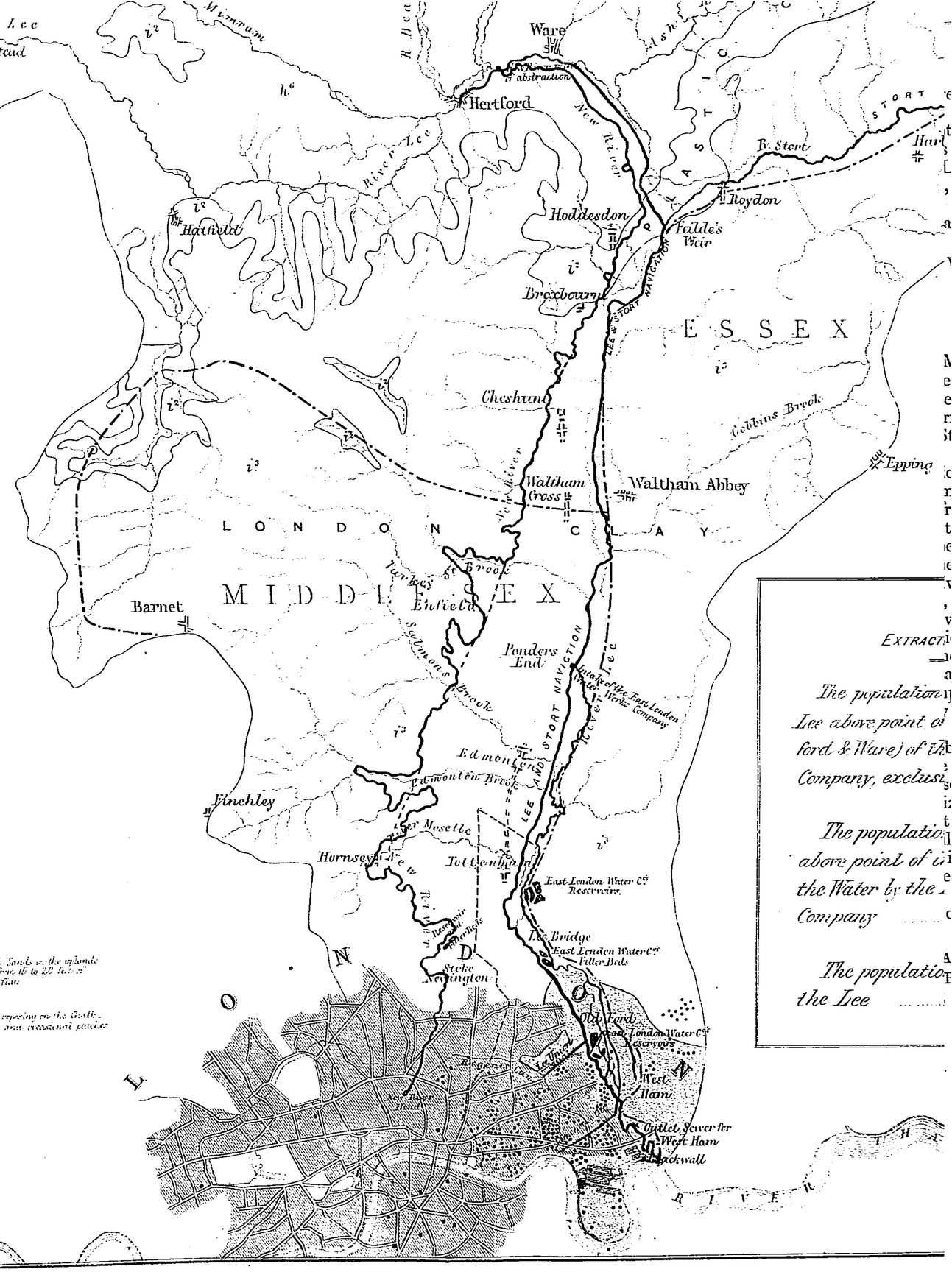
Alluvium .....

Area of Basin about 500 Square miles or about 320,000 Stat: Acres.

Boundary between New River and East London Water Works District _____

County Boundary —·—·—·—·—·—·—·—·—

Note // The black dots(•) shew the distribution of deaths from Cholera in the districts most severly visited from June 27th to July 31st 1854.



MAP

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i^3 Covered with Brick Earth, Red Gravel and Sands on the uplands and Mid. Surface Clay, Peat, Sandy Clay and from 15 to 20 feet of mixed Flint Gravel and Sands in the valley flat.

i^2

h^6 Covered with Gravel and beds of Fine Sand resting on the Chalk - the surface being Brick Earth in the Hamlet and occasional patches of Drift Clay on the summits.

i^1

les or about 320,000 Stat: Acres.

London Water Works District _____

tribution of deaths from Cholera in the
June 27th to July 31st 1866.

River Lee
Wheathampstead
Mimram
Ware
R. Beane
Lea
Sawbridgeworth
Pincey R.
abstraction
Hertford
New River
River Lee
STORT
Harlow
E. Stort
Roydon
Hoddesdon
Folde's Weir
Hatfield
Broxbourne
LEE & STORT NAVIGATION
ESSEX
Cheshunt
Cobbins Brook
Epping
New River
Waltham Cross
Waltham Abbey
LONDON
CLAY
Turkey Brook
MIDDLESEX
Barnet
Enfield
Ponders End
Salmons Brook
Intake of the East London Water Works Company
LEE & STORT NAVIGATION
Edmonton
Edmonton Brook
Finchley
River Moselle
Hornsey
Tottenham
New River
East London Water Co's Reservoirs
Lea Bridge
East London Water Co's Filter Beds
Stoke Newington
LONDON
Old Ford
East London Water Co's Reservoirs
West Ham
Outlet Sewer for West Ham
Blackwall
THAMES
RIVER

EXTRACTED FROM CENSUS TABLES OF 1861.

The population in the Basin of the River Lee above point of abstraction, (between Hertford & Ware) of the Water by the New River Company, exclusive of Hertford, ... 73,520

The population in the Basin of the Lee above point of intake (at Ponders End) of the Water by the East London Water Works Company 153,030

The population in the Entire Basin of the Lee 733,072

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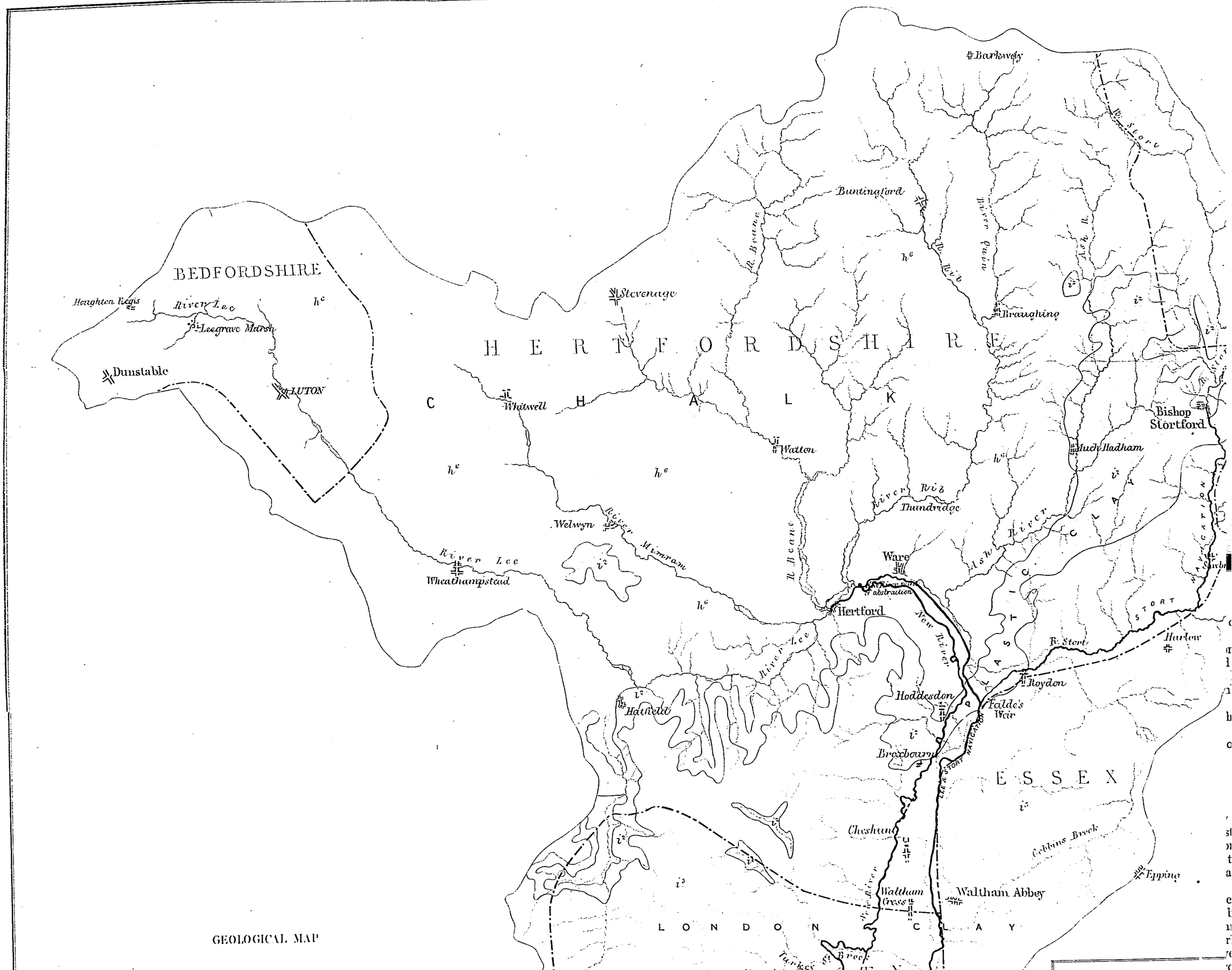

SHIRE

LUTON

HERTFORDSHIRE

CHALK

Barkway

Buntingford

Stevenage

R. Beane

River Rib

River Quin

Braughing

R. Stort

Whitwell

Watton

Bishop Stortford

Much Hadham

River Rib

Thundridge

Welwyn

River Mimram

River Lee

Wheathampstead

Ware

New River

Aqueduct

R. Beane

New River

CLAY

Sawbridgeworth

Pincey Brook

STORT NAVIGATION

Hertford

River Lee

R. Stort

Harlow

Hatfield

Hoddesdon

Roydon

Falde's Weir

Broxbourne

LEE & STORT NAVIGATION

ESSEX

Cheshunt

Gobbins Brook

Epping

New River

Waltham Cross

Waltham Abbey

LONDON CLAY

Turkey Brook

MIDDLESEX

MAP

BASIN

SECOND REPORT

OF

THE COMMISSIONERS

APPOINTED TO INQUIRE INTO

THE BEST MEANS OF PREVENTING THE POLLUTION OF RIVERS.

(RIVER LEE.)

VOL. II.

MINUTES OF EVIDENCE AND INDEX.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED BY GEORGE E. EYRE AND WILLIAM SPOTTISWOODE,
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FOR HER MAJESTY'S STATIONERY OFFICE.

1867.

18034.

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MINUTES OF EVIDENCE

TAKEN BEFORE

THE COMMISSIONERS

APPOINTED TO INQUIRE INTO

THE BEST MEANS OF REMEDYING THE POLLUTION OF RIVERS.

INQUIRY INTO THE STATE OF THE RIVER LEE.

Westminster, Monday, 10th December 1866.

PRESENT:

ROBERT RAWLINSON, ESQ., C.B., IN THE CHAIR.

JOHN THORNHILL HARRISON, ESQ. | Professor JOHN THOMAS WAY.

(*Chairman.*) Gentlemen,—The nature of the evidence which we propose taking is indicated in the following terms:—"Notice is hereby given that the "Rivers Commissioners will hold a public inquiry at "No. 2, Victoria Street, Westminster, on Monday "and Tuesday, December 10th and 11th, relative to "the state of the river Lee and its tributaries. They "will be prepared to receive evidence under the following heads: 1. Pollution by town sewage. 2. "Pollution by other forms of refuse. 3. Nature and "extent of manufactures carried on upon the banks "of the river Lee and streams, and involving the use "or pollution of the water. 4. Cause and extent of "flooding upon adjacent lands. 5. Water supply, "especially as affecting the river Lee and its tributary "streams." Our attention has been specially drawn to the river Lee by letters from the Privy Council Office, enclosing a memorial from a private association formed for inquiring into the defective water supply of the metropolis, and also by an application from the Secretary of the East London Waterworks Company.* If any of the officials of the River Lee Company wish to see the memorial they can do so.

LONDON.

Mr. E. Bates.

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Mr. ELIHU BATES (London) examined.

1. (*Chairman.*) You are secretary to the East London Waterworks Company?—I am.

2. When was that company established?—The bill passed in 1807, and the works were opened in 1809.

3. Do you know what was the extent of the supply in the first instance?—It was very small indeed.

4. Do you know what the capital was then?—The company started by purchasing two other old established works, the Shadwell waterworks at Shadwell, and the West Ham waterworks at West Ham, and entering into the district which had been previously supplied by the New River Company. Our capital I think at the outset was something like 120,000*l.*

5. Then you have increased the capital progressively from time to time?—We have.

6. Up to the present time?—Yes.

7. Do you know what your capital is at present?—If the shares were all paid up (they are nearly so) our capital would consist of 1,300,000*l.*; a small portion of that is not yet paid, but it will be.

8. Did you pay any dividends at the commencement?—Our dividends for a series of years were very small indeed; only two per cent. per annum for a considerable number of years. I am now speaking without book, but to the best of my memory up to the year 1820 the dividends were very small; from 1820 to 1822 a suspension of dividends took place. From that time our dividends have increased, and they are now what may be considered a fair remuneration for the capital employed.

9. What are your present dividends?—Our present dividends on the stock are six per cent. The stock consists of 975,000*l.* out of the 1,300,000*l.* Upon the shares we are paying 4½ per cent. at the present time, which will continue up to 1868, when they will merge into capital the ordinary stock.

10. Have you any power under your Act to recoup yourselves in the first instance for the losses upon the capital embarked?—No special power.

11. Has the loss in the first quarter of this century been considered a dead loss?—Quite so.

12. Then you had no power to consider that in your future dividend?—No, excepting that you may consider that the Waterworks Clauses Consolidation Act enables us to pay back dividends, to make up the dividends to 10 per cent.

13. Have you borrowed any money upon the security of your works?—We owe nothing at the present time. The capital which I have stated is our whole responsibility.

14. And it is all capital upon which you can pay the full dividend?—It is capital upon which we pay the full dividend.

15. Whatever that dividend may be?—Yes.

16. Have you any restriction as to dividend?—Yes, but not in our own Act. I think that the Waterworks Clauses Consolidation Act limits us to 10 per cent.

17. Then if you rise to 10 per cent. you must give extended accommodation, or reduce your rate of charge?—I presume so.

18. Or pay up your back dividends?—Or pay up our back dividends. I am afraid that we are a long way off paying for the past time.

19. Do you know the number of your customers?—About 90,000; we call it 90,000 houses. We give returns monthly to the Registrar-General, which are the true figures as far as we can render them.

20. Of course you know what you supply for domestic purposes and what you supply for trade purposes?—Yes, that is to say we can ascertain the

* Copy of the application will be found printed at the end of he evidence of Mr. Bates, the secretary to the company.

LONDON.

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10 Dec. 1866.

amount for trade purposes and deduct it from the total quantity of water pumped. Our trade supplies are at present almost entirely through meters.

21. For the means of calculating the sums which are due there is a record of the measure by meters?—There is.

22. There is also a record of the sums paid?—Yes.

23. And you also have a record of the purposes to which the water is put in trade?—Yes.

24. Can a return of the supply for domestic and trade purposes be furnished?—Yes, it can for 1865.

25. Do you supply water gratuitously for any public purposes, such as for fires?—For fires, certainly. As a rule we do not supply water gratuitously for public purposes. There are special cases where we write off rates, for instance, a small affair like the Cholera Hospital in Commercial Street; we wrote off the rate there, but it was only an act of grace.

26. As the evidence which we are now taking will no doubt become parliamentary, I think that it would be advisable that you should state as fully as possible any cases where you have written off the rates?—All hospitals and charities we as a rule supply at half-rate, but I cannot say that we give gratuitous supplies, with the exception of fires, not to any great extent.

27. Do you remember at your board any discussions or objections as to the fouling of your water by river pollutions before you receive it?—No, nothing from outside at all.

28. Amongst yourselves have you had any discussions as to the growing pollution by the extension of buildings above your point of abstraction?—Not as a general rule. The only cases in which such a statement has appeared before the board have been from the reports of our own engineer.

29. I suppose that it is notorious to the outside world, and that it must have been notorious to the company, that pollution has been growing up with the growth of the population?—It has been a growing pollution.

30. Do you know the number of points where pollution now passes into the water supply?—I do not.

31. Have you had any complaints by your customers as to the condition of the water, either this year or previously?—Never.

32. Have you a book containing a record of any complaints made?—We have a book in which we enter every complaint which comes, whatever it may be.

33. Would the company, in your opinion, object to giving us a copy of that complaint book for the last 12 months?—Not at all; you may have the book here and see the book itself.

34. How long have you filtered your water; I presume that you did not filter it in the first instance?—We did not filter it until after the Act passed in 1852. We had some thought of filtering it, but the inquiry which was then promoted by the Government led us to postpone further plans until after 1851 or 1852.

35. Previously to that period the water was supplied as it came from the conduit, and was stored in your reservoirs without filtration?—When our bill first passed we took the tidal water at Old Ford. In 1825 or 1826 application was made to Parliament to enable us to take the water at Lee Bridge. It was conveyed from Lee Bridge to Old Ford in an open canal into open reservoirs, where it was allowed to deposit, and it was thence pumped. In 1852 a further Act was passed enabling us to take the water from a higher source and to divert sewage, and to filter and to supply water partly from Lee Bridge, and partly from Old Ford.

36. To divert sewage from where?—To divert the sewage so as to render the river pure from Enfield downwards.

37. Within the last year or two have you contemplated any proposed extensions of your works, either in reservoirs, or in filter beds, or in engine power, or in any other way?—We have constructed additional reservoirs. We are always liable to be called upon for additional engine power. Our district is growing rapidly, and we have a constant necessity to be looking a-head, and to provide for a further supply, so that our thoughts have been continually upon the subject.

38. Have you land enough in your possession now to make your projected improvements?—We have now 120 acres of reservoir, which we had not three or four years ago. We have obtained that additional land under this power, and can obtain 100 acres further.

39. Do you contemplate having a further bill before Parliament?—We intend to have two bills before Parliament.

40. For proposed extensions and alterations?—Yes.

41. Of course, whatever those bills are, they speak for themselves?—Yes. Here are the notices for them (*producing the same*).

42. And whatever powers you obtain will depend upon what you have applied for, and upon what committees of Parliament will grant you?—Certainly.

43. Therefore that must be in the future?—Yes.

44. Can you state to us briefly what are the powers which you are going to seek?—The engineer will be better capable of doing that than I am.

45. Have you had any analysis made of your water, either in former times or recently, which you could furnish to the Commission?—We have had, during the last two or three years, analyses made monthly by Dr. Letheby. Copies of those analyses are quite at the service of the Commission.

46. We shall be very much obliged if you will let us have copies of those analyses?—You shall have them.

47. (*Professor Way.*) These analyses have been for private purposes; they are not published?—Just so.

48. (*Chairman.*) Have any of your directors, or has your engineer made any special inspection of your works and district for any purpose within the last 12 months? You are aware that it has been said that cholera having been rife in the eastern district which you supply it had something to do with the water?—Yes.

49. Are you aware whether your directors, or your engineer, have made any special examination or inquiry thereon?—The engineer must answer for himself. Our directors have not made any special inquiry personally.

50. You are aware that I personally, with Mr. Taylor, made a very complete inspection?—We had two officers from the Privy Council, Dr. Seaton and Dr. Buchanan, who received all the information which we could give them. That was after the outbreak of cholera.

51. That was previous to my investigation?—Yes.

52. And afterwards Dr. Buchanan accompanied me to your board?—Yes.

53. You say, I think, that you are not aware that the directors either made or advised such an inquiry?—They did not instruct any inquiry to be made.

54. Not that you are aware of?—No.

55. Had you any report from your own engineer?—We have had no report from our engineer as to any cause which should have accounted for the outbreak of cholera in our district.

56. Had you any report prepared indicating the character of the works to meet the charges made by the Registrar-General?—The Registrar-General made a mistake in his first statement, and described our works as they originally had been before the alterations in 1852. I myself called the attention of the Registrar-General to it. The engineer likewise called at his office, and pointed out the incorrectness of his statement.

57. Did the Registrar-General admit that he had made an incorrect statement in any of his documents?—Not fully.

58. Did your board ever receive a copy of the report made by myself and Mr. Arnold Taylor?—No.

59. It was not transmitted to you?—No.

60. You did not ask for it?—We have never asked for it.

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61. Did you receive a copy of any report made by Dr. Buchanan and his colleague after their inspection?—None at all.

62. Neither did you ask for it?—Neither did we ask for it. I think that we should have done so if we had known that we could have obtained it by asking.

63. Did it not occur to you that public officers would be required to report?—Yes; but we were never told that the report had been made.

64. If it were in your favour or against you, would it not have been of the utmost importance that you should have known what was said?—We certainly have been very desirous of seeing those reports, whether in our favour or not in our favour.

65. Is there anything which you wish to add to your evidence?—There is nothing further, I think, which I could tell you.

The witness withdrew.

Copy of a Letter from the Secretary to the East London Waterworks Company to the Rivers Commission, referred to in the Chairman's opening remarks (*vide supra*).

East London Waterworks Company,
Office, 16, St. Helen's Place, E.C.

Sir, 22nd October 1866.

I am instructed by the directors of this company to ask the attention of the Rivers Commission to the case of the River Lee, and the best means of preserving it from pollution.

By the River Lee Water Act, 1855, the water of the Lee, subject to making provision for the navigation (which is invested in an incorporated body of trustees), and the annual payments secured to the trustees, and also subject to certain other rights specified in the Act, are transferred to the New River Company and the East London Waterworks Company for their respective use in the supply of water in their respective districts.

The companies have from time to time expended considerable sums in works for preventing sewage and pollution coming into those channels of the river from which they take their supply, but what has been done leaves very important portions of the river and its affluents (and portions in which the East London Company is far more interested than the New River Company) without any adequate protection, whilst the evil is, from the rapid increase of the riparian population, daily on the increase, and the East London Company is powerless in the matter.

The directors of the company are desirous to increase their protective powers in this respect, and are willing to face a considerable expenditure with that object, but they are advised that they may probably fail in obtaining the concession by Parliament of the necessary powers.

It appears to this board that it is peculiarly the province of your Commission to inquire into the case, and especially desirable that Parliament should, in dealing with the subject, have the aid of a report from so experienced an authority as your Commission.

I need scarcely point out that there is scarcely a river in the kingdom of which so large a proportion of the waters is devoted to purposes which call for protection from pollution, nor one in which so important a population as that located in the East London district is exclusively dependent for its supply. The River Lee therefore would seem especially entitled to the early consideration of the Rivers Commission.

In these circumstances I am to express the hope of the directors of this company that the attention of your Commission may immediately be directed to the Lee, in the expectation that the case must appear to you one in which legislative protection analogous to that given in the last session to the Thames, should, in the next session of Parliament, be extended to the Lee and its affluents.

I am to add that every information and aid which the officers of this company can give to the Commissioners will be at their disposal, pending the inquiry and afterwards.

I have, &c.
(Signed) E. Bates,
Secretary.

G. Lushington, Esq.
Secretary of the Rivers Commission,
Victoria Street, Westminster.

Mr. Charles Greaves (London) examined. *Mr.C.Greaves.*

66. (*Chairman.*) How long have you been officially connected with the East London Waterworks Company?—I was appointed their engineer in the latter part of the year 1851.

67. Had you been connected with them previously?—Not at all.

68. Have you been engineer-in-chief for the whole of that time, or did you act under any other engineer in the first instance?—I was appointed engineer-in-chief at that period and have acted so ever since.

69. Who had been the engineer previously to your appointment?—Mr. Thomas Wicksteed.

70. You succeeded Mr. Wicksteed?—Yes.

71. Do you hold any other appointment?—No.

72. Can you state briefly the extent of your works, the points at which you take your water, and the area of ground which you occupy at Old Ford?—The approximate acreage of land property of the East London Waterworks Company held for the purpose of the works at their several stations, viz., Old Ford, Lee Bridge and Walthamstow, and in Tottenham, Edmonton, and Enfield parishes, is four hundred (400) acres.

73. What is the point at which you abstract your water from the river Lee?—The highest point at which we have absolute control of the channels, so as to call them our own, may be said to be Higham Hill or the parallel of Stone Bridge Lock.

74. Whereabouts is that as regards Enfield; is it on the London side of Enfield?—Yes.

75. How much?—Measuring along the valley, about three miles. Measuring along the course of the river itself, it is about four miles.

76. Have you any jurisdiction over the river or its pollutions above that point?—Other works for the diversion of foul water have been constructed, extending to a greater distance from London, and therefore, although we have not jurisdiction, we have influence over the whole of the river from Enfield Mill downwards.

77. You have legal jurisdiction from the point which you have named downwards?—Yes.

78. You have permissive jurisdiction to a certain extent up to Enfield above that point?—Not permissive.

79. Is it by Act of Parliament you have diverted the foul water?—Decidedly.

80. You have legal jurisdiction there?—Undoubtedly, in that sense.

81. Have you any jurisdiction beyond Enfield up the river?—We have no jurisdiction above, except such as might come under the general Acts which are inefficient in such matters.

82. What is the class and character of the works between Enfield and the point where you abstract the water for domestic purposes; is there any intercepting sewer?—Simply an intercepting sewer which discharges itself into the river considerably below the point which I have named as the source of our special channels.

83. In such a manner as not to contaminate your water in any way?—Quite so.

84. How much of the Enfield sewage does that intercept?—The greater part.

85. Anything besides Enfield?—Nothing beyond Enfield northwards, but southwards very largely; the greater portion of the parish of Enfield, the whole of the parish of Edmonton, the whole of the parish of Tottenham, the whole of the parish of Hornsey, and the whole of the two Barnets, and Monken Hadley.

86. To what extent is the Lee a tidal river, as regards the point at which you abstract the water; does the tide influence it at all up there?—No, those

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points are far above the influence of the tide; the utmost extent to which the action of the tide reaches is between Old Ford and Lee Bridge; the ordinary known limit of the tide is at Temple mills, where posts were erected years ago to show the extent of the jurisdiction of the city; the river is considerably ponded above that, but the tide does not flow upwards.

87. Have you at any point of your works any notorious flooding?—The whole of the valley of the Lee is subject to very great floods.

88. Has it been flooded during the last month?—Yes; the floods have only just gone off.

89. Do those floods reach in elevations so as to get into your conduit?—The conduit brings down flood water. The great flood in October 1857, which was one of the heaviest that we ever had, was up to the top of several of our banks, but the streams themselves were all flood watered at the time.

90. Have you any reservoir-room which will enable you to tide over a flood so as to shut out the flood waters and to work without them until the flood subsides?—We have reservoir enough now to enable us to shut out the river for several days.

91. For how many days?—I shut out the river for four days last week. I do not exactly know how far I could go, but I should imagine that I could shut it out for six or seven days if I had occasion to do so.

92. Is the water ever in such a condition that it is advisable to shut it out during flood periods?—It is always advisable to do so when a flood comes on, as a source of economy; it chokes the filter beds so much that it is desirable to shut it out until the river has passed away some of its heaviest suspended matter.

93. Have you sufficient land in your possession to give larger reservoir room so as to shut out the flood water?—I cannot say that we strictly have; we have entered into the purchase of more lands than we have yet made reservoirs upon, but we cannot complete the site for reservoirs without parliamentary power.

94. Will the bills which you have now before Parliament, if they become law, give you a larger area of land which you might use for that purpose?—They will enable me to supply an additional area of about 100 acres.

95. The 100 acres, if turned into water space or reservoir room, will give a very large area of water in proportion?—A very considerable area in proportion to the depth to which reservoirs can be filled.

96. Do you know by inspection the condition of Luton?—Roughly.

97. Does the sewage from Luton go into the river, which water you afterwards take for domestic supply?—Yes.

98. Do you know Bishops Stortford?—Yes.

99. Does the sewage there pass into the river?—Yes.

100. Does the sewage of Hertford also pass into the river?—Yes, the water does, after purification.

101. And the sewage of any other towns above?—There are villages; there are not many large towns. Ware and Waltham Abbey are towns.

102. I assume that you are aware that this Commission proposes to hold a public inquiry at some of these towns forthwith?—I have heard that that is likely to be the case, and I expect that you will do so.

103. Do you think it at all desirable that measures should be adopted, if possible, to prevent the contamination of the waters of the Lee by sewage and foul matters?—Speaking for myself as engineer, and for the company whom I represent, it is a matter of extreme importance that some kind of jurisdiction should be exercised, at as early a period as possible, for the prevention of the discharge of sewage matter into the river, wherever such discharge does ori possible to take place.

103*a*. You have stated that you have certain reservoir room, and you also have filter beds; what is the area of your filter beds?—The filter beds at present in use have 12 acres of sand surface.

104. Do you use the whole of them at one and the same time?—They are all continually in use, with the exception of such as may be under process of cleaning; they are never disused for any other reason.

105. What volume of water do you calculate passes through each square yard of filter bed; what is your mode of calculation for delivery in each 24 hours through your filter bed when it is in good condition?—There is no particular calculation necessary from time to time to ascertain the quantity which is being filtered.

106. But you know what your beds will pass, 1,000 or 2,000 or 3,000 gallons through each square yard or square foot in 24 hours; there is a limit to the capacity of passing water through?—The practical way in which the efficiency or inefficiency of the area of filter bed shows itself is in the depression of the water on the low side. If your filter beds are too small you draw away the water from below because it will not come through fast enough, and it is not desirable to work a filter bed with too much pressure upon it.

107. What is the sectional area of the conduit which brings the water from the river Lee to your filter beds?—The sectional area of the conduit was constructed for 100 square feet; it is filled a little fuller than that measure, and therefore would give an excess on 100 square feet.

108. Of what length is that conduit?—The length of that section is a mile and a quarter.

109. Is the bed of the conduit pitched, or is it the earth of the district?—It is the earth of the district.

110. It is not pitched?—It is not.

111. It is a simple open canal?—Yes, with puddled sides, and formed of the ground at the bottom.

112. Is the puddle so placed that the water has action upon it?—No, the puddle is in the centre of the bank.

113. Is the bed gravel or soil?—It is partly soil.

114. At what velocity do you ordinarily draw the water through that conduit?—The average velocity would be 20 feet a minute.

115. That is about one foot in three seconds?—It varies according to the time of the day, from midnight to midday.

116. Is it a velocity which disturbs the fine particles upon the bottom or the sides, or not?—Far from it; the tendency is to deposit, no abrasion takes place at all from velocity.

116*a*. Do you know what the surface fall is in that mile and a quarter; can you level it?—There is a fall, but it is slight; it would require very nice levelling to ascertain it.

117. How frequently do you find it necessary to clean your filter beds?—Before we constructed settling reservoirs the filter beds required cleansing more frequently than they do now; at present they are cleansed about once in five or six weeks on the average of the year, but the rate of cleansing will depend upon the turbidity of the water and the tendency to vegetate, which differ at different times of the year.

118. According to your experience would your filter beds require more or less cleaning in a wet than in a dry summer?—I should think that a dry summer would create the greatest amount of growth. A balancing of two conditions is not very easy to make; it is a question of degree in each case which one could not be critical about.

119. Is the vegetation which bothers you upon your filter beds more prolific in warm weather or in wet weather?—It is more prolific in hot or warm weather, with a short flow in the river.

120. Do you know the botanical name of the vegetation which so troubles you?—I have not the name of it, we call it "silk weed."

121. What do the navvies call it when they take it off?—They call it "blanket."

122. Did you ever ascertain the weight which you take off at a cleansing?—Never.

123. I assume that it is mixed up with the sand?—Yes; there is very little occasion to take sand off, but

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the shovel, which has to be used for taking off the mud, necessarily brings a certain quantity of sand with it.

124. In cleansing the filter beds, are any fish or fish spawn found entangled with the scrapings?—We find a few fish occasionally; fish spawn I do not know of.

125. Does the river Lee contain fish above the point at which you abstract the water?—At the point at which we abstract the water there are numbers of fish in the river.

126. Have you any grates or screens or apparatus for keeping out fish or floating vegetable matter from the river Lee itself at the point at which you abstract your water?—Yes, there are screens erected in front of the channels by which the filter beds are fed.

127. At the junction of the conduit with the river Lee have you any screens?—No.

128. Then anything which the Lee contains is free to come into the conduit at that point?—Yes.

129. And to be brought down towards your filter beds?—Passing towards the sluices where the river is let in there are always accumulations of weeds which are floating down the river; there are many ways in which the trash coming down the river is diminished before reaching the inlet.

130. If there were any dead dogs or cats, or floating carcases upon the Lee, could they float into your conduit?—Possibly at the upper parts, but they would meet with interruption before they got far.

131. Have you ever seen such refuse brought into your conduit?—I have never seen any dead animal in the channels since the present channels have been made. I do not at the present moment recollect ever seeing one.

132. I suppose that your duties do not frequently take you along that channel?—Frequently; if it were a common thing I should have known of it.

133. But I suppose that the river Lee, like all other open channels, is liable to that form of abuse?—People will go and drown dogs at all points of the river, it is utterly impossible to stop it at all points.

134. Are you aware whether there is much bathing in the river above the point where you abstract your water, or is there any prohibition or any supervision to prevent it?—There is bathing here and there, but I think not to any great extent.

134*a*. Have you any means of preventing any bathing near your conduit or reservoirs?—Our own private conduits are fenced to a certain extent.

135. And I assume that you would prevent it?—Of course anything in the form of bathing would be strictly prohibited.

136. You would exercise the provisions of the Waterworks Clauses Act?—Immediately; or we should carry out absolute prevention by taking care that persons should not come there to bathe.

137. In your filtering operations are you troubled most by the growth of the vegetation, or by the actual deposition of mud which is strained from the water in the filtering process; which of the two things bothers you most, the vegetation or the actual sediment of mud?—I should think that the trouble in the operation is about equal. I have never been able critically to decide between the influences of the two.

138. If that vegetation remained long enough would it become offensive?—Not in the filter beds.

139. Not in the water?—Not in the water.

140. Does it become offensive when it is cleansed out and thrown in a heap?—When it is accumulated and thrown in a heap and remains there for any length of time, if the weather is warm and that heap is broken down for cleansing, there is an odour from it which is excessively disagreeable, but in ordinary weather it is not particularly noticeable.

141. That I suppose you cart away?—The filth which is removed from the sand is carted away.

142. You have twelve acres of filter bed in use and your pure water reservoirs from which you pump; have you any conduit or open reservoirs in which water is stored, or into which you can bring water, which are not regularly in use?—I have reservoirs still in existence which were originally made as depositing reservoirs where the simple water is received from the river; those reservoirs until lately were in a position to be drawn upon in the way which you mention.

143. Are those reservoirs capable of being filled by a conduit or by a pipe, would they be filled by sluices directly connecting with the Lee, or by what means would they be filled?—They were capable of being filled by a sluice connected with a disused canal, a canal which was in use as the company's principal line of conduit previously to the year 1852.

144. And that conduit and those reservoirs exist now?—That conduit and the reservoirs exist at present.

145. Are they now full of water?—They have been absolutely severed.

146. Are they full of water?—One of them is considerably depressed and has been emptied, the other one is not full.

147. Are they now in a position so that you could connect them with your lower pumping engines?—No, not now at all.

148. When where they disconnected?—In the last autumn.

149. Could they have been connected this spring?—One reservoir could have been drawn upon this spring.

150. To your knowledge were they or were they not drawn upon this spring?—A small quantity of water was taken out of one of them.

151. Then the water from one or other of those open reservoirs was drawn upon this spring?—Yes.

152. Can you give us the date?—I have not the date.

152*a*. Was it drawn upon by your order?—Not precisely, but there was an implied sanction.

153. For what purpose was it drawn upon? Was it because you were short of water in your store?—I should think that it was because the foreman thought so.

154. He thought that it required it?—Yes.

155. Would he do it without consulting you?—Yes, if I were not present. I lost my foreman early this year; he died quite suddenly of apoplexy, and I had to appoint a new man, and in giving him discretionary instruction as to how he was to manipulate the water, I described this possibility as something which he must keep in mind, rather than suffer an accident, and so I suppose he may have acted in that sense.

156. Do you know about the date when those reservoirs were last drawn upon? Was it before the outbreak of cholera in the east end of London?—I have not the date. I cannot answer that question now.

157. Do you know whether it was or not before the outbreak of cholera?—You mean the last occasion that they were drawn upon?

158. Yes?—I cannot say.

159. Do you remember the period of my visit?—Quite so; it was I think on the 2nd of August.

160. Have they ever been drawn upon since that visit?—Certainly not.

161. Then it was previous to that visit?—Certainly.

162. I suppose that the cholera had been prevailing a month when I visited you?—Yes.

163. Then the probability is that the reservoirs had been drawn upon previously to that time?—Probably June was the latest date, but I cannot say.

164. You did not think it of sufficient importance to ascertain that fact when that charge was brought against your company of supplying impure water?—I certainly did inquire into it, but I cannot give the date now.

165. At this time you say that it is impossible to connect with those reservoirs?—Yes, we have made a barrier.

166. Have you any power to use that water now, if you thought proper, by sluice or by any other means?—No.

167. If your present lower reservoir, the pure water basin, were pumped dry or were run dry, is there no filtration through the subsoil from the old reservoir works to the pure water basin?—None whatever.

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168. What is the relative level of the bed of the pure water basin as compared with the open basin, is it higher or lower, or about the same level?—It is about the same level; it may be a trifle deeper. The river intervenes between the pure water basin and the open one.

169. Then you do not imagine that any subsoil filtration could affect it?—I do not imagine so.

170. Is the bottom of the reservoir pitched?—The bottom is the ordinary natural bottom covered with gravel.

171. Are there any springs in it?—No.

172. When it is empty are there no ground springs?—No; I do not know that it is absolutely tight.

173. Is it all a gravel subsoil there?—No; the greater part of it is the London clay.

174. Then you would have no springs there?—None whatever in the clay.

175. Would it be difficult to give us about the date of the last communication with this open reservoir?—I will find you an approximate date.

176. And do you think that you could give us about the volume of water pumped or the length of time that you used it?—I could do so.

177. What are those open reservoirs filled from, are they filled from the new conduit or from any other connexion with the Lee?—They were filled in one way by the overflow of filtered water from the special filtered water basins. They were also capable of being filled through the line of the now disused conduit, which was a special conduit up to 1856.

178. Was that conduit capable of taking water at a lower point than the new conduit which supplies the filter beds above?—I suppose that it was capable in a certain sense, because every opening which you have as an outlet may possibly be used as an inlet.

179. Could you take water from the river Lee below the point of discharge of the intercepting sewer at Enfield?—Water could have been let in.

180. At a point below the works which you have for separating the sewage of the places which you have mentioned to us from your upper conduit?—Yes, water could have been let in.

181. Do you know whether it was so let in or not?—I cannot know absolutely; it is impossible to know absolutely, but I have no suspicion that it was.

182. Why did you abandon those old works; that is to say, why did you abandon their use and yet retain them?—They were abandoned because the system of filtration, as a matter of course, put them out of use, then they were not applicable to any other purpose, and I thought myself more justified in keeping them full than I was in emptying them, considering that the question of quantity was at times of such importance; with reference to accidents, that it was advisable to keep reservoirs which were already constructed and which I could not apply to any other purpose, to meet such necessities as might arise.

183. Your company carried out the filter beds, and the new conduit, and the fitering arrangements in compliance with the requirements of an Act of Parliament passed in 1852?—Strictly so.

184. That was your purpose and intention?—That was the course of action.

185. That being so, do you think that it was complying with the spirit of the requirement to keep reservoirs which you could use which could not filter the water, would it not have been advisable in your opinion to have abandoned them entirely and utterly?—Perhaps it would. My judgment at the time was, that it was more advisable to keep them.

186. What is your present engine power?—From 1,100 to 1,200-horse power.

187. Did your company use engine power from the first commencement?—Yes; they never had any other means of distributing water.

188. I thought that perhaps in the first instance they might have distributed it to districts which were within reach of gravitation?—Not at all. The company's position, when established, was, under parliamentary power they were authorized to take water out of the Lee, but they were prevented from taking any water but tidal water.

189. Did they pump by steam, or by water power?—The first power erected at Old Ford was steam power, but by the works which they acquired by purchase also at their first establisment at the West Ham Waterworks, they pumped by water power.

190. Do you retain that water power?—The West Ham Waterworks have been discontinued for 15 or 16 years.

191. Was it a tidal wheel?—Yes, there was a small amount of tidal water power, but it was principally river water power.

192. Do you know what water was consumed in the first year of your operations?—I have rough notes which I have drawn into a series for my own use, but I cannot say that it is known with any precision; the early engineers did not keep any correct records of those things, or if they did, they have been lost.

193. What volume of water do you now pump?—It is now about 20,000,000 gallons.

194. What height do you lift the water?—The average lift may be reckoned as about 111 or 112 feet from Trinity high-water mark.

195. What was the character of the mains first used by your company?—I am not aware that the East London Waterworks Company ever laid any wooden pipes of their own, as a proper work; they had such apparatus at the first, but I imagine that it was for the repair of previous wooden pipes.

196. Then they inherited a system of wooden pipes?—They inherited several lines of wooden pipes which had been laid down by the owners of the Shadwell Waterworks and the owners of the West Ham Waterworks, in previous years.

197. Then your company began to lay cast-iron pipes when they purchased the works?—So I have been informed.

198. Had they flange joints?—Yes, put together with bolts, but with a very small number of bolts, as compared with what we should do now.

199. Have you any of those pipes now in use?—I believe that there are a few on one line of pipes not far from where the West Ham Waterworks were.

200. Have you disused all the wooden pipes?—Yes.

201. What were the first house connexions made with; were they made with lead?—I imagine with lead.

202. What are your present connexions?—With lead; lead is the best.

203. Did you ever try wrought-iron?—Yes.

204. What form of joint do you now use in your mains?—Spigot and socket, and lead for all the larger pipes, and iron rust cement for the smaller pipes.

205. What is your largest diameter of main?—Forty-two inches under pressure.

206. What is the size of the smallest?—The size of the smallest main is an empirical point. I do not generally call anything a main under six inches, but still we have some pipes which are here and there used as mains which are only five inches, but those are exceptional. In making up our account we call all over six inches, mains, and all below that not mains.

207. What length of mains have you?—I cannot answer that question off hand, but I can give you the figures probably up to Christmas 1865.

208. What was it then?—I should think 500 miles altogether, for mains and services.

209. What should you call "services"?—Three inches, four inches, and five inches.

210. By the word "services" you do not mean the communication pipes?—No, I mean iron altogether.

211. Is the report by Mr. Austin to the Board of Health in 1852, correct so far as it goes, as applying to that date?—I think so.

212. And with it there is a plan of the area over which you supply?—That plan is correct.

213. But you have extended within that area your means of supply; you have multiplied your customers?—We have multiplied our customers; we have filled up vacant places; a great many districts then unbuilt upon have since been built upon, and we have spread further into the country.

214. You are now supplying 20,000,000 gallons per day; to what limit could you go; could you supply 30,000,000 or 40,000,000 gallons per day if you had a sale for it?—If I acquired the water I could sell it; I have not the means of supplying 30,000,000 gallons a day at present throughout the year.

215. What volume could you take per day from the Lee with your present means; are you at the extent of it with your 20,000,000 gallons?—No, I am not at the full extent.

216. What would the Lee afford you per day; what would be the probable limit which you could set from the Lee?—There have been times when I have been very short.

217. Even with your present demand?—Yes.

218. Then if London goes on increasing the population must not hope to get very much more from you than you are now giving them?—We benefited our position by the construction of storage reservoirs, of which we had none worth naming at all, until within the last five years; we merely helped ourselves from the river as it flowed, and took things in a state of nature. Any river of such dimensions as the Lee has a great excess of water during a very large portion of the year, and if that water is well stored the supply may be very considerably extended, but without storage and subject to such years as the year 1864, the works are in considerable peril.

219. Will the bills which you are promoting give you additional storage?—An additional 100 acres is covered by one of those bills, and the other bill seeks power to draw 10,000,000 gallons daily from the river Thames.

220. At what point?—Sunbury is the name of the parish where the supply is proposed to be taken out of the river.

221. (*Professor Way.*) Mr. Bates said that you would give us a better account of these bills than he could?—I shall be happy to do so.

222. (*Chairman.*) You propose taking a supply from the Thames above Teddington lock?—Yes, some little distance above the point where the other companies are now taking their supply.

223. If you are met in Parliament by a proposition to bring in water from North Wales, or from anywhere else, upon the plea that you cannot give a sufficient volume, that will be your reply. You are aware that very large schemes for supplying London are talked about?—Yes.

224. And that it has been stated that one of the reasons for those schemes is because a larger supply is required. If you are at the limit with the Lee now in a dry season, and as London has not come to its limit, the question may be asked, where are you to get the additional volume from? and your reply is that you will take 10,000,000 gallons daily from the Thames?—I am proposing to extend our life by helping myself to 10,000,000 gallons daily from the Thames.

225. If you get it?—If I get it.

226. But in the event of your not getting it, would it be possible by works within your reach to get a larger volume from the Lee than you have hitherto got?—I could not execute works which would enable me to make the Lee good for 10,000,000 gallons per day additional, more or less.

227. That is to say in dry weather?—Just so.

228. Probably not by works on your own site, but are there no sites for reservoirs in the upper valley of the Lee?—I do not think that it could be done to the extent of 10,000,000 gallons a day. There are difficulties in the way of finding sites for reservoirs, and suitable soil to make them upon, and suitable rivers to fill them with.

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229. Do you know Dr. Angus Smith's patent for varnishing cast-iron mains?—I am acquainted with it.

230. Have you used it?—Not at all. We do not find any necessity for the use of anything of that sort with pipes for the supply of chalk water, or water at all impregnated with chalk; we find that the chalk water puts an enamel on the pipes inside in a most beautiful manner, and which you can hardly imitate; but as a practice, I have had all the pipes which have been sent out for laying lime washed inside for the last 10 years.

231. Is that common limewash?—Yes.

232. Is it sized at all?—No, it is simply a solution of ordinary chalk lime.

233. It is not Portland, or any hydraulic lime?—No; I find that occasionally the pipes when fresh laid become rusty if not drawn upon by any great number of houses, and that the water becomes quite bad, and I find that whitewashing the pipes inside entirely or almost entirely prevents that.

234. Is your supply at present constant or intermittent?—It is a mixture of both.

235. Which portion is constant?—I cannot answer the question strictly, but I suppose that all the mains from 200 to 220 or 230 miles are permanently charged. All large consumers, trades, and manufactories are supplied from them, and they are all of course on constant supply.

236. As regards that portion which is intermittent, how is the intermittent period regulated? Is the supply regular every day, and if so, at what periods of the day?—It is all worked by book; the supply is daily throughout the whole district, excepting such parts as have a constant supply; every day's work is alike, and the work is performed to strict order by the turncocks, who have charge of the letting on.

237. Is Sunday a day with you?—We do not give a Sunday supply to those houses which are supplied intermittently; we have a large number of domestic houses which are supplied on the constant system in addition to the trades and manufactories which I first mentioned.

238. Did you waive that objection to a Sunday supply, and establish it during the prevalence of cholera?—Yes; we gave a very considerably increased supply on Sundays during the prevalence of cholera, but it was not done at random, but with discretion, where we thought it most required.

239. Where the districts are intermittently supplied, with whom do you treat, with the landlords of the lowest class of houses, or with the tenants?—The lower the class the nearer we like to get to the landlord.

240. How is the mode of supply arranged? Do you supply a cistern or tank, or is it by an open stand pipe?—In some courts the water is laid on house by house.

241. Each separate house having a tap?—Yes, and although it is a court, the water is laid on as if it was a street. There are many courts where the water is laid on with a single stand pipe, which is on the intermittent system; the stand pipe being turned on for a definite length of time. There are many other courts where the water is laid on upon the constant system with an apparatus which enables us to control or to prevent inordinate waste.

242. In the courts where an intermittent supply is given, and where the stand pipe is, say, an inch pipe with a turned neck at the top; is there any control as to the waste from that pipe if persons are not catching the water?—Any account which I could give you would not apply to all the courts; they are in all kinds of states and conditions, bad and worse, but we endeavour to prevent a continuance of such things as standpipes without any power of control at all. I am, however, afraid they do exist.

243. For how many minutes is the supply given, 60 or 90?—It is not nearly so long.

244. You turn the water on for a certain length of time?—Yes; say for about half an hour in the courts.

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245. For whatever length of time the water is on, if there is not an individual catching it, is it necessarily wasting?—Yes, if there is no tap.

246. Are you aware whether there are any cases in which there are no taps?—I think, not many. There may be a few, but these things are in such a fluctuating condition, being repaired and getting out or repair, that it requires the attention of several men to maintain the fittings in anything like a proper state.

247. Are the fittings supplied by your company?—The company themselves supply nothing whatever beyond the iron pipe in the street.

248. Then any person wishing to become a tenant of the company must make application and give notice of his purpose to connect; would he make the connexion himself, or would it be done by your workmen?—We make the connexion ourselves; we do not allow anyone to touch the iron pipes, but the connexion is made by our men with the material belonging to the consumer, and with the apparatus of drills and screws belonging to us, at the expense of the consumer.

249. Do you at all dictate the form of apparatus by which consumers shall draw from your works, whether it shall be an open swan-necked pipe, or whether it shall be a stand-pipe, self-acting, or whether they shall have a cistern, or shall be supplied in any other way?—We regulate more or less precisely the fashion of the laying on of every house, and we record it.

250. I saw those swan-necked pipes of an inch bore in some of the courts running full open, and as long as the water was on, there was nothing to check the waste?—It is very likely. I cannot state how many there are, but it is certain that there must be some, because there is no way of making it otherwise. The robbery of brass taps is so frequent that it is utterly impossible to maintain the presence of them at the end of every pipe in every court.

251. Are all your service taps brass taps?—Yes.

252. Have you seen any of the iron service taps recently made by Mr. Lambert?—Yes, and I think we have tried them; but so far as my judgment goes they are not desirable things to use.

253. Do you know how many fire cocks there are on your mains?—I could furnish you with the number of fire plugs which we have. We have not fire cocks, except for private houses. (*The witness subsequently furnished the information, and it will be found printed at the end of his evidence, Appendix No.* 1.)

254. Are they the old fashioned plugs?—The ordinary wooden plugs.

255. Are they provided by the company?—Yes, at the company's expense.

256. Are the fire police at liberty to attach hose to the main at any point where a fire may occur without application to you or your turncocks?—Quite so; they do what they choose to do, we have no denial; they expect the presence of a turncock, but the police are very careless in giving notice to the turncock of a fire which has broken out. If the turncock is there he is ready to draw the plug or to give assistance.

257. Are either one or other of your works in operation so as to give a high pressure in that respect?—Always.

258. What height would the water rise through a hose from one of the plugs in the centre of your district; would it play to any great height without the intervention of a fire engine?—It would depend upon the time of day or night, and the position, whether it is well placed, and whether it is in the neighbourhood of a considerable pipe, or whether it is up a long series of small courts with small pipes, but 25 or 30 feet is a moderate height.

259. Would your service, without the intervention of a fire engine, give you a hose pressure of 25 or 30 feet?—Generally in most places; in many places a great deal more.

260. Is the hose used upon your services without the intervention of a fire engine?—Constantly. The parish of West Ham very seldom use a fire engine.

261. They have a fire engine, and they have a fire apparatus?—They have, but they put out a great majority of their fires by applying the hose through the use of what is called a dummy direct to the pipe.

262. Have you many dead ends on your branch mains?—A good many I should think.

263. Have you any arrangement for washing them out?—In laying a pipe, if the street is finished and the upper end has not to be extended, we put what we call an end fire plug in the line of pipe, that is, a fire plug near the end, the extreme end is generally capped, and when we think or know that there is any occasion for washing the pipe we discharge water through it into the street.

264. You draw the plug?—Yes.

265. As a rule, do you find the water bright or not in your dead end pipes?—The water is now generally bright, but there are occasions when there is an accumulation of sediment at the dead ends which must be blown out, by washing out. The mains are generally looped together, whenever it is possible, so that parts may be shut down for the purpose of making new connexions without interfering with everything.

266. Have you reason to believe that you have much or little leakage from your mains?—I do not suspect any leakage at all from the mains. I think that the mains are quite tight.

267. Have you any ready means of ascertaining where the leakage is, if there is one?—No; if a leakage takes place into the sewer, it may go on for a length of time without our having any knowledge of it, except the knowledge which we might have of an inordinate increase in the flow, but in 20,000,000 gallons a day that would not show itself.

268. Have you at any point any incrustation in your mains?—No.

269. You never have anything like this (*producing a piece of pipe deeply incrusted*)?—Never. I have never seen anything of that sort from chalk water. I should imagine that that would be a deposit from boiled water, and not from cold water.

270. That is a part of the supply for an ordinary city service, and it has been 38 years in use in the city of Bath?—We have nothing of the sort. I took up several of the pipes of the West Ham service in 1862, which had been there since 1762, and there was not the eighth of an inch incrustation anywhere.

271. Have you bursts occasionally in your mains?—Occasionally.

272. Do you find that bursts take place after a main has been working several years, or is it generally in the first year of its life?—Bursts generally arise from defects in pipes, and therefore may be probably expected to be proved in the first year's use, but bursts sometimes are occasioned by frost, or by weakening occasioned by frost.

273. Are your mains laid at such a depth as to come within the influence of frost?—Yes; when frost is extreme.

274. What is the greatest and least depth of covering for the pipes?—The rule is, two feet above the barrel of the pipe, but there are cases in which it is frequently less.

275. Have frosts touched them at that depth?—Yes; in certain cases. In the last very cold weather which we had, several of the pipes burst. A particularly cold wind in that winter seemed to catch the ground in certain places, and the frost went very deep.

276. Would an open end so as to give a motion to the water in the pipes, be an advantage?—I do not think so.

277. Was there anything to prevent your laying those pipes at a greater depth?—On the average, 2 feet is deep enough. The number of breakages is not great, and the depth at which pipes are laid has to be regulated for the convenience of the consumer's pipes. The expense is generally increased by going to a greater depth, and that has become the depth which we have considered sufficient.

278. Do you know how many gas companies

there are in your area? Is there more than one?—Yes.

279. Are you at all bothered with their pipes interlacing yours?—We have had to grumble and squabble and fight several times with the gas companies on account of the proximity of their pipes.

280. Have you any rule as to the nearness at which water pipes and gas pipes should be laid?—We have clauses in our Act of Parliament which restrict them from coming within a certain distance, and which orders the way in which pipes should be put together so as to escape as much as possible the chances of contamination.

281. Do you use puddle, or cause them to use puddle, if they come near you?—No, we have never done so. Of late years the contaminations which have commonly occurred have been very few indeed, scarcely any.

282. Are you aware that in some parts of the metropolis, if not in yours, the water pipes and the gas pipes literally interlace each other?—I am aware that they do, and I do not see how it can be otherwise.

283. The external surfaces of the pipes are in contact?—I dare say that that is so, but with mains and pipes constantly charged there is not much danger, it is in pipes which are used for a daily supply, that the danger exists.

284. Where the supply is intermittent would there, or not, be danger?—There would be danger. I have heard of gas burning at the mouth of a supply water pipe.

285. Then it forms a gas pipe as well as a water pipe?—Yes.

286. Are you at all troubled with blown joints?—Not much.

287. I suppose you occasionally have a blown joint?—Occasionally, especially if there is an excess of pressure. We have had a little trouble under those circumstances, but with our ordinary pressure, which is by no means an excessive one, we are very well as to joints. I should have to find fault with our pipe laying contractors if we had any frequency of blown joints, but we have not.

288. Do you lay by contract?—Yes; entirely.

289. What depth of lead would you give to a six-inch pipe?—About two inches and a half, or not much less.

290. Do you think that an intermittent supply is more wearing upon joints and pipes than a constant supply, or otherwise?—With our pressure I do not think it makes any difference. There is no stress which need be talked about with a pressure not exceeding 120 feet.

291. Do you supply the whole of your water by means of a stand pipe, or do you ever pump directly into the mains?—It is all pumped directly into the mains.

292. Does not the opening and shutting of the valves affect your engines?—Not in the least. If a maincock in the neighbourhood of the works on the principal line of pipes were opened or shut it would quicken or slow the engines, but such openings and shuttings as those, are done by a man of ours especially employed.

293. Your engines are balanced?—Yes, they are all balanced against a certain height of hydrostatic pressure. They are upon the Cornish principle.

294. Have you safety valves to blow off when the pressure is exceeded?—No.

295. Do you know what number of houses you serve?—The most authentic return is that made to the Registrar-General monthly, in which the number now somewhat exceeds 90,000.

296. Do you know the volume which you supply for trade, and the volume which you supply for domestic purposes?—The volume of water delivered for trade purposes being entirely delivered through meter is known to a nicety.

297. Then you will probably let us have the number of meters, and the volume supplied through them?—Yes.

298. What is your price by meter?—There are three prices.

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299. Is it according to the scale in your last Act of Parliament?—Yes.

300. Does that Act also regulate your domestic supply?—The domestic supply is by a per-centage on the annual value.

301. Is it 5 per cent.?—Yes.

302. Have you a separate supply for waterclosets or soil pans?—There is a separate charge.

303. That is all stated in the schedule?—Yes.

304. A copy of which schedule we can get?—A copy of which schedule we can furnish you with.

305. It will also state whether you make a separate charge for watering gardens, or watering streets, or any purpose of that sort?—Yes.

306. Do you charge for the water supplied for watering streets?—Yes, that is all done by meter.

307. Have you any idea how many waterclosets and soil pans there are in your district?—I have not the precise knowledge, but I have an approximate knowledge of the number of closets which exist in the houses which are supplied.

308. What is that number?—You must allow me to refer to papers for that, because these are not subjects which are often brought forward, and it is a matter of statistical knowledge which can only be furnished by looking particularly into it.

309. We should very much like to have it if you could tell us the number within 1,000?—I do not think that I could give it to you all over the area, but I could select a district vestry or a board of works, and I could tell you how many houses of the total number of houses, within that district, had water supplied to closets, and how many had none, because where there are closets and no water supply, we have not made an account of the closet pans. (*The witness subsequently furnished the information, and it will be found printed at the end of his evidence, Appendix No.* 2.)

310. But if you have 90,000 private consumers you would know whether you have 20,000 or 30,000 waterclosets?—Yes.

311. Would they amount to 40,000?—I should think more.

312. We do not care even to 1,000, but we should very much like you to give the number in round figures?—I will do my best to furnish you with that information. In 78,710 houses situate within the metropolitan district of the company there were, at Christmas 1865, 36,214 having water fittings to the closets.

313. Do you know anything about the sewerage which is carried out in your district? Have you any plan of the main sewers?—I have no plans but the general plans. We have laid down on such maps as we use the lines of the main sewers, but we have never endeavoured to lay down the lines of the smaller sewers on a system generally.

314. You keep, I presume, for your own purposes, separate plans of your own mains?—Precisely, both of the mains and of the services.

315. On what plan are they recorded?—On the 5 feet ordnance plan.

316. Do you use the skeleton ordnance plan, or the other plan?—We use the detailed 5 feet ordnance plan. It requires hundreds of sheets to fill up the whole system of piping, and we keep it posted up as early as possible. I like to correct it every year if it can be done.

317. What meter do you use for sale?—We have been entirely using Siemen's patent.

318. Do you find that it answers to your satisfaction?—I have every confidence in it.

319. In the event of its measuring intermittently would it not measure air as well as water?—If air were blown through it would revolve, and the index would count, but all meters are on constant supply.

320. Then the only time when they would be on intermittent supply would be in the case of repairs

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or of additional services being put on in your district?—Yes, if the main was emptied there would be a possibility of air being blown through the meter.

321. And the parties would have to pay a little extra?—Yes.

322. Do you know the number of meters which you have in use?—I think that is 1,200.

323. How long have you adopted the meter system of supply for private purposes?—I think that we began the meters in 1855.

324. Do you find that system advantageous?—In every way.

325. Is it equally satisfactory to the consumer?—That is rather a difficult question to answer. The consumer wants to get the most which he can for the least money.

326. At all events he is supposed to get what he pays for, and not to pay for more than he gets?—Certainly, and he does not pay for more than he gets; and in the case of any consumer who treats with us on the common ground of honesty we have no difficulty. He admits that the meter is the fairest mode and far more fair than any estimation which can be made by the judgment of an officer.

327. What was the mode of supplying for trade purposes previously to the introduction of the meter?—The duty of estimating the quantity was committed to a special officer whose department included that work and he had to get at a knowledge of it in the best way that he could, and the methods of doing so were most imperfect and most inefficient.

328. Did he apportion the bore of the service to the requirements or was it a mere guess?—In many cases he tried how much was delivered at a house with the pressure and with the sized pipe. In many trades we got into the system of estimating according to the work done. Brewers were supposed to require a certain quantity of water to brew with, and the same with spirit manufacturers. If dyers turned out a certain quantity of goods they were supposed to use a certain quantity of water, and it was the same with all of them formerly more than now. Within certain limits there were the means of knowing what amount of goods they turned out, and a certain quantity of water was allowed to so much work done.

329. Do you now supply water for brewing?—Largely.

330. And for dyeing?—Yes.

331. Where are the dye works situate?—In various parts of the district.

332. What kind of dyeing is it?—I can hardly describe it to you.

333. Is it in connexion with Spitalfields weaving?—Yes, silk dyeing. They are small trades, they are not very large.

334. But you do supply dyers?—There are several dyers on our books.

335. And for condensing purposes for distilling, you supply water?—Yes, very large quantities, and also for condensing purposes, for sugar baking, for the production of vacuum.

336. Do you also supply water for steam engine boilers?—Yes, largely. We supply water for any purposes for which the people can use it, and since the adoption of the meter system, it is of little consequence to us how they use it, or for what.

337. Would it be difficult for you to let us have an approximate list of the different trades for which you supply water; if you have 10, or 15, or 20 trades of the same kind. I do not want to know how many cases there are of each trade, but I want a statement of the kinds of business carried on for which you supply water by meter?—I think that we can give you a pretty near account of it. (*The witness subsequently furnished the information, and it will be found printed at the end of his evidence, Appendix No. 3.*)

338. (*Mr. Harrison.*) We should like to have the quantity of water used for the production of the kind of material?—I do not think that we could do that at all.

339. I thought you said that it was the duty of a special servant to determine the volume of the water used?—That was 10 years ago, but I do not think that those data would be reliable.

340. (*Professor Way.*) I suppose that more water is used in your district for trade purposes than in any other part of London?—No returns since 1852 have been at all minute. We do not know what the quantities used in other districts are, but we imagine that our supply for trade purposes is as large as any.

341. (*Chairman.*) Do you at all supply by meter for domestic purposes?—A few houses.

342. Have you ever made any experiments yourself to test what is the daily consumption for domestic use? If you are told that in a town the domestic supply is 20 gallons per head of the entire population, do you believe that any such volume is legitimately used?—I believe that that is what is used in our district.

343. Used or wasted?—Used or wasted, I believe that it goes to the domestic supply.

344. Did you ever set up any experiments to find out what would be a legitimate use, and what would be an improper use?—Yes, I have investigated the matter a good deal. The experiments which I have made are only such as metering a district and dividing the quantity supplied by meter by the number of houses in the district.

345. What did the result turn out to be in that case?—When we had measured various districts some of them were bad and some were good, some of them gave much more than we ought to be delivering and some of them scarcely gave enough.

346. (*Professor Way.*) In that experiment, I presume, the parties would be paying by meter?—No; it was a meter put in at my own instance to obtain a knowledge on the subject.

347. Did they know that the water was being measured?—In some cases they did. In some cases where the quantity was excessive we had to tell them that they were using a great deal more water than they should use, and their first inquiry was, "How did you know it?" and that found out the experiment.

348. The experiment would have some elements of fallacy?—It is a very difficult thing to know precisely.

349. (*Chairman.*) Whatever the volume of water is, which you use, you may make a rule of three sum of it with regard to the coal you use, the volume representing the coal or the coal representing the volume?—According to the condition in which the engines are; there is a pretty uniform correspondence between the amount of coal and the water.

350. What is your present annual consumption of coal?—About 6,000 tons per annum.

351. What coal do you use?—Entirely small Newcastle coal.

352. Do you find the coal yourself?—No.

353. At what is it laid down at your place?—The present price is 12*s.* 6*d.*, those are the siftings of house coal.

354. What is called slack?—We call it slack, but it is not correctly called slack, because slack in the North means some inferior stuff which comes from the shale.

355. (*Mr. Harrison.*) Is it what in the North is called nuts?—Nuts are too coarse, but we use the fine siftings of Firsts and Seconds.

356. (*Chairman.*) Do you think that 6,000 tons of coal per annum represent the lift of 20,000,000 gallons of water per day 112 feet?—It would go on for a few years correctly, if the engine is not suffering any damage, or has not any great improvement, and I suppose that it would remain pretty uniform.

357. Have you any tabulated record of work done per month, or per cwt., similar to that which is kept by the Cornish engineers?—Yes, I have it for some of the separate engines, and also for the whole power which is in use.

358. Could you let us have an extract from that record showing the results of your own experience?—I think that I could make a table. Taken in the gross it would be mixed up with a certain amount of water power, and it would have in it some steam power doing special work. I could give you an approximate idea on the gross.

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359. Do you ever require to cleanse the open conduit leading down to your filter beds?—Yes, it is desirable to cleanse it frequently.

360. What is taken out of it when it is cleansed?—Deposit mud and growing weed.

361. If it were made into a tunnel and the light shut out, and pitched the whole length, do you think that it would bring down cleaner water?—No, I do not think that it would improve the water at all. Until water is filtered I do not think that it is advisable to enclose or cover up or shut up water. I think that the action of the light and air upon it produces more benefit than detriment.

362. Have you had any experience of enclosing water, and seeing its condition after such enclosure? Have you ever to cleanse or examine the cast-iron conduit which connects your upper filter beds with your lower pure water beds?—No.

363. Have you any ventilation upon that line of pipe?—There is a ventilator at ever furlong.

364. Was it ventilated when you first laid it down?—Yes.

365. Of what diameter is that main?—Four feet.

366. And of what length is it?—Two miles.

367. What fall has the water? What volume can you deliver out of it into your lower pure water basin?—I can deliver 20,000,000 gallons a day in 24 hours.

368. Have you any filter beds at all in connexion with your lower pumping engines?—We have only one system of filter beds, and they are exclusively situated at Lee Bridge.

369. Your twelve acres of filter beds are situated at Lee Bridge?—Yes.

370. Your service reservoirs for a portion of your supply are situated at Old Ford?—Yes.

371. What area of reservoir have you at Old Ford?—The upper surface is two and a half acres. That is when the reservoirs are full.

372. What is the cube in gallons, or in feet?—I have not the figures by me. The form is very irregular.

373. You have no filter beds at Old Ford?—None whatever.

374. The whole of the filtered water must come from the upper filters?—Yes.

375. Then, when you are supplying filtered water it is essentially one and the same water at the upper and at the lower works?—Yes.

376. Have you any division in your services in the district which you supply so that the lower water and the upper water are received separately?—None, except by the force of a self-acting arrangement. The water being pumped into a general district the ends will meet somewhere; there is no division intended.

377. Could you supply the whole of the area through which you give water, from any set of engines, or any engine?—Not properly. It is necessary for the two sets to be working together to supply the district properly.

378. Why?—Because I have not power enough at the upper one to do it to the full elevation, and I have not power enough to do it at the lower one within the 14 hours a day.

379. Supposing that you are not supplying a gallon from your mains, but that you have to pump the water in until it ramifies and fills them as far as it will do so, would any single engine of yours fill the whole of your mains?—I have no doubt that several of them would fill the mains, supposing them to be all shut.

380. Have you any means of supplying your mains by any of your engines separate and distinct from any other engines?—We have no such means or method ordinarily in use. We are well provided with sluices for dividing the mains if necessary, but with the exception of our having two portions at a higher elevation than the others, the mains join each other promiscuously.

381. What engine, or what water supplies those two small elevated districts?—One is at the north end of the parish of Hackney comprising Upper Clapton and Stamford Hill, and I have another in Essex lying beyond Epping Forest. The Stamford Hill district I am able to supply either from Lee Bridge or from Old Ford. The Essex district is exclusively supplied from Old Ford.

382. Then both those high districts are supplied from your lowest pure water basin?—The Lee Bridge water-wheel is now working to Stamford Hill, but for some years past I was entirely supplying Stamford Hill from Old Ford.

383. If water went into your services from the open tanks during the beginning of the year, or before cholera broke out, would it go to the higher districts or to the lower districts?—There is no choice; it would be free to go any way.

384. Is there anything in your mode of supply, so far as you know, which would give a separate water to any separate district?—As to those higher districts, nothing whatever, but as to the lower district a very considerable influence is effected in the following way: For some years past the engines at Lee Bridge, the upper station, have done all the night work. Varying with the season and the condition of the engine, we start the engines at Old Ford earlier or later, but seldom start them later than half-past 5 in the morning, and seldom stop them earlier than 7 or half-past 7 in the evening, and from half-past 7 in the evening till half-past 5 in the morning the supply is entirely produced from the Lee Bridge station, and therefore there is a very considerable difference, taking the way in which your question stood.

385. You are aware that cholera, from whatever cause it comes, did not prevail equally throughout the district which you supplied, but was more intense in some parts than in others?—Yes.

386. So far as your knowledge goes of your own mains and works, was there anything in your mode of water supply to account for that?—Nothing whatever.

387. Was it really the same water, so far as you know, where the cholera was worse and where it did not rage so badly?—Certainly.

388. Was the mode of domestic supply at all different?—Not at all.

389. If the water had anything to do with producing cholera, as far as you are acquainted, the water was the same all through your area?—Yes.

390. (*Professor Way.*) Are you sure that all the water is the same?—Yes.

391. And that it is merely passed from one reservoir into the other?—The lower reservoir is a little further off than the upper one.

392. But the water of it has all gone through the upper one?—Yes.

393. (*Mr. Harrison.*) After filtering the water, you do not let the water come from the upper reservoir at all, except that it goes to the engine and to the pipes?—Yes.

394. Is the water which you pump from the lower station entirely excluded from the light?—The reservoirs are covered over.

395. At Old Ford as well as at Lee Bridge?—Yes, but there is a very small amount of reservoir at Lee Bridge. The Lee Bridge engine may be said to draw almost directly from the filter beds.

396. When you pump from Lee Bridge, in which direction does the main go?—To the west and south-west.

397. When you pump from Old Ford, in which direction does the main go?—The majority of it goes west because the position of the district is west.

398. Would not the water pumped from Lee Bridge and the water pumped from Old Ford have to pass through a considerable length of pipe before they they would meet?—Yes, in any bulk.

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399. Therefore, would not the answer to Mr. Rawlinson's question be that a considerable district must be supplied from the lower reservoir, and another considerable district from the upper one?—It is quite probable that it is so.

400. It is almost certain?—Yes, it is a practical difficulty at certain periods of the day.

401. Was the district where the cholera raged supplied distinctly either from one or other of those two sources?—Yes.

402. From which source was the water supplied to the district where the cholera raged?—Probably from the lower one.

403. (*Chairman.*) Then, if at any time the water was drawn from the open reservoir and the conduit which we have spoken of, it would be supplied to the lower district?—Yes.

404. Then the lower district would feel the effect of it if there was any effect?—Yes.

405. (*Mr. Harrison.*) Do you supply West Ham with water?—Yes.

406. From which source do you supply West Ham?—From the lower source during the day, and the upper source during the night.

407. Did cholera rage much in West Ham?—It was bad there.

408. West Ham is thoroughly sewered, is it not?—Yes.

409. A complete system is carried out?—Yes.

410. And the sewage is taken rapidly away from the whole area?—It flows into Bow creek.

411. Do you know whether in the lower area which you supply there are any private pumps from which water is taken for domestic use?—There are.

412. Are they numerous?—No, I should not call them numerous; they are decreasing.

413. Are they both in West Ham and at the opposite side of the river?—Yes, there are some in the metropolis. West Ham is not a part of the metropolis, and there are several in West Ham.

414. Have you ever had the water from those private supplies analysed?—No.

415. Do you know whether it has been analysed during the cholera?—Yes; it has been analysed from time to time.

416. Lately?—That I do not know.

417. (*Professor Way.*) Have any of those pumps been shut up by authority during the last few months?—I believe several of them.

418. Does Dr. Letheby furnish an analysis of your water every month?—Yes, for our private knowledge and information and justification. (*The witness subsequently furnished an analysis for the years* 1865 *and* 1866, *and it will be found printed at the end of his evidence, Appendix No.* 4.)

419. Does he accompany that analysis with any written report?—A short letter.

420. Stating what the quality of the water is, so far as chemical analysis shows it at that time?—Yes, he gives a distinct analysis of the constituent elements of the contents, but that is not furnished by Dr. Frankland.

421. Does he give with it any comparison of other water supplies in the metropolis?—Not when he sends the report to us.

422. But you have the means of comparison?—We have, but he now reports to an association of medical officers, in which they are all arranged side by side.

423. Within the last few months, that is to say, during the prevalence of cholera in that district, did he make any special report or any special recommendation?—No special recommendation.

424. Was his attention as medical officer and as analyst called in any particular way by your board to the condition of the water?—He analysed some samples for us during the prevalence of cholera, which otherwise would not have been sent to him.

425. With the view of ascertaining whether there was any real ground of complaint of the nature of the water?—Yes

426. What was his report upon that subject?—The water turned out very good upon the analysis. It gave the ordinary result.

427. That was a special report separately from his ordinary monthly report?—Yes.

428. Did he make any remarks in that report?—I think not. I do not recollect any, except that the remark was that the water was a very good water, or some such remark as that, that there was no difference in the analysis.

429. Can you let us have a copy of that report with the other analysis which have been promised to us?—Yes. (*The analysis was subsequently furnished by the witness, and will be found printed at the end of his evidence, Appendix No.* 5.)

430. Do you know whether Dr. Letheby has ever analysed the water before passing through your filters?—Yes, I think that I once sent him a specimen of unfiltered water, but there was a great deal of sedimentary matter after a flood, and I wanted to know what the sediment consisted of, because in conversation with some chemists it had been stated that the quantity of matter in suspension was organic, which was not my opinion. My idea was that it was clay, and I had an analysis specially made to see whether it was so, and it turned out to be so.

431. Do you know at all of your own knowledge whether any change is effected in the chemical composition of the water by filtration. Do you consider that your water is not only cleared from sedimentary matter by filtration, but that it is improved so far as organic matter is concerned?—We conclude that it is.

432. Therefore if the water was bright, and did not require filtration to remove the suspended matter, it would still be improved by filtration?—I think so. I should recommend water being filtrated in either case, unless I knew by special analysis that it contained nothing objectionable.

433. If the powers sought by your Bill for obtaining water from the Thames were given to you, would the additional supply be inferior or superior in quality to your present supply?—I do not think that there would be much difference, the waters are very much alike.

434. With regard to the pollution of the water by the districts lying above your sources, I suppose that it is the intention of your company to put a stop to it?—We are particularly desirous that some system should be commenced under the advice of this Commission, or in any other way in which it could be brought about, by which a diminution should be effected of the free liberty which people have to put anything and everything into the river.

435. The pollution by sewage would be one source of pollution, but I suppose that your attention has been called to other causes of pollution?—We do not know of other pollution on the Lee besides domestic sewage. The manufactories on the Lee are not numerous, or the mills for grinding anything except flour.

436. Are there any paper mills on the Lee?—I think not. Corn and oil may be put down as occupying all the mill power on the Lee to which the Lee water is applicable as a source of power.

437. (*Chairman.*) Do you know whether your filtering area is in greater or less proportion than that of the other metropolitan water companies?—It was in greater proportion, but alterations have been made in the area of the filter beds, which have not been strictly rendered up. I, however, believe that I am now not behind anyone in the area for filtering purposes.

438. Have you at any time recently put in animal charcoal or carbide of iron, or any other matter to oxidize your water?—Nothing at all, but simply fine sand filtration.

439. Have you ever tried such a thing experimentally?—No.

440. Have you ever had it recommended to you?—Yes, by Dr. Frankland.

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441. Have you ever seriously thought about it?—I have certainly seriously considered the matter, as to whether it was practicable, or feasible, or manageable.

442. Would not Dr. Frankland be a great authority upon that question?—Yes, as to the chemical view.

443. Have you turned over in your mind the question of future purification, as to what mode could be adopted to purify the waters of the Lee from the sewage of those towns which now pollute it?—The only idea which I have in my own mind runs to the prohibition exclusively of the incoming of deleterious matters, and not to any difference in the mode of cleansing the water after they have got in.

444. The Lee is, I think, a navigable river?—It is in parts. There is a navigation extending from the river Thames to Hertford, and branching out of that to Stortford.

445. As to the mode of purification. If you are to prohibit the sewage from passing in, what is to take place then? Would you have a parallel conduit, and land it into the great outfall of the metropolitan sewers?—That is one way of diverting it. But is it impossible that in certain cases it could be applied upon land?

446. Certainly not. You mean that you would have a prohibition similar to that which was put into the Thames Conservancy Act of last session?—That appears to be the most recommendable plan.

447. Have you looked over the clauses in that Act?—I have carefully read the Act.

448. What do you think of the protective clauses in that Act?—I think that it is quite a step in the right direction. Looking at the interests of water drinkers and water users, I think that they are entitled throughout the kingdom to have protection secured.

449. You see that by that Act the companies have to pay a certain rate or rental to the Conservators for the work done?—Yes.

450. 1,000*l.* a year each?—Yes.

451. Do you think that your company would object to pay a contribution for the necessary work?—I am quite sure that they would not object to pay a contribution—of course I cannot say anything as to amount.

452. It must be equitable and reasonable?—Yes.

453. What body do you think would be competent to carry out the necessary prohibition—would it be yourselves or the River Lee Trustees as a company, or would it be a new body to be set up?—I think that you would have to establish a new body.

454. Do you think that the Trustees would not take that if they were held free from cost?—The Trustees of the Navigation at present are an unpaid body of gentlemen belonging to the neighbourhood of the Lee. They might undertake onerous duties, and duties which would be much more invidious than anything which they have had hitherto to undertake in the exercise of their duties as a trust.

455. Are you aware whether the Conservators of the Thames are an unpaid body or a paid body?—I thought that they were paid.

456. I believe that there is an allowance made to them?—(*Mr. Beardmore.*) The River Lee Trustees have no payment.

457. (*To Mr. Greaves.*) They pay their officers?—No doubt.

458. Then the Conservancy of the river Lee would come under the cognizance of their officers?—Yes. But I think that if the duty in question was confided to a trust, the representatives of all those interested should be able to put in their own appearances. I do not think that you could altogether delegate it to a trust; you might delegate it to a body of paid officers.

459. Are the members of the trust not elected?—I am not aware of that.

460. (*To Mr. Beardmore.*) Are they nominated in and in amongst themselves or are they elected?—Some are elected, but there are a good many *ex officio* Trustees, the members for the counties and the New River Company are representatives *ex officio*.

461. I suppose that the trust is framed something like the old Conservancy of the river Thames?—The New River Company are represented officially by the Governor, and the Deputy-Governor, and the Treasurer.

462. (*To Mr. Greaves.*) So far as you have considered the question, you think that the duty must be performed by a special body?—I think so; the question is a wide one, and will require a good deal of consideration. You are aware that the jurisdiction of the Metropolitan Board of Works ends of course in the metropolis, and the metropolis is bounded by the river Lee. The jurisdiction of the Essex Commissioners of sewers comes up to the borders of the Metropolitan Commissioners, they therefore have an interest in that portion of the valley of the Lee, as far up as their district runs, down to the Thames. Then there are several suburban parishes, where sewage is becoming a great annoyance and a detriment to the district, which are beyond the limits of the district of the Metropolitan Board, and are beyond the limits of the district of the Essex Board, and they would not exactly be at one with us, because their ground reaches down to the point where we take clean water. It therefore seems to me that there are many interests to be represented beyond those of the mere water drinkers, whose interests would be well confided to some general body or commission, to whom all these interests should be confided.

463. But as in this country taxation and representation are considered to go together, do you think that your company, if they are to be rated at all, should not also be represented?—I am strongly of opinion that they should be very distinctly represented.

464. Have not you a larger interest in preventing pollution than any other individual, as your success depends upon your giving water which shall not be open to the charge of producing disease?—Certainly.

465. (*Mr. Harrison.*) What is the character of the subsoil of the district which you supply with water?—Mostly gravel.

466. Are there cesspits or anything of that sort to any extent remaining in the district, or is it thoroughly sewered, and is the sewage carried away by a regular sewage system?—There are still a great number of cesspits.

467. Are any of those in juxtaposition to the wells which you have mentioned?—They were. I cannot from my own knowledge say that they are at present, but it is almost impossible that it should be otherwise.

468. If there are these cesspits, and if the subsoil is gravel, and if you have these private wells, there is a probability of an intercommunication?—Certainly.

469. I presume that you are well acquainted with the general area of the river Lee?—Pretty well with the whole district.

470. Besides your company, the New River Company take their water from the river Lee, do they not?—Yes; principally from the river Lee, and if not from the river Lee, from springs issuing in the district close adjoining it.

471. Then there are three bodies which are interested in the water of the Lee, the New River Company, the Trustees of the River Lee for the Navigation, and you, the East London Waterworks Company?—Yes; there are those three bodies who are interested in the water.

472. How far do you say that the navigation goes?—The main line goes up to Hertford, and there is a branch from that to Stortford.

473. From what point do the New River Company take their water?—At a place called Balance-Engine, between Ware and Hertford.

474. Is the town of Hertford above the point from which they take their water from the Lee?—Yes.

475. Have they any intercepting system similar to yours, so as to carry the sewage of Hertford below the point from which they take the water?—Yes, they have an intercepting system, and drains are laid

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into it from Hertford, by which the water coming down, after having been treated by a special process, is carried forward into the river.

476. What towns are there above Hertford situated upon the base of the area from which the New River Company draw their water?—The principal town is Luton.

477. Is that a very large town?—It is the largest town in the whole watershed of the Lee.

478. Do you know the number of inhabitants of Luton?—17,000 by the last census.

479. Are you pretty well acquainted with the geology of the basin of the Lee?—Yes.

480. What is the geological character of the district from which the New River Company obtain their supply?—I should say that certainly chalk predominates as the subsoil, and may be considered to be the main geological stratum of the district, it is overlaid with patches of one thing and another, but in no great quantity.

481. Can you give us the total area of the water basin of the Lee?—The total area of the water basin of the Lee may be called 500 square miles.

482. Can you give us the area of that part of it above the point from which the New River Company take their water?—On my papers it stands as 244 miles.

483. That is about one half?—That is about one half of the whole watershed.

484. There is the Lee Proper, from Luton down to Hertford, does it chiefly flow over the chalk formation?—It chiefly issues from the chalk formation.

485. Does it chiefly flow over the chalk formations?—I do not think that chalk appears very extensively as a surface in the valley, but I believe that it is not far below.

486. The Mimram is a tributary coming in above Hertford, is that principally through the chalk?—There is chalk to be found at no great depth, and there are chalk cuttings.

487. Would you call it a chalk district?—Decidedly.

488. Then there is the Beane, is it a chalk district?—Yes.

489. Do they obtain their water from the Rib?—Yes, those three rivers and the Rib or Quin unite.

490. Is it chalk?—Yes.

491. Then there is the river Lee running northward by Hatfield?

(*Mr. Beardmore.*) That is the Lee Proper.

492. Is that upon the chalk?—Yes, but a large tributary shown on the clay does not exist; the ordnance map should be corrected.

493. What is the volume of water which the New River Company have power to supply?—The New River Company have power to draw from the river at that point, 2,500 cubic feet per minute.

494. How many gallons a day would that be?—22,500,000.

495. What volume of water is required for the navigation, is any certain quantity reserved for that?—Those quantities are strictly defined; there are three quantities, an upper quantity, a middle quantity, and a lower quantity, and they can be stated.

496. Those two volumes of water are the first claim upon the river at the upper part?—The New River draft is the first draft, but that is subject to the quantity required for the navigation. Then the quantity of water used for the navigation is not altogether abstracted from the river, because the navigation goes in and out again, here and there using the natural course of the river, and then passing from it in short cuts which re-unite with the river.

497. Have you any information as to the volume of water which passes Hertford from all those sources in a very dry season, such as 1864 and 1865?—I have no precise information.

498. You have not gauged the river?—No measurement of the river has been made there.

499. Besides those rivers which supply the Lee at Hertford, is there the Ash?—That is the next stream.

500. Is that in chalk formation?—Yes.

501. Throughout its whole course?—I think so. I have never been all round the borders of it, but wherever there are any deep cuttings made or any excavations about the Ash they show chalk.

502. Is it the same with the Stort?—The Stort is chalk in the upper portions of it, but there is a large extent of clay in the Stort Valley.

503. Those are the two principal tributaries from which you derive your supply, independently of what may be left after the New River Company and the navigation have abstracted the quantities which they have the power to abstract?—Yes.

504. What volume of water does the Stort afford in a very dry season like 1864 and 1865?—I do not know that any precise measurement has been taken or can be taken of the water issuing from these rivers as distinct from one another, it would be a difficult and intricate process, and in order to be worth anything it must be maintained through a long series of observations.

505. Is it or not the case that the Stort in a very dry season is reduced to a very low ebb?—I have no doubt that it is.

506. From the character of the soil do you not think that it would be so?—Yes, and no doubt it is so.

507. The rivers above would be more of a perennial character, and the Stort would be much more of an intermittent character?—Yes.

508. So that in a dry season the Stort is not to be relied upon for a water supply?—No, you cannot rely upon it for a delivery of water as you can on the others. The Ash also runs very small in dry weather though it is very much in chalk.

509. Then in dry weather that would reduce your source of supply chiefly to the leavings of the navigation and of the New River Company above?—No, I can hardly say that, I think that it is quite possible that there may be as much other water; that is a point which I have hardly come upon.

510. If the Ash and the Stort are your chief sources of supply besides that above, and if those streams, as you state, are reduced to a very low ebb in a dry summer, it seems to me you are left with the leavings of the New River Company and of the navigation above?—Yes.

511. Although those streams are of large area they really do not afford you much water in a dry summer?—No; but there are very considerable springs below the point at which the New River Company takes its water out of the river.

512. In the years 1864 and 1865 what was the fact as to the volume of water which came down to afford you a supply?—It was barely enough in 1864.

513. What volume of water was then coming down the river at the point from which you take your supply?—20,000,000 gallons a day, I suppose, or more.

514. Between the point from which you take your supply and Hertford, is there not a very considerable population?—There is.

515. Even above the point from which you divert the sewage past your works?—Yes.

516. Is that a population lying comparatively near the river?—Some of it lies very near the river, and some of it lies at a distance. I do not know whether that would characterize the whole population, but a good deal is near the river.

517. Is that population to a very great extent situated upon the London clay?—No, I suppose that you would hardly locate the population of Waltham upon the London clay, although a part of it is upon the clay. The population of Waltham Abbey and Ware are entirely in the flat part of the valley with clay and gravel and some chalk, and the population of Stortford is on clay resting upon chalk.

518. Any liquid falling upon the surface is not likely to get through the London clay on to the chalk?—Not through the amount of clay which there is there.

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519. Is there any system of sewerage carried out throughout that district?—No general system; each town is left to its own affairs.

520. Have they carried out any system of sewerage?—There are drains more or less.

521. Where do they discharge?—Into various parts of the river; none discharge into anything else but the river.

522. Can you give us the population between the point where you take the water and Hertford, including Hertford and Ware?—I think that I have notes of the population of different places. The population of the parish of Waltham Abbey, which is a very extensive parish, and the majority of it on the eastern side of the Lee with some on the west stands in the last census as 5,044. The population of Ware which is next above is 5,397. The population of Hertford is 7,086.

523. Are there not some towns or considerable places intermediate between Waltham Abbey and Ware?—There is Cheshunt which is a populous place, it stands in the census as 6,592. The population of Hoddesdon stands as only 1,898.

524. Is there any considerable population on the Stort?—There is Sawbridgeworth on the Stort with a population of 2,701, that is taking the whole parish. I have not the towns or the populous places. Stortford is the most important place on the Stort with a population of 5,390.

525. Besides those places there is a considera rural population?—Yes, and a considerable population of small hamlets and villages, but those are the principal accumulations of people. I have taken out figures from the population tables, but I have had no means of separating between the more townlike sets of inhabitants and the pure rural districts.

526. The sewage of all these places you say comes into the Lee and its tributaries above the point at which you take your water supply?—Yes.

527. And the water of the Lee is diminished by that abstraction; the Stort and the Ash are reduced in the summer to a very low ebb as to supply?—Yes.

528. Does it not follow that with that small quantity of water coming down to you, and with a large population resident upon the banks, in such a summer as those of 1864 and 1865, the water at the point at which you take your supply must be very much polluted?—It does not follow so clearly as to put it in that simple form, because during the time when the river is low the discharge by all these towns and villages is low; I do not know that the pollution is very much worse then than it is at other times; there is no doubt that the pollution militates against the prospect of having pure water.

529. For how many days supply did you say you had the means of storing water?—For seven or eight days, and still having something left.

540. So that in a dry summer such as those of 1864 and 1865 you are practically dependent entirely upon the river itself as it comes down to you?—Yes.

531. And you cannot take advantage of any considerable flood, so as to store a large quantity of water after the river has been cleared out and the water comes down comparatively pure?—No reservoirs have been yet made with a view to store over such a length of time as you would imply; there are none to store winter water for summer time; it is possible that they might be made to a limited extent so as to supplement the flow very considerably.

532. Have you gone into the question of the Acts of Parliament which have been passed at different times bearing upon this inquiry?—I believe that I am acquainted with all the Acts of Parliament.

The witness delivered in the following paper:

Paper delivered in by Mr. CHARLES GREAVES, the engineer of the East London Waterworks Company.

1. The river Lee rises in Bedfordshire, flows by Luton and Hertford, then takes its course by Ware, Hoddesdon, Broxbourne, Enfield, Tottenham, and Hackney, to its confluence with the Thames.

2. Its principal tributaries are,
The Upper Lee at Hatfield;
The Mimram above Hertford;
The Beane and the Rib immediately below Hertford;
The Ash below Ware;
The Stort at Hoddesdon (including the Pincey Brook);
The Cobbin Brook at Waltham Abbey;
The Chingford Brook at Edmonton.

3. Of these several streams none but the Lee and Stort is subject to any special statutory regulation.

The following are the Acts relating to the Lee:

1.—13 Elizabeth cap. 18. An Act passed at the instance of the Corporation of London authorizing them, with the aid of Commissioners named in it, to take lands for making and to make a navigable cut from the Lee at Ware to or nearly to the Thames.

2.—Jac. 1. By which Act the New River obtained their original power to take water from the Lee.

3.—12 Geo. 2. cap. 32. An Act to extend the Lee navigation, as effected by the Corporation of London, under the Act of Elizabeth from Ware to Hertford, to ascertain and settle the quantity of water which the New River Company might take from the river and the mode of taking it, to appoint Trustees to carry the Act into execution and watch the New River Company's works and draught, and to make the New River Company liable to pay certain annual sums (300*l.* and 50*l.*) to the Trustees for the support of the navigation between Hertford and the Corporation cut.

4.—7 Geo. 3. cap. 51. (1763.) An Act for authorizing various improvements of the navigation by new cuts and otherwise for extending it to the floodgates at Hertford, and for vesting the entire jurisdiction theretofore exerciseable by the Corporation of London and by the Trustees appointed under the Act of Geo. 2., with various new powers for improving and managing the river for the purposes of navigation in a new body of Trustees, being in substance the same body of Trustees as now constitute "the River Lee Trustees." This Act also gave the Trustees the first power of taking tolls for the use of the navigation and to borrow monies on the security thereof.

5.—19 Geo. 3. cap. 58. (1779.) This Act for increasing the tolls on the navigation, for conferring some further powers on the Trustees, and ratifying certain arrangements between them and some of the millowners.

6.—45 Geo. 3. cap. 69. (1805.) This Act was principally for confirming arrangements between the Trustees and some of the millowners.

7.—47 Geo. 3. cap. 72. (1807.) This Act incorporated the East London Waterworks Company for supplying a large area in the east of London with water, and authorizing them to take the waters of the Lee for the purpose "at or near Old Ford," but only "during such time as "the tide water should be flowing up the river, and had "flowed to such a height as to stop the working of the "mills below on the river."

8.—48 Geo. 3. cap. 8. (1808.) This Act sanctioned the absorption by the East London Company of the previously existing Shadwell and West Ham Waterworks, which had certain statutory rights of taking water from the Lee below Old Ford: but the whole matter is entirely obsolete.

9.—10 Geo. 4. cap. 117. (1829.) This Act first authorized the East London Company to take water above the influence of the tide, viz., between Lee Bridge Mills and Old Ford Lock, and for this purpose to make an aqueduct of limited size from the tail stream of Lee Bridge Mills to Old Ford. This Act in protection of the navigation restricts the company from taking their water higher or elsewhere, but seems to have left them at liberty still to take the tidal water, at all events it contains no clear repeal of the power to do so. The navigation and mill and riparian interests were propitiated in respect of this higher taking of the water by an annual payment of 250*l.*, secured by the Act to the Trustees, by the company becoming bound to construct and maintain "compensation" reservoir at Hackney, and by divers special enactments for the protection of the navigation and other interests.

10.—13 & 14 Vict. chap. 109. (1850.) This important Act (ordinarily called the River Lee Improvement Act 1850) effected many objects. It improved somewhat the construction of the trust and incorporated the trustees. It authorized several new cuts and other navigation works. The Trustees took on themselves some works with reference to the East London Company's supply, and that company came under obligation to make considerably increased annual payments to the Trustees, and the

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quantities of water they were to take and the manner of taking it were regulated. Several special arrangements were sanctioned between the Trustees and the East London Water Company, and other (mill and riparian) interests, and the Trustees acquired the power of selling for the purpose of supply to certain specified districts the surplus waters of the Lee, so nevertheless that proper reserve for navigation purposes should be made. As regards millrights, the river was to be gauged and the amount of the river's water power throughout ascertained by engineers, and compensation given to each mill, &c., for any loss by reason of any act of the Trustees.*

(This Act is full of important details.)

11.—15 Vict. cap. 164. (1852.) By this Act all the previous Acts of the East London Waterworks Company were repealed, but several scheduled provisions contained in them (as to the compensation reservoirs and the like), and all the provisions relating to the company to Trustees; the Acts and the New River Company's Acts were saved and the company was re-constituted, its capital and powers and district defined afresh, but without alteration (except as next mentioned) of their point of supply from the Lee; and as regards general regulation it was brought under the Waterworks Clauses Act, 1847. The company acquired powers to make reservoirs and filtering beds at Lee Bridge, and new cuts upwards from thence to Tottenham mill tail and mill head so as to separate their water from the general stream and the navigation at a higher point. They also acquired powers to make and maintain an intercepting drain so as to intercept sewage and foul waters then reaching the Lee at divers points on its right bank above the company's supply head, and to take them lower down and pass them into the river (navigation) below the company's supply head.

12.—16 & 17 Vict. cap. 166. By this Act (which is now the governing Act of the East London Waterworks Company) the company's Act of 1852 was repealed, but all its provisions material to the present consideration were re-enacted, the company's district was somewhat extended, further reservoirs were authorized, and some few further provisions as regards outside interest inserted; but a main object of the company in coming before Parliament in 1853, that of raising their supply head to a much higher point on the river, failed.†

The unsuccessful parts of the company's application to Parliament in 1853, although at first sight not directly material to the present inquiry, ought not to be passed by, for the same difficulty in 1866 exists, and renders the nonpollution of the stream more important.

The company in 1852 were required by Parliament to seek in 1853 powers to take water from a higher point on the Lee, and accordingly they prepared plans, &c., and sought by their Bill of 1853 powers to make new cuts from the neighbourhood of Lee Bridge to a point on the river immediately below the confluence of the Lee and Stort. This proposal was opposed by the Government as owners of the powder mills and armoury works at Enfield, and was necessarily abandoned, and the legislation of 1853 ended therefore without affecting materially that of 1852.

In the same year and as part of the same plan, the company proposed a scheme for intercepting the drainage of Hertford, but this fell (as not worth pursuing) when the higher supply head was denied them, and it was besides understood that the New River Company would undertake it as immediately affecting their main supply.

13.—17 Vict. cap. ., 20 Vict. cap. . (1854 & 1857.) By these Acts the New River Company undertook the making of a system of drains for Hertford, and obtained provisions for preventing sewerage being discharged into the Lee.

14.—18 & 19 Vict. cap. 196. (1855.) By this Act there was vrey important legislation respecting the Lee, it was obtained at the joint instance of the River Lee Trustees, the New River Company, and the East London Company, and its main objects were to settle differences between the Trustees and the New River Company, and to define more conveniently the relations of the Trustees with each of the companies and the rights of the companies *inter se*. The general effect of the Act is, after making due reservation to the Trustees of water in the upper parts of the river for the purposes of the navigation, and of all its water below Old Ford Lock, to transfer all the water of the river to the two water companies on the New River Company paying a sum in gross and the two company's jointly paying a perpetual annuity of 3,500*l.* to the Trustees. The Act limits the draught of the New River Company from the river at Hertford, and that of the East London Company at their lower point, and subject to the above-mentioned reservations and their own draughts and their respective limitations, the two companies are by this Act placed at liberty to take the entire river *pari passu*.

15.—29 & 30 Vict. c. 89. (1866.) This "The Thames Navigation Act, 1866," contains provisions extending (not by name) to parts of the Lee, viz., those provisions relating to "pollution of water," (63 and following sections,) and which reach those parts of the Lee situate within three miles of the Thames measured as in that Act mentioned.

The following are the Acts affecting the Stort.

32 Geo. 2. (1729), 6 Geo. 3. cap. 78. (1766.) By these Acts (the latter seems to repeal the former), certain "undertakers" were authorized to execute works and maintain jurisdiction over the river Stort between the town of Bishop's Stortford and the confluence with the river Lee.

As matter analogous to direct statutory jurisdiction affecting the Lee, there is also the jurisdiction of the Commissioners of Sewers for the levels of Havering in Essex and Middlesex.

533. You have handed in a list of the Acts of Parliament; may we take that as being correct, and as giving all the necessary information?—Yes, as giving all the facts belonging to the statutory position of the company.

534. Is there any special points in any of those Acts to which you wish to call our attention?—I am not aware there is anything in which I could assist you by describing it. The East London Act of 1853, is the principal Act upon which we rely for all our domestic arrangements and management, and the the Act of 1855 is the Act on which we rely for the arrangements as to taking water from the river, between ourselves and the New River Company and the River Lee Trustees.

535. I think you mentioned that the river Lee floods the adjoining lands to a considerable extent?—Yes, very largely.

536. How far does that extend up the river?—Throughout more or less.

537. Is the valley much flooded above Hertford?—Certainly not to the extent it is below.

538. By the tributaries above Hertford?—There are floods considerably above Hertford, but not very bad; the heaviest flooding begins below the junction of the sixth tributary, that is to say, below the junction of the Stort.

539. After the river has got upon the London clay?—Yes.

540. Do the two rivers, the Ash and the Short, pass down in flood time a very considerable volume of water?—The Stort sends down a large quantity of water very quickly in floods. I do not know much about the Ash in flood time; it is a river which one does not often visit.

541. Is that more strikingly the case with those rivers, than with the Lee Proper above Hertford, and the Mimram, the Beane, and the Rib?—So far as my knowledge goes, I think so; I cannot speak with precision as to that point; I do not think that the tributaries flood very much.

542. Have any steps been taken to prevent the flooding of the lower part of the Lee, by embanking or other means?—None at all, there is no system of embanking in the Lee anywhere.

543. To whom does the bed of the river proper belong?—To various owners; there is no jurisdiction; there is no statutory power governing the channel, or the bed of the river as an old river apart from where it may be used for navigation. The riparian proprietors have never joined together, nor is anybody charged with any duties with respect to it; in fact the majority of the flat lands on the Lee are common lands or lammas land, that is to say, common for six months in the year; each parish has a large extent of meadow lands of that kind, but in some of the parishes the Enclosure Act has been taken advantage of, and these flat lands have been appropriated to individuals.

544. Is the flooding advantageous or otherwise to those meadows in an agricultural point of view?—That is a question which I cannot answer, and I do not know how it could be answered; there are no data to institute a comparison.

545. Do you know whether the flooding affects the health of the people adjoining?—I have no doubt that there is a greater amount of ague and ailment arising than there otherwise would be from cold and damp air, in consequence of the extent of flooding in the low land.

546. Do you know as a fact that there is ague?—It is not a fact that ague is rampant, but rheumatic fever is a very common ailment with working people all through the valley of the Lee, which I think shows that the damp air does affect their health.

547. It was mentioned in the evidence before the commission a fortnight ago, that some improvements made many years ago below Skipton upon the river Aire had had the effect of removing ague, and that some further improvments which had been made within the last few years had had the second beneficial effect of removing fever, which had been very rife before?—I am glad to hear it.

548. (*Chairman.*) A storage of 20,000,000 gallons a day for seven days would give a reservoir area of 140,000,000 gallons; do you think that you have anything like that amount of reservoir space at your command now?—I think that the amount is 170,000,000 gallons, and I am not quite sure whether it is not a little more.

549. In the spring of this year, when the old reservoirs happened to be connected with your pumping machinery, were you at home or not?—I think not; I will not say precisely.

550. You admit that there was a period when the supply was pumped in from the open reservoir?—A quantity of water was let in.

551. In the spring of this year?—Yes.

552. But you do not know the date?—No.

553. And you do not know whether you were at home or not?—I do not think that I was; I will not say.

554. Do you think that it is worth while clearing up that point?—I do not know that any new fact would come out of it.

555. There would be this fact, as to whether or not a large volume was pumped in, and as to the time when it was pumped in, and under what conditions it was pumped in, and why it was pumped in?—It would not alter that condition of things.

556. What necessity existed for pumping that water into the mains?—Only as I described before, that the water on the covered side may have been rather lower than they liked it to appear, and that therefore they replenished it from the other.

557. Had it been customary in former years to subsidise from that source?—We had a little in the year 1864.

558. And no evil results that you are aware of arose from it in 1864?—No.

559. There was no cholera?—There was no cholera.

560. Will you think over the question of any practical form of Conservancy by which the purification of the waters of the Lee and its tributaries may be brought about?—I will do so; that is, assuming that a prohibitory power is a possible enactment.

561. Take the River Thames Act, which you have before you, as a basis, or as a thing accomplished; Parliament has there enacted certain regulations which are to be put in force by a certain machinery?—Yes.

562. If you would quietly look over that Act, and seeing that your company is so vitally interested in the question, if you would give it a consideration, we should be very much obliged to you; it might facilitate our making a proper recommendation upon the subject?—I shall be very happy to give it any consideration which I can, but after the better experience which you as Commissioners have on this matter in a general way, we are rather inclined to look to you for correct advice on the matter. It is not an easy thing to determine how a new Conservancy Board can be established without any previously existing basis, and the case of the Lee does not compare precisely with the position of the Thames, as given over to the Conservancy Board, because in that case they have multifarious duties besides keeping clear the upper valley of the Thames.

563. The River Lee Commissioners are commissioners for purposes of navigation?—The trustees of the navigation itself have certain funds for the purposes of the navigation.

564. And so long as it serves the purpose of navigation they have fulfilled their trust?—Yes.

565. And you think that they would hardly be the body to be entrusted with conservancy powers?—I think that the conservancy body should consist of a certain number of members elected from all the different interests.

566. I suppose that primarily you would say that any conservancy, however constituted, should be a conservancy capable of being worked at the least cost necessary for efficiency?—Most decidedly.

567. As your board would be one of the boards served, and very probably one of the bodies rated, you think that the conservancy should not be a very extravagant conservancy?—It should not; there should be no more money spent by it, or upon it, than was necessary to sustain a common course or line of action.

568. Having the wide experience which you have, and being resident upon the ground, do you think that a Conservancy Board may be established which shall be worth its salt?—I think so.

569. Which shall not cost more than the work which it is capable of doing will be worth?—I think so; but unless a board of that kind were in some sense elective, if it only consisted of a number of persons specially charged with a certain duty, they would be a river police, and they would have all the unpleasant side of the matter to face, not for their own interests, but simply in discharge of a duty for which you may suppose that they would have salaries.

570. If a new Conservancy Board is to be established, and if it is to be elected, I presume that all the towns and all the riparian owners would have votes for representatives, and that your company and the New River Company would either nominate or have elective powers, and that some Government office, such as the Board of Trade or some other public office, might have an elective power and a supervision in case of appeal, similar to the case of the Thames Conservancy?—I think that that seems to be the shape which it appears most reasonable that it should take.

571. (*Professor Way.*) You say that when the river is in flood you endeavour to shut it out from your reservoirs as much as you can?—Yes.

572. Are you always able to do so?—We have excluded every flood which we cared to exclude since we have had the reservoirs, from which we can draw during the prevalence of the flood.

573. Is it not the case that the months of May and June and the whole of the early spring in this year were droughty?—Not this year; the river has been abundant this year.

574. Was not it a dry spring?—We did not find it so in the rivers; these rivers are very abundant in their springs, the sources of them being deep, and being in chalk, they are frequently in very good flow when the weather may be apparently dry. The floods which I speak of are floods of quantity in the river, and not floods of rainfall.

* These gaugings were made and recorded and are now in operation.

† In this year (1852) also there was passed the Metropolis Water Act, 1852, which *inter alia* interdicted the companies from the supplying of water not previously filtered and gave the Board of Trade jurisdiction to inquire (on the memorial of consumers) as to the quantity and quality of water supplied.

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575. Those two things are not necessarily coexistent?—They do not correspond; 1864 is the only year which we can speak of as a droughty year; the year 1865 was very irregular, there were months without much rain, and there were months with a good deal of rain.

576. (*Mr. Harrison.*) Did you find September 1865 the period when the river was lowest?—I do not know; I do not think that I have any paper by me which could recall that to my mind. I believe that in September 1865 the flow was low.

577. Have you kept any rain gauges in this district?—I have rain gauges on my own establishment.

578. Can you give us a return for the last two or three years?—Yes; my rain gauges are kept at Lee Bridge. I can give you returns from there. (*The witness subsequently furnished the return, and it will be found printed at the end of his evidence, as Appendix No.* 6.)

579. Have you any evaporation gauges to show the quantity of evaporation?—I have made some experiments on evaporation, but they are hardly in a condition to report. I should be rather diffident in putting them forward.

580. How many years have you tried it?—More or less imperfectly for seven or eight or ten years. I shall probably make some returns of those experiments some day, when I can get them carried on long enough unbroken to make them fit to be exhibited.

581. Do you know the experiments which Mr. Dickenson has made upon percolation?—Yes.

582. The soil being all chalk, the difference between the rainfall and the percolation would be evaporation?—Yes.

583. Do you find that your experiments at all accord with his observations for a number of years?—I think that my percolation shows rather less than Mr. Dickenson's observations have given.

584. Is your gauge of a similar character?—Yes; the water passing through it is measured, and is registered as percolation.

585. For how many years have you had that gauge?—I think since 1853 or 1854.

586. How frequently has it been observed, once a month?—More frequently than that, it has been according to the quantity; the receptacle for the water cannot be adjusted to contain more than a certain quantity, so that if it gets too full it is emptied and is registered off.

587. Is that up to the present time?—Yes.

588. If you could let us have the result of it, so as to make a comparison, it would be very valuable?—I will furnish you with some abstract.

589. Have you any observations upon evaporation, as well as upon percolation?—I have also endeavoured to make some observations upon evaporation from the surface of the water, as compared with evaporation from the surface of the ground, but they have not been carried on so long. (*See Appendix No.* 6 *at end of this witness's evidence.*)

590. What result have you come to as to evaporation from the surface of the water in this neighbourhood?—In 1864 we had an evaporation of seven inches straight away upon the surface of the water, which very much surprised me.

591. Within what period was that? — Three months; and it reached 9·371 inches in five months.

592. It varies at different times?—Yes, it is continually varying.

593. What have you found to be the average evaporation per annum from water?—I have not the figures at hand sufficiently precise to quote.

594. (*Chairman.*) Are your experiments so far as you have gone confirmatory of the prevalent notion of evaporation from water, or are they subversive of it?—So far as I have been able to read up the subject of evaporation, as treated of in books, I have found the evaporation to be greater in amount than I have been instructed from books that it is.

595. You have tried to get at the accurate amount of evaporation by a method of your own, which you think puts it in a much fairer way than the ordinary evaporating pans?—Yes; I think that the ordinary evaporating pans are rather delusive, and difficult to manage. I think that you may take it as a frequent result that four-fifths of all the rain which falls is re-evaporated, and that rather more is evaporated from the surface of the water than is evaporated from the surface of the ground.

596. (*Mr. Harrison.*) What would you say is the average rainfall in this neighbourhood?—25 inches.

597. Then four-fifths would be about 20 inches?—Yes.

598. (*Chairman.*) But the evaporation from an evaporating pan gives you more than the entire rainfall?—Evaporating pans acquire accumulated heat, and they evaporate more than they ought to do.

599. If you expose water to the continuing action of the atmosphere, the effect is something above the fall of rain?—That is not the result of my gauge.

600. The Birmingham Philosophical Transactions give it as such for Birmingham, if I recollect rightly?—I have no faith in evaporating dishes in ordinary cases.

601. I should say not; but if you could know what a reservoir of 10 or 12 feet evaporated, it would give a reliable test?—Yes, if you could cut out a portion of the surface.

602. (*Mr. Harrison.*) That would be merely evaporation from the water, and not from the surface of the ground?—Yes.

603. You do not mean to say that four-fifths is the evaporation from the surface of the water?—It would be rather more than that, it would be four-fifths from the surface of the land; you cannot depend upon more than one-fifth to percolate and to form springs.

604. That is only reliable under certain circumstances?—Certainly, and occasionally.

605. You cannot apply that rule to the west of England, the rainfall being considerably larger and the evaporation smaller?—Certainly not, and perhaps the rainfall occurs at a different period of the year.

606. There are cases of that kind which make it necessary to examine each locality; you could not apply the experiments made in London to any other district in England?—No, it would be scarcely fair to do so.

607. (*Chairman.*) Do you remember about the period of the floods this year, had you any floods early in the year, in January and February?—I cannot call that to mind, I have not directed my attention to that point for this evidence.

608. But this has been a wet year throughout?—Yes, there is no question about that.

609. At no period have you been short of water?—Not at all.

610. (*Mr. Harrison.*) You gave us the area of the basin of the Lee above Hertford and Ware, can you tell us at all the population upon that area independent of Hertford?—I have not taken it out exactly in that form.

611. In what form have you taken it out?—The population of the whole watershed of the Lee, taking it down to and inclusive of the districts which many years ago we diverted, I put down as 174,000, that is down to the border of Hackney, not including Hackney or Walthamstow.

612. Can you give us the population below Hertford, including Hertford, in the same way?—I can give you the population in 1861 of the district diverted in 1852. I have it as 51,900, you may call it 52,000.

613. (*Professor Way.*) I do not think that I made myself understood just now. When you are short of water in the river Lee you are necessarily short of water for your supply, are you not?—Yes, if we had it not in any way the supply would run short.

614. If you had not a considerable store?—Yes.

615. When the river Lee is in flood you object to take it into your reservoirs, because of the matter in suspension, which chokes your filters too much?—Yes.

616. In either case is it not possible that you might run short of water, that is to say, if the flood was continuous for five or six days, and if you had only five or six days' supply in your reservoir, you would be short of water?—But then I should let in the flood; I should not run short when there was an abundance outside.

617. There are times when you would run in flood water?—Yes, rather than go short of water.

618. Has that occurred at any time this year; at any time during this year have you let any water out of the river Lee in time of flood?—You may shut out a flood one day and let it in the next.

619. You do let in the flood water?—Yes.

620. Can you practically always shut out flood water from your reservoirs?—Yes.

621. But if the flood went on for five or six days you would be obliged to take it?—Yes; I have not reservoir enough to shut out such a flood; in fact this way of working the reservoir is more an incidental advantage which has arisen from the character of the work than from any previous design.

622. Is it not the fact that when you let in flood water you have a large quantity of sediment which is injurious to you; have you not the washings of all sorts of different places which the flood would bring down?—I do not think so. I do not think that there is a greater proportion of anything which is bad in the water when the river is in flood than at other times. Speaking for myself, I should prefer a flood to a drought at any time. I think that the water is more prejudicial during periods of drought than during times of flood.

623. (*Mr. Harrison.*) I think that that is rather contrary to what you said just now, when I asked you as to the condition of the water of the Stort, and the Ash, in the summer time?—I said that it was not worse during a drought than in the ordinary condition.

624. Your argument was that there being very little water about, very little dirt was washed into it?—It is not easy to draw precise comparisons upon all these points.

625. I presume that when a flood comes down it brings a great amount of refuse?—According to its degree, according to its duration. Sometimes a flood brings down mud into the river, it is exceedingly desirable to shut it out, that is almost entirely mineral matter.

626. How many days is it before it comes?—I could not put down any precise duration for a flood, it all depends upon the continuance of the rain, and where it comes from.

627. (*Mr. Harrison.*) But generally after a flood commences will the water run thick for a while?—We generally find that upon the third day from the commencement of a flood the great body of deposit in the water is cleared away, the river in fact has cleared itself of a great body of deposit.

628. So that if you had a full supply in your reservoirs before a flood commenced, you might continue to give off water from that supply, and at the end of seven or eight days receive a volume of water from the flooded river which would be comparatively pure?—Yes, that is the precise explanation of the matter which I have described.

629. (*Chairman.*) Although it had more visible mud in it, the water itself would be of a better character?—I do not fully apprehend that question. The water would be improved by its course through the reservoirs.

630. The water would be more diluted, and although there was visible mud in it, it would come into your pure water basin a better water than the dry-weather flow?—I think that it would hardly go to that extent; that is putting it too much the other way again.

631. (*Professor Way.*) I suppose that the different materials from the towns above your water supply would be washed out by the flood?—Yes, and they would come down with the first of the flood, and the first of the flood is very turbid in consequence.

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632. Supposing that you had a flood supervening upon a very dry period, you must take in water earlier than you would wish to do?—Yes.

633. That you say has not occurred this year?—No, I cannot discriminate that it has done so; we have had no trouble this year. If the excessively turbid water has passed by we fill up so much the sooner.

634. The turbid water I presume is a guide by what you can see to what you do not see?—It is.

635. (*Chairman.*) Do you know whether any foreign substance, such as charcoal or carbide, or any material of that description, is used in any place upon a great scale for filtering water?—I believe that it is not, from inquiries which I have made, and information which I have gathered.

636. Do you know anything of the supply of water at Wakefield?—Nothing more than that I believe that it is one of the places where Mr. Spencer's process has been tried.

637. And where it is being carried on?—I believe so.

638. Have you made any experiments upon a small scale, for your own satisfaction, either with wood charcoal, bone charcoal, or carbide?—Not recently. I did a little in the way of filtering dirty water through vegetable charcoal some years since.

639. Do you know what is the chemical or mechanical action of charcoal in water filtration?—It seems to have an attractive power on organic matter, and to draw the matter to the grains of charcoal; but it does not seem to me at all proved whether the action is purely mechanical, or whether there is anything which may be called chemical in it.

640. Do you know that, whether rightly or wrongly, or whether beneficially or otherwise, in all the filters which are sold in the shops the filtering medium is either wood or bone charcoal?—I believe that it is charcoal and sand.

641. And that filters are made with Mr. Spencer's carbide?—I do not know as to that.

642. If any beneficial results are obtained from household filters by Mr. Spencer's system, do you think that those results could be obtained upon a great scale at a less cost than the present results?—I cannot see any facility for carrying out the process of filtering large quantities of water through charcoal, unless one was going to construct works. I do not at present see my way to do it so as to obtain the benefit described.

643. What is the base of the filter bed, is it concrete?—Yes.

644. And then you have a series of drains upon that concrete?—Yes.

645. What do you fix in between the drains?—Large stones, and the coarsest gravel which I can get.

646. As big as my fist?—Yes.

647. And then you diminish the size until you get to the size of peas before you come to your sand?—Yes.

648. Of what depth is your sand?—It varies. I may take 18 inches as the normal depth.

649. Supposing that you put upon your peas a layer of any kind of charcoal of five or six inches thick, either wood or bone charcoal, or of carbide, all the water must come in contact with that charcoal until you get down to the drains?—Yes.

650. Do you see any difficulty in that?—No, it is the only way which I can see of using the charcoal.

651. (*Professor Way.*) Dr. Frankland has stated, I think, that 300 tons of charcoal would be sufficient for the whole water supply of London?—Yes, but Dr. Frankland does not imagine that it is used in your way. He thinks that after the water is filtered it

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may be sent through some vessel in which a cage for the charcoal can be put, but that I think is altogether impracticable.

652. (*Chairman.*) Professor Way, I daresay, will tell you what the chemical action of charcoal is, and that it is necessary for the water to be in contact with the charcoal for some time; and that pouring a large quantity of water through a minimum amount of charcoal, will do a minimum amount of good, or no good; and that if you are to do it upon a great scale, it must be somewhat in the way which I have sketched out to you?—Yes.

653. (*Professor Way.*) The price of the carbide is 10*l.* a ton, and the price of animal charcoal I think is generally about 12*l.* a ton, so that there is not much to choose between them?—Just so.

654. And if Wakefield can afford to use carbide in the way in which they use it, they can afford to use animal charcoal?—Yes.

655. (*Mr. Harrison.*) Can you state whether the population in the neighbourhood of the river is increasing between the point from which you take the water and Hertford?—It is increasing very greatly in the neighbourhood of the river; Cheshunt is a very increasing town.

656. Considering the position of the point from which you take the water of the river Lee, and the large population on its banks, with every care which may be taken, do you think that the river Lee at that point would be a proper source from which to derive a water supply for London?—If a reasonable authority is used in excluding the sewage the river is as pure there as it is further up, because it suffers no other contamination.

657. You do not think that the refuse matter from that populous district, which must more or less find its way into the river, would cause that river to be an objectionable source of supply?—No. I do not see anything there, other than domestic and house sewage, which would be liable to contaminate the river.

658. (*Chairman.*) Is there anything which you wish to add to the evidence which you have so kindly given us?—I do not call to mind anything now which would help to elucidate this matter, or which would affect anything I have said.

The witness withdrew.

Adjourned to to-morrow at half-past 10 o'clock.

APPENDIX No. 1.

To the Evidence of CHARLES GREAVES, Esq., Engineer-in-Chief (referred to supra, Question 253).

The number of fire plugs in the East London District in the public streets at Christmas 1866, were 9,292.

(Signed) CHARLES GREAVES,
Engineer.

APPENDIX No. 2.

To Evidence of CHARLES GREAVES, Esq., Engineer-in-Chief (referred to supra, Question 309).

PROPORTION OF HOUSES HAVING CLOSET FITTINGS IN PARTS OF THE EAST LONDON DISTRICT.

No. Houses.	No. having Closet Fittings.
5,938	4,5
8,474	4,611
1,984	1,402
14,394	2,866

(Signed) CHARLES GREAVES,
Engineer.

APPENDIX No. 3.

To Evidence of CHARLES GREAVES, Esq., Engineer-in-Chief (referred to supra, Question 337).

EAST LONDON WATERWORKS COMPANY.—DESCRIPTION OF TRADES AND LARGE CONSUMERS USING WATER BY METER, ALSO VOLUME OF WATER COMPUTED DELIVERED.

Ale and bottle merchants.
Almshouses.
Asylums.
Baths and washhouses.
Biscuit bakers.
Bone boilers.
Braid manufacturers.
Brick makers.
Brewers.
Cabinet makers.
Chapels, churches, and colleges.
Chemical and colour works.
Chocolate makers.
Coal companies.
Coopers.
Confectioners.
Curriers.
Distillers.
Docks, wharves, and ponds.
Dyers.
Engineers.
Fish curers.
Ginger-beer makers.
Gardeners.
Gasworks.
Gunsmiths.
Guttapercha and rubber works.
Harp string makers.
Horse slaughterers and butchers.
Hospitals.
Ink makers and printers.
Laundries.
Maltsters.
Oil refiners.
Paper makers.
Pickle makers.
Police stations.
Potters.
Provision merchants.
Railways.
Road trusts.
Rope makers.
Saw mills.
Scum boilers.
Sewers.
Shipbuilders.
Soap makers.
Stables and cowhouses.
Sugar refiners.
Sundry trades.
Tobacconists.
Tripe dressers.
Urinals.
Water troughs.
Water sellers.
Workhouses.

WATER COMPUTED DELIVERED TO LARGE CONSUMERS AND TRADES.

	Gallons.
1857 - -	748,703,199
1858 - -	903,127,399
1859 - -	1,028,261,850
1860 - -	1,090,219,200
1861 - -	984,683,524
1862 - -	1,126,835,850
1863 - -	1,239,557,550
1864 - -	1,273,931,400
1865 - -	1,488,809,700
1866 - -	1,515,045,000

(Signed) CHARLES GREAVES,
Engineer.

APPENDIX No. 4.

To Evidence of CHARLES GREAVES, Esq., Engineer-in-Chief (referred to supra, Question 418).

EAST LONDON WATERWORKS.—LETHEBY'S ANALYSIS.

	1865.		1866.		1865.		1866.		1865.		1866.	
	Reservoirs.	London Hospital.	Reservoirs.	London Hospital.	Reservoirs.	London Hospital.	Reservoirs.	London Hospital.	Reservoirs.	London Hospital.	Reservoirs.	London Hospital.
	JANUARY.				FEBRUARY.				MARCH.			
	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.	Grains.
Carbonate of lime and magnesia	13·5	13·0	12·1	12·8	12·0	11·2	13·3	14·7	13·9	13·1	16·1	15·6
Sulphate of lime	3·7	3·3	4·7	4·3	2·2	1·9	4·8	4·5	3·3	3·4	4·0	4·4
Alkaline sulphate	—	—	—	—	1·7	1·4	—	—	—	—	—	—
„ chloride	1·8	1·8	1·8	1·7	1·7	1·6	2·0	1·6	1·9	1·8	1·4	1·0
„ nitrate	2·4	2·2	3·7	4·4	0·4	0·5	1·1	1·0	2·2	1·9	0·9	1·3
Silica, alumina, &c.	1·0	1·0	0·6	0·5	0·6	0·5	0·5	0·6	0·7	0·8	0·6	0·6
Non-organic	22·4	21·3	22·9	23·7	18·6	17·1	21·7	22·4	22·0	21·0	23·0	22·9
Organic impurity	0·4	0·5	1·0	0·6	0·4	0·6	0·5	0·6	0·8	0·8	0·5	0·4
Total impurity per gallon	22·8	21·8	23·9	24·3	19·0	17·7	22·2	23·0	22·8	21·8	23·5	23·3
	APRIL.				MAY.				JUNE.			
Carbonate of lime and magnesia	12·0	12·8	13·8	13·5	10·5	9·8	13·9	13·1	11·3	12·0	11·4	11·2
Sulphate of lime	3·1	3·1	3·6	3·4	3·7	3·5	2·9	2·8	2·9	2·9	2·2	2·0
Alkaline sulphate	—	—	—	—	—	—	—	—	—	—	—	—
„ chloride	1·8	1·7	1·3	1·3	1·7	1·6	1·2	1·5	2·0	2·0	1·2	1·1
„ nitrate	1·5	1·0	2·6	2·6	0·9	0·6	3·1	3·6	0·2	0·5	2·5	2·0
Silica, alumina, &c.	0·7	0·5	0·3	0·4	0·6	0·7	0·5	0·3	0·6	0·6	0·2	0·5
Non-organic	19·1	19·1	21·6	21·2	17·4	16·2	21·6	21·3	17·0	18·0	17·5	16·8
Organic impurity	0·6	0·6	0·4	0·4	0·6	0·6	0·4	0·4	0·6	0·8	0·2	0·4
Total impurity per gallon	19·7	19·7	22·0	21·6	18·0	16·8	22·0	21·7	17·6	18·8	17·7	17·2
	JULY.				AUGUST.				SEPTEMBER.			
Carbonate of lime and magnesia	12·0	11·5	—	12·00	10·0	9·2	—	11·51	13·5	13·2	—	13·05
Sulphate of lime	2·9	2·9	—	2·42	3·2	3·2	—	3·05	3·1	3·1	—	2·52
Alkaline sulphate	—	—	—	—	—	—	—	—	—	—	—	—
„ chloride	2·0	1·9	—	1·32	2·0	2·0	—	1·52	1·4	1·4	—	1·27
„ nitrate	0·6	0·7	—	1·52	0·2	0·5	—	1·28	0·5	0·6	—	0·86
Silica, alumina, &c.	0·2	0·2	—	0·50	0·4	0·3	—	0·27	0·3	0·3	—	0·43
Non-organic	17·7	17·2	—	17·76	15·8	15·2	—	17·63	18·8	18·6	—	18·13
Organic impurity	0·5	0·3	—	0·40	0·4	0·6	—	0·56	0·4	0·4	—	0·39
Total impurity per gallon	18·2	17·5	—	18·16	16·2	15·8	—	18·19	19·2	19·0	—	18·52
	OCTOBER.				NOVEMBER.				DECEMBER.			
Carbonate of lime and magnesia	12·5	12·0	12·67	10·17	13·3	13·0	14·72	14·98	14·3	13·5	14·96	14·28
Sulphate of lime	2·8	2·8	2·82	3·39	4·1	3·8	2·97	2·97	4·5	4·7	3·68	4·16
Alkaline sulphate	—	—	—	—	—	—	—	—	—	—	—	—
„ chloride	1·8	1·8	1·27	1·58	1·9	1·8	1·02	1·01	1·7	1·6	1·42	1·42
„ nitrate	0·3	0·4	2·52	2·29	2·7	2·0	1·81	1·99	2·8	2·7	2·26	1·97
Silica, alumina, &c.	0·5	0·4	0·25	0·58	0·9	1·0	0·50	0·42	0·9	0·8	0·67	0·50
Non-organic	17·9	17·4	19·53	18·01	22·9	21·6	21·02	21·37	24·2	23·3	22·99	22·33
Organic impurity	0·4	0·2	0·56	0·68	0·9	1·1	1·08	0·72	0·8	0·9	0·84	1·16
Total impurity per gallon	18·3	17·6	20·09	18·69	23·8	22·7	22·10	22·09	25·0	24·2	23·83	23·49

Where there are two samples in a month, one is taken at Lee Bridge and one at the London Hospital. Grains per gallon are denoted throughout.

(Signed) CHARLES GREAVES.

APPENDIX No. 5.

To Evidence of CHARLES GREAVES, Esq., Engineer-in-Chief (referred to supra, Question 429).

EAST LONDON WATERWORKS.—SPECIAL ANALYSIS.

Extract from Dr. Letheby's Report on waters sampled August 9, 1866. College Laboratory, September 3, 1866.

"The following are the results of the analysis."

	Old Ford filtered. Grains.	Old Ford uncovered. Grains.
Carbonate of lime and magnesia	10·81	11·06
Sulphate of lime	3·45	2·91
Alkaline chloride	1·42	1·53
Alkaline nitrate	1·27	1·90
Silica and alumina	0·50	0·50
Organic matter	0·48	0·56
Total per imperial gallon	17·93	18·46
Hardness before boiling	12·5	13·5
Do. after boiling	4·	4·

These results show that practically the two samples are the same, the differences being too slight for any notable distinction.

The samples also correspond in quality with the other samples analysed during this month, namely; the samples sent early in this month and the sample taken from the main at the London Hospital.

	Sample from works.	Sample from main.
Carbonate of lime and magnesia	10·96	11·51
Sulphate of lime	2·91	3·05
Alkaline chloride	1·52	1·52
Alkaline nitrate	1·39	1·28
Silica	0·50	0·27
Organic matter	0·40	0·56
Total per gallon	17·68	18·19

These results are nearly the same as were obtained last month, and they are a little above the results of the corresponding month of last year, when the solid matter was about 16 grains per gallon.

(Signed) H. LETHEBY.

LONDON.

Mr. C. Greaves.

10 Dec. 1866.

APPENDIX No. 6.

To Evidence of CHARLES GREAVES, Esq., Engineer-in-Chief (referred to supra, Question 578).

EAST LONDON WATERWORKS.

RAIN PERCOLATION and EVAPORATION GAUGES kept by Mr. GREAVES at LEE BRIDGE.

	Rain.		Percolation.		Evaporation from Ground.		Evaporation from Water.	
1860.								
March - -	5·227		3·175		2·052		1.227	
June - -	10·520		2·387		7·133		8.645	
September - -	9·312		1·837		7·475		8·187	
December - -	7·499		3·662		4·136		2·998	
		32·558		10·761		21·797		21·058
1861.								
March - -	6·932		3·062		3·874		4·932	
June - -	4·141		·187		3·953		8·766	
September - -	5·374		·0		5·374		9·749	
December - -	7·852		2·762		5·090		3·727	
		24·299		6·012		18·287		27·174
1862								
March - -	6·645		3·437		3·207		1·895	
June - -	7·813		1.649		6·163		7·064	
September - -	5.332		·0		5·332		6·457	
December - -	6·791		3·462		3·329		1·916	
		26·581		8·548		18·032		17·552
1863.								
March - -	4·062		2·387		1·674		2·062	
June - -	5·270		·0		5·270		7·520	
September - -	5·206		·0		5·206		7·331	
December - -	5·228		1·374		3·854		1·354	
		19·766		3·761		16·005		18·266
1864.								
March - -	4·728		2·862		1·866		1·228	
June - -	3·770		·062		3·708		8·016	
September - -	3·936		·0		3·936		8·186	
December - -	3·457		·899		2·557		1·206	
		15·891		3·823		12·067		18·636
1865.								
March - -	7·145		5·425		1·720		1·770	
June - -	5·083		·025		5·057		8·208	
September - -	7·896		·837		7·059		8·646	
December - -	9·124		4·862		4·262		1·499	
		29·248		11·159		18·098		20·123

(Signed) CHARLES GREAVES, Engineer.

Victoria Steeet, Tuesday, 11th December 1866.

PRESENT:

ROBERT RAWLINSON, Esq., C.B., IN THE CHAIR.

JOHN THORNHILL HARRISON, Esq. | Professor JOHN THOMAS WAY.

NATHANIEL BEARDMORE, Esq., examined.

LONDON.

N. Beardmore, Esq.

11 Dec. 1866.

659. (*Chairman.*) You are engineer to the river Lee navigation?—Yes, under the Trustees.

660. Will you state what their proper title is?—The Trustees of the river Lee.

661. Are they constituted under an Act of Parliament?—They are constituted under several Acts of Parliament, they were finally incorporated in 1850.

662. I presume that the most recent Act of Parliament defines the constitution and qualification and other particulars?—Yes; I have requested the secretary to prepare a short paper referring to those matters, which, when completed, he will put in.

663. How long have you acted as engineer for the Trustees of the river Lee?—For about 16 years.

664. For what distance is the river Lee navigable from the Thames?—From the Thames it is navigable to Hertford, a distance of about 28 miles. Bow creek is also under the jurisdiction of the Trustees; that leads from Bow to Blackwall, and is a natural creek of the Thames. The jurisdiction of the Trustees does not extend up the Stort branch, which is about 13 miles from near Hoddesdon to Stortford.

665. Does the jurisdiction of the Trustees extend to the junction of Bow creek with the Thames?—From Bow locks to the Thames there is a mixed jurisdiction, for the Thames Commissioners are as much masters there as the Trustees of the Lee.

666. Do the works belong jointly to the two bodies?—There are no works on that part; it is a natural river with banks, subject to the control of the Level Commissioners.

667. What is the length of that part of the navigation?—About $2\frac{1}{2}$ miles.

668. Then there are three bodies concerned in the lower or tidal reach of the navigation, the river Lee Trustees, the Conservators of the Thames, and the Essex Sewer Commissioners?—Yes, they have one side.

669. They have charge, I suppose, of all the lowlands, the marshes ditches, and embankments?—Yes.

670. I believe that body nominate three members on the West Ham Local Board?—Yes, they do.

671. Have you acted as engineer for the commissioners of sewers?—Yes; for several years.

672. Was Mr. Walker their engineer before that?—Yes. I was consulted by them for several years before his death, and two years before his death I was appointed.

673. In constructing the Victoria Dock works, what body would have been consulted, the river Lee Trustees or the Essex Sewer Commissioners?—The Essex Sewer Commissioners entirely; the Victoria Dock works enter from the Thames. The Conservators of the Thames no doubt had control over the entrance works. I may say that great improvement in the drainage of the marshes was effected when these docks were formed, arising out of the construction of the docks, but their formation has also brought about complications as to the drainage which are still unsolved; on the lower side there is a strip between those docks and the Thames, which is awkwardly situated.

674. Do you mean the part on which Silvertown is erected?—Yes, it is quite out of the Lee.

675. That strip, by the construction of the Victoria Docks, has been cut off from the general area of the marsh?—Yes, but it does not suffer so much for that reason; it is becoming a great town, and the West Ham local board has not yet constructed sewers there; it is a very difficult thing, unless some new scheme is introduced, for them to do it.

676. At what date was the river Lee first formed into a navigable river, was it navigable before there were locks upon it, or do you know the origin of the navigation?—Our first navigation Act was passed in the reign of Queen Elizabeth, but it must have been a navigation of some kind long before that. I have little doubt of that, because the Danes went up the river Lee in the time of King Alfred as far as Ware, but no doubt in those days the marsh was more of a morass, and consequently the navigation would have been easier. I have no doubt that in those days there were rough kinds of weirs, that is the original kind of weir; whether there was anything like a scientifically formed weir I should have a doubt, but I think there were most likely weirs to fish with, with arrangements for boats to go through, and for the trouble taken in letting them pass through a toll was paid; we know that a toll exists to this day. I have very little doubt about it, because I have seen the same on some of the rivers on the continent. Those who had fishing weirs, made arrangements to pass the barges, and they were paid a trifle for each; there is a vestige still left of the the old weirs, and the property in them has come down by inheritance; when we dredge in the present river we now and then come across one of these old weirs. After Queen Elizabeth's time they became regular weirs formed by the commissioners; they were made scientific constructions, and the old weirs exist in the bottom of the river to this day; there is one close below Ware, and that has not been used for 100 years.

677. (*Professor Way.*) I suppose as there is nothing above the water there are no tolls levied now?—No. When Smeaton formed his design for canalizing the river, the weir owners evidently appeared in Parliament and made the Trustees pay them compensation for abandoning their tolls, and fixed payments were maintained in the Act that was passed. As to some of them we do not know where they existed. I do not know at least where one or two of them did exist, and yet a sum of 20*l.* or more a year was paid for them in compensation. A man would have said, you will destroy my property by making the new cuts, and therefore you must pay me. These places are spoken of in our Acts of Parliament as turnpikes, I believe legal ones; since Elizabeth's time they were, I think, treated as turnpikes; they may have varied in construction, but no doubt the system still exists, and you can see it upon other rivers. In the first place two piles were driven down into the river at a distance apart which would admit the largest barge, then there were sills, and those piles were connected with the shores by wings; on one side of the piles there was an iron pin, and a beam swung upon that iron pin; this was the turnpike, that beam was confined at the other end, and then upright boards were put in one after the other to pen the water up.

678. (*Mr. Harrison.*) There are such weirs existing now above Oxford on the River Thames?—Yes; and also on the river Nene and on another river near Bury St. Edmunds. We have, as I before stated, from time to time grubbed up these materials, and I rather guess that they were of the form I have described, and that the turnpike was that swinging beam; from which we get the name of turnpikes on the roads. Tolls are mentioned as payable at such places as Waltham turnpike, which is a water passage on the old river.

679. I suppose that the name "Ware" comes from a weir on the river?—I have not the slightest doubt of it.

680. What is the geology of the Lee?—Down to the parallel of Cheshunt it is chalk covered by beds of sand, gravel, drift, and clay; some small extent boulder clay exists still in part of the valley, and the district varies greatly in the amount of the drift. Some of the upper valleys have vast beds of gravel, sand, and tertiary drift; there being in some other valleys surface clay, and patches of boulder clay.

681. If you could strip the alluvium from the chalk you would probably find a distinct set of contours and pot-holes in the chalk?—Certainly.

682. The valleys between the ridges and pot-holes are filled in by drift?—Yes.

683. Therefore, I assume that a bore-hole in any one part of the valley would not be a sure indication of what it would be in another part of the same valley?—When you come to the higher parts of the valley, there you would always find chalk nearer and more certain; but the valleys themselves vary greatly in the amount and character of the drift. The charm and beauty of the Lee, as a water bearing country, are in fact that it is a great natural filter; there are some of those streams above Hertford that never flood nor overflow except with very unusual rain. When the Great Northern line was cut, you could see the beds of fine sand running from 10 to 15 feet thick, and those beds prevail largely; indeed over at least 150 out of the 444 square miles above Fielde's weir, they are of that fine character.

684. Would you say that the Lee is essentially a spring fed system of rivers?—Most essentially of the spring water character, surface water drains out within three days of a flood, sometimes within two days; in the earlier part of the winter and in the spring the flood water passes off, and the gauging shows that the river is mainly composed of spring water almost immediately.

685. (*Mr. Harrison.*) With almost a steady supply?—Yes. During the last month we had a flood, and within a week the river had gone back to its normal spring volume.

686. (*Chairman.*) Are you able to name the principal springs upon the tributaries and upon the main river of the Lee, where they are situated, and their probable volume?—The river Mimram is a large spring of water. The rivers Beane, Rib, and Ash to a great extent are composed of spring water, but with no very large springs on either of them showing anywhere.

687. (*Mr. Harrison.*) Do you find that there is an accession of spring water into the beds of those rivers throughout their course?—Yes; they are so highly porous that the springs must come from the hills into the marsh, and then down into the bed of the river; they are not very perceptible.

688. There is a constant accession of volume as the river proceeds?—Yes. On the river Mimram I do not think it is possible to build so as to foul the stream unless you have pipe drains. It is absolutely a rural district, and there is nothing to foul it. It is so porous that it would be difficult to do it, except by pipe drainage going down to the Lee Proper. The upper part rises with springs direct out of the chalk above Luton. The river has a gradual accession of water, but not by means of any large prominent springs that I know of until you get below Hatfield, and even there I know that the bed of the river is a vast deposit of sand. It flows in a porous sand bed with

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chalk not very far off; the water passes through the sand, and in a very dry time portions of the valley will drain by natural filtration. Two miles below Hatfield the springs present themselves in a very large form; they are to be seen boiling out on the hill sides. There is one very considerable spring at Woolmer Park, but that spring being one of the higher springs fails in a dry year, for at least three months. In the last 15 years that spring has twice fallen off from August to October.

689. (*Chairman.*) Is that a spring which is known in some districts as a levant, or in others as a bura, or are there intermittent springs which appear and disappear?—We have no such name; it is a fine boiling pool, under a chalk cliff. You can see the gravel and sand on the chalk when not grown over with shrubs and creepers.

690. You say that it is intermittent?—Yes, so far so that in a dry year it has fallen off and come to nothing.

691. The flow ceases?—Yes.

692. Do you know the Bourn at Croydon?—Yes.

693. Which only breaks out after there has been a certain rainfall?—I know nothing of that kind in the Lee valley; it is all too highly porous and consequently the flow is more regular. These springs doubtless prevail, but not visibly, all the way down to Hertford, because the Lee Proper increases in volume and becomes there a very considerable stream. Below Hertford the first large spring that you meet with is the one that was taken originally by the New River Company, the Chadwell spring, which is between Hertford and Ware; below Ware, the western side of the valley becomes a succession of boiling springs all the way down to Hoddesdon; the last great spring is at the Hoddesdon Mill. The volume of that spring is not less at any time than 300 feet a minute. There appears to be a fault in the valley at Broxbourne; I think the London clay exists below the parallel. Comparatively speaking there are not many springs below that point, but if you bore through the clays and drift you will find boiling springs again, showing that the whole valley is full of springs which cannot come out on account of the weight of the clays, the mottled clay, and the London clay lower down than that. These springs will boil up as far down as Edmonton. There is one which has been bored within seven years, which is now running over in ample volume at the roadside near Angel Road Station.

694. The word "boiling," I presume, is not used as having any application to heat, but simply to coming up and flowing over?—Merely this, that they come upward and flow entirely over.

695. Did you ever test the temperature of any of those springs?—I have often tested them.

696. What is their mean temperature?—According to the season; they vary from 51° to 53°.

697. Or from 48° to 50°?—I do not think that the mean temperature goes as low as 48°. They vary with the latitude.

698. (*Mr. Harrison.*) Will they not vary to some extent with the depth at which the spring is seated?—I think you would get in the winter a more uniform temperature, nearer the mean temperature of the latitude; less according to the mean temperature, and more according to the latitude. A deep spring will vary less, and that is the difference.

699. (*Professor Way.*) If the springs are in large volume, I suppose the surface does not affect the temperature?—No, they follow a fixed law. I tried some springs the other day in the centre of the coldest part of Russia, and they followed the same law.

700. (*Chairman.*) Have any records of the rainfall been kept upon the river Lee?—Yes, I have kept one at Fielde's weir for 16 years.

701. Shewing the least and the greatest rainfall, and about the average?—Yes, and I will put that in. (*The witness subsequently furnished the same. It will be found printed at the end of his evidence, Appendix No.* 1.) About four or five years ago I published a statement, and that I will refer you to; it gives almost as good a statement for 10 years as you can have. You will find it at page 346 in the tables contained in "Beardmore's Manual of Hydrology, 1862." (*See end of this witness's evidence, Appendix No.* 6.)

702. Have you any gaugings of the flow of the water, its minimum and maximum, at any fixed points upon the river?—I have kept for 16 years gaugings at Fielde's weir, where I consider the maximum of the spring water obtains, or nearly so.

703. What variations have you found in the flow of of the water;—The variations between a wet year and a dry one is very considerable, and perhaps I might almost say that that would be rather better given in the form of a table, for it is so very difficult to give all the figures in any other way.

704. Will you be good enough to give us the highest and the lowest and the mean?—I will refer you to the best gaugings on the Lee; that I can supply, at page 151 of the same book (*see end of this witness's evidence, Appendix No.* 2); but I will also furnish you with the details of the year 1858. (*The witness subsequently furnished the same, and it will be found printed at the end of his evidence, Appendix No.* 2.)

705. (*Mr. Harrison.*) Referring to that former table, can you give the rainfall down to the present time?—Yes, I will give you a further table. Referring to the minimum flow of the river Lee, at Fielde's weir, I think the years of 1857–58 will afford a good specimen; in that year the minimum of the month of August, after the New River Company had taken its supply, was 2,073 feet per minute, but for supply purposes you should take the mean of that month; in August 1857 it was 3,654 feet after the New River Company had taken their supply.

706. Was that the dryest season?—Yes, that I consider to have been a very dry year. We had also a very low discharge in October 1854. The mean of that month was only 3,041 cubic feet per minute at Fielde's weir after the New River Company had taken their supply. Under such circumstances you may take it, according to my experience, that it was entirely and absolutely spring water.

707. Can you give us the volume in September 1865?—The mean flow of the river at Fielde's weir was 4,550 cubic feet per minute, inclusive of the water flowing towards London through the New River.

708. Have you a return which has been kept continuously of the volume of water passing down the river?—I have kept records continuously, but they are not yet calculated up. I do it entirely as an amateur matter, but I have not got them yet quite complete. I will have some of them prepared.

709. (*Chairman.*) With the knowledge you possess of the river and supposing that the navigation question could be superseded and the water supply could be made permanent, would it be difficult to secure for the metropolis a supply of spring water at all times, putting aside also the amount of money that might be required to accomplish that object?—Not in that sense I think, because the spring water flow is collected from such a large area, and you must have the surface flow mixed with it when there is rain.

710. You think that you could not insure, by any system of collection or by conduits, a supply of the largest volume of spring water the river and streams are capable of yielding?—I think it would be a very difficult operation and an expensive one, for you would have to drive into the very neighbourhood where your collecting places would be liable, from being lower than others, to collect the foul drainage, in that would be the difficulty, because the whole valley is so porous, that driving for springs in that way must lead to your getting sewage and drainage water.

711. (*Mr. Harrison.*) You mean that at present the water comes from below, and if there was sewage or any matter of that kind above it, and you were to tap from below, the sewage would follow and be mixed with it?—That I think would be the difficulty. Take the valley below Ware as an example; at the bottom of the valley drift there are large boulder stones, and

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from the hills, this substratum is teeming with springs, and when they boil out they flow over the ground and come into the river. The difficulty of the sewage question is that by touching anything like the valley itself you would run the danger of getting the sewage into the water; at the present time from a large majority of the buildings along the valley the sewage never gets to the river at all, they have cesspools of their own and drains and ditches and so on and it filters through and evaporates.

712. (*Professor Way.*) To carry out the supposition of the chairman, if any scheme could be devised with any hope of success for securing a supply of spring water, the interception of the sewage would in all probability form a part of that scheme, so that the fear of pollution would not exist?—You must keep them very clear of each other, and I fear if you did that to any beneficial extent your volume of water would fall off and you would not have supply enough; you would have to be so careful to shut out foul drainage, that you would have to shut out clean water. This difficulty has arisen at Hertford; the town was sewered by the New River Company, with the object of carrying the filth past and below the point where they took in their water, it being manifest that the town standing so close to the source of supply did not give nature any time to act to get rid of the bad effects of the sewage; the town was sewered through open gravel and the consequence has been that the New River Company have drawn a great quantity of fine spring water into their deodorising beds, which is a waste of the water, and oftentimes there is a very great difficulty in deodorising; they could not help it, for when the sewer was laid down in came the clean water.

713. If the bed had been dry the sewer water would probably have mixed with the spring water at another place?—Yes, it might.

714. (*Chairman.*) At the present time works are being carried out on a gigantic scale on the south side of the river; they have also been in progress on the north side for the low level metropolitan drainage. Do they, or do they not, shut out the foul water from those sewers?—They do not, I should say, shut out any; they have sucked out the water from everywhere. I was concerned in a case at Hackney where it was found that the sewer had taken away everything from some very valuable springs which used to supply some ancient watercress beds which were originally established there in Sir Joseph Banks's time.

715. Do you think that that is an absolute taking away of water by the internal conduit, or a draining away along the external line of the sewer in the gravel from the ground having been broken?—Originally, no doubt, it was a draining away on the outside, but I believe it got into the sewer eventually somewhere.

716. That is to say by filtration or bad joints?—By bad joints I should think.

717. I think you will find that Mr. Bazalgette, who is the engineer for the works, professes to keep the drainage out?—They say that not a drop came in in the first instance. The impossibility of doing this, however, was shown in the Lewisham road case. The Kent Waterworks Company contributed towards the construction of a sewer for the sake of carrying the sewage from the Crystal Palace away from their source of supply; the sewer was laid in drift of precisely the same character as the drift in this case; the springs poured into the sewer and they never succeeded in keeping them out. The springs disappeared from the ornamental gardens and from the brook altogether, and the Kent Waterworks Company have in consequence entirely altered their system of supply. The sewer took the brook water as well as the sewage, every effort was made to keep the water out and enormous expense was gone to to line the sewer, but in spite of everything the springs blew in the work. I do not mean to say there are many such springs within the metropolitan area as would act in a similar way and you may be correct in thinking that the drainage of the water is by the side of the sewer and that it gets away, but if you were to apply the same law to collecting sewers up the valley of the Lee you would find the same thing happen. I myself built a lock near to the Amwell springs, and it was blown up by the springs just as if a barrel of gunpowder had been placed under my works.

718. The springs lifting the work bodily?—Yes, and blew it up; the difficulty there was enormous. I got down into boulders, chalk and large boulder-stones which prevail there, and the water boiled up in a manner that I had never seen before. In the Lewisham sewer, a year after it was made, you could see the springs boil up in the middle of the sewage from the bottom.

719. (*Mr. Harrison.*) Before the passing of the sewage into the metropolitan sewer, did not a large party of gentlemen pass through on the occasion of the sewer being opened, and go and inspect the reservoirs?—Yes.

720. At that time was there any water coming in to any great extent before the sewage entered?—That I cannot speak to.

721. Do you not think it would have shown itself then?—I cannot tell you, but where the metropolitan middle level sewer goes there are large beds of gravel which are full of springs, and they have had to lay little pipes into the sewer by scores, so that anybody might now go into the middle level sewer in Finsbury and Bethnal Green and collect sweet drinking water fit to supply the population if it were not for the locality.

722. Do you think the springs are under considerable pressure there?—No. That sewer is constructed as it were on a hill. It is not the condition of things that I spoke of before where the springs boil out on the river Lee, but the springs generally flow in through pipes. You may see them in the sides of the middle level sewer.

723. (*Professor Way.*) The engineer of the metropolitan board, I think, does not say that the subsidiary or secondary sewers are water-tight by any means; he only claims exemption from leakage in the main sewer. The water that you speak of may come in at some short distance from, but yet not in the main sewer?—Yes, that is what I mean. The water may pass along, and by and by it will come to some place where they have put a pipe in and so it is let in.

724. (*Chairman.*) Is any part of the river Lee embanked above the tidal influence?—Small portions of the navigation are embanked, which has the effect of keeping the floods off the neighbouring lands, but not to any extent, or beyond what is necessary for the due management of the river itself.

725. Up to what point in the Lower Reach does the tide flow?—A very high tide would tail up to Lee Bridge mills.

726. How many miles up would that be from the Thames?—Five miles.

727. Is there any record to show the period when the river Lee and the Thames along the marshes there were embanked?—No, but it must have been at a very early date. We know from the annals of the city of London that the corn required for the use of the citizens was ground at the City mills at Stratford, and those mills could not have existed without embankments; they were essential to them. When I say that no part of the river Lee is embanked, I exclude the part which lies below Old Ford where it is all embanked.

728. What is the rise from the Thames up to the highest point to which the river can be navigated?—The highest point is 119 feet above Trinity high-water mark; that is the level of Hertford Pond.

729. What is the whole distance?—It is nearly 28 miles from Limehouse, taking the whole length.

730. What number of locks are there upon that length of the river?—There are 20 locks, besides six extra flood and tidal locks or stop gates.

731. At what date was the earliest masonry or timber lock of an ordinary character constructed on the river Lee?—They were built by Smeaton. I have

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always considered them to have been built by Smeaton between the year 1770 and 1780.

732. They were perhaps the first that were constructed in England?—I do not know.

733. It has been stated that Brindley constructed the first locks on the Bridgwater canal, but that is not correct?—I should think so. I believe that ours were not the first that were constructed in the country.

734. Is it your opinion that Smeaton was the first person who improved the river Lee navigation?—We know that he laid out the works, and that they were executed under his general advice. No doubt other engineers were called in occasionally, but Smeaton laid out the line of the navigation as it is defined by the Act 7th Geo. III. cap. 51. His works have since been improved on the same general course.

735. Are all the locks now in existence that were designed and constructed under Smeaton?—Many have been removed and others altered in situation; the fall of two or three locks has been concentrated into one in several places.

736. Were they made of timber, or brick, or stone?—The waist, platforms and foundations were of timber, but the upper and lower recesses for the gates were of brick.

737. I suppose with piling between?—Yes, there were piles placed about 16 feet apart with horizontal campsheeting.

738. What is the greatest and the smallest lift?—Smeaton laid them out for about a maximum of three feet draught of water, and a rise of about four feet, but now they have been very much increased. The width of his lock was 13 feet, but the width of the present locks up to Enfield is now 18 feet 6, and above Enfield the locks are made 16 feet wide.

739. What is the length of the locks?—96 feet from centre to centre of the gates.

740. What is the greatest lift that you have on the river Lee?—Abont 9 feet 6, except at the tidal lock at Limehouse; that will lock down to 13 feet fall, according to the tide. There is no doubt that a line should be drawn in forming locks so that there should not be less than 6 feet, nor more than 9 feet of fall The loss of water is enormous in a 9-feet fall, and the loss of time as well, with a greater fall.

741. Have you what are termed side ponds on any of your locks for the purpose of economising water?—There is a lock at Tottenham which has a side pond.

742. Does that enable you to save half the water?—Yes. We have also double locks at Old Ford, and they can be worked one against the other as side ponds. Those works were carried out in the year 1856.

743. (*Mr. Harrison.*) And since you have been engineer?—Yes.

744. (*Chairman.*) What is the present draught of your boats and the tonnage?—The present draught is four feet in order to get to Hertford, and six feet to get to Enfield. With regard to the tonnage, the maximum tonnage that can be carried to Hertford now is about 85 tons, and that with difficulty. The maximum tonnage that could be conveyed to Enfield would be from 100 to 110 tons.

745. Is there any steam navigation on the river Lee now?—Not practically to any extent. The Trustees do employ a steam barge, which answers well and has done a great deal of work.

746. Is there any steam towing or are the barges themselves worked by steam?—No, not besides the Trustees' own steam barge, excepting this, that the Grand Junction Canal Company send a pair of boats to Enfield lock now and then, but that is not done to any very great extent; they have steamers on their canal and they send a pair of boats sometimes which carry iron to the Royal small-arms factory at Enfield.

747. Is the towing done by horses?—Our towing is done by horses entirely.

748. I assume that the towing-path belongs to the navigation, but do the powers of the trustees extend to any defined line beyond the towing-path on one side and the water on the other, or do the water and the towing-path limit them on both sides?—Except on the old river, the bank on one side and the towing-path on the other are the boundaries on the cuts which form the major part of the navigation as defined on the section I have put in. The foot of the bank on each side is the boundary, or where there is no bank there is generally a defined boundary, but upon the newer portions of the river the Trustees have acquired land with fixed boundaries; they have a good deal of wharfage ground.

749. When the navigation was first formed and before much improvement had been carried out, do you know what the practice was, if the channel altered its course in any way, or the towing-path was washed away. Had the Trustees power to form another, irrespectively of any riparian rights to keep up and maintain their navigation?—I believe that the Trustees were kept to their line as a general rule; whether in olden times they did not evade it and whether they did not gradually encroach on the land is perhaps doubtful; but in my time, when I have had anything carried away during a flood I have attempted to restore it.

750. Is the ownership of the soil vested in the Trustees, or is it claimed in any way by neighbouring riparian owners?—It is vested in the river Lee Trustees. The opinion of counsel has been taken on the subject, and the different Acts of Parliament distinctly vest it in the Trustees. In that respect the river Lee Trustees are different from any others in England, the soil is vested in them and they are a body corporate; they were made a body corporate in 1850.

751. Do you find that much or any dredging is requisite in order to maintain the navigation?—A great deal of dredging is required in the lower parts of the valley where the sewage comes in, and that is gradually increasing and more dredging is required.

752. What is the material that is generally brought up, is it gravel, or sand, or filth?—There are certain points such as Limehouse cut and the Bow river, and to some extent near Tottenham where what is dredged up is sewage; but we have been gradually deepening the river, and so up to this time we rarely dredge without taking a good deal of clean gravel out; that is in the lower part. In the upper part of the river there is very little to dredge out except gravel and sand, but at certain points were the cut is entered from the old river, the floods form banks of silt which has to be taken out. These, however, are localised points that we know, so that we can go to any point after a very heavy flood and do what is necessary.

753. Have you any surface scavenging carried out under your directions or have your banksmen instructions to scavenge and cleanse the surface from weeds and floating carcases?—Yes; we cut the weeds and we dredge on a regular system. The officers employed on the river Lee are required to get out and bury any carcases, but these are very rarely seen above Tottenham. Latterly, in the Limehouse cut and all the way up the river towards Tottenham, there are in hot weather a considerable number of dead dogs and other things, but we have systematically had them collected and buried, and so got rid of.

754. Have you laid down any regulations with regard to bathing within your jurisdiction?—No very strict regulations; we warn parties against bathing so far as our jurisdiction extends; but there are parts of the old river in a few convenient places where bathing goes on without any control being exercised by the Trustees, but not to any great extent.

755. Do the Trustees claim the ownership of the fishing rights, or do they in any way regulate or license the fishing?—No; the fishing generally is held by private owners; the Trustees by the right of purchase are the owners of some fishing; at all the weirs, they catch eels; but those fisheries are let where they are worth letting.

756. What mill power is there upon the Lee that belongs to or is in any way controlled by the Trustees?—I may say, generally, that nearly all the mills from Ware to Lee Bridge belong to the two water companies or the Trustees, with the exception of one at Broxbourne and the Government mills, from King's weir down to Enfield.

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757. What kind of mills are they principally?—They are flour mills almost entirely with one or two exceptions; there is a chain of powder mills from King's weir down to the small-arms factory at Enfield.

758. Which are the Government mills?—Yes, these all belong to the War Department who allow their surplus water to grind corn at Waltham, and the water power at the small-arms factory turns grindstones for sabres.

759. Do you know anything of the river tributaries beyond your jurisdiction above you and up towards the sources?—I know them generally.

760. Are there any mills on the tributaries?—Yes, a great many, but they are entirely corn mills; I think there is scarcely an exception; there may have been one small paper mill near Luton some years ago, but I doubt whether it is there now.

761. Do any of those mills that you know of use steam as an auxiliary?—Yes; steam has been very much introduced.

762. As an auxiliary to water?—Yes, as an auxiliary to their trade, the demand increasing. A man cannot work a mill to any advantage unless he can draw plenty of wheat through it, and so he puts on steam; it is not altogether an auxiliary to water.

763. I need not perhaps ask you whether you would restrict the putting of ashes into the river within your jurisdiction or not, but suppose a man burns coal to any large extent and he puts the ashes into the stream, of course, you would complain of that?—Yes; but I hardly think there is a ton of ashes thrown into the Lee in a month; they are too valuable.

764. Because they are so well checked within your jurisdiction?—Nowhere on the Lee is it done; there are no steam mills of any importance above us at all; within our jurisdiction I should say that there is not a ton of ashes thrown in in a month.

765. As to the condition of the streams above you, do you think that any solid refuse is put in by riparian owners or by persons having access to the river at any point?—A little perhaps at Stortford; it is not as sweet as it should be there, and I think there must be some come in from Ware.

766. You think that as a rule the river is not subject very much to abuse from being polluted by solids or obstructed?—As a rule, I think not much above Waltham.

767. Have the river Lee Trustees any jurisdiction above the point to which they navigate to prevent such a state of things if it exists?—The Trustees have no jurisdiction beyond being the body who can make a legal complaint to the Court of Chancery and obtain an injunction; they can do nothing more than that, and that is a most expensive and troublesome process.

768. You can put in force the common law of the land which is applicable to nuisances?—Yes, but not any special law; that is what the Trustees very much want.

769. There is I believe no such body as a conservancy having charge of the entire valley of the Lee and its tributaries?—No; that is what is wanted, and that is what did occur to me when I was called in in 1850 as being a most desirable thing to have, that the Trustees should be a drainage board as well as a river board.

770. You say that the river or the navigation is now managed by the Lee Trustees, but supposing that persons above your jurisdiction thought fit to abuse the river by casting in solids, there is no recognized body whose duty it would be to step in and immediately prevent it?—No.

771. The offenders would have to be indicted by any parties who chose to take the matter up?—Yes, they must either proceed by indictment at common law, or move for an injunction in the Court of Chancery.

772. Would you be surprised to learn that in Yorkshire and other parts of the kingdom ashes are thrown into rivers and streams by thousands of tons annually, that foundation materials and road scrapings are thrown in in the same large quantities, and in fact every form of solid refuse, and otherwise, is thrown in because a river happens to be near, and it is cheaper to throw it in than carry it anywhere else?—Yes, I am aware of it; but I can san say absolutely that such a practice as that does not prevail at any point in the valley of the Lee. The river is owned by millers and landowners to such an extent that they would immediately stop such a state of things, because if permitted it would immediately affect the next mill below. I can give you an instance; in Luton there was a board of health and some years ago they began to foul the river, but a large landowner close below commenced a Chancery proceeding against them, and he holds them under terror to keep all the solid matter back, and practically, I believe that Luton does not hurt the river in consequence. By clause 109 in the 7th of George the Third, it is enacted that "if any person "shall wilfully throw ballast or gravel into the said "river, cuts, or canals, he shall be committed and "put to hard labour for a period not exceeding three "months," but that only applies to the river as a navigation.

773. (*Mr. Harrison.*) For a considerable distance the navigation and the river run parallel?—Yes.

774. Have the Trustees of the navigation any control over that part of the river?—No, very little indeed; nothing more than if there was any overt act by which the river was damaged, coming in afterwards into the navigation, then the Trustees would, by common law, have a right to complain.

775. They do not take any steps to keep it at a proper depth, or pass over the water in any way?—They have no interest at all in any way in that.

776. There are some parts of the river which have been canalised?—Yes.

777. In those parts of it, are you obliged in the summer time to give any considerable fall to the water?—No, there are very fine deep reaches in the river very much like the Thames, and we keep them perfectly clear, we keep them regularly dredged.

777*a*. I see that you have deepened some of them considerably?—Yes; we also dredge after gravel for profit in some of these rivers, and some of them are very fine deep rivers.

778. In those parts where the river has been formed into a navigation, have your improvements had the effect of passing off the floods more rapidly than before?—Very much so; in the last 10 years the valley has been sensibly improved in its drainage by the works which have been carried out by the Trustees.

779. Does that remark extend to those parts of the river which do not form part of the navigation?—Not entirely, but partially it does. There are certain portions of the river, say between King's weir and Chingford on the Essex side of the valley, that are comparatively in their natural state still, because they are only relieved by the improved navigable river in one or two parts in the whole of that distance.

780. Is the effect of passing off the floods more rapidly from that part of the river which forms the navigation to expedite the passing down of flood waters from those parts which do not form part of the navigation?—Yes; all that has been improved, but there are portions of the valley which are left in their original state.

781. Has the effect of the improvements that you have made in the parts of the river that form the navigation been to pass off the floods more rapidly, but to pass them on to parts of the river not under your jurisdiction, and which remain in their primitive condition?—Yes, to some extent that is so; but as the river has to pass at many points through the new navigation, the general effect has been to get the water

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off the valley more quickly, at the same time, as I have said before, there are some portions between King's weir and Waltham and between Waltham and Chingford which are not much affected by these circumstances.

782. Would it be beneficial to the whole of the valley of the Lee if the other parts of the river were placed under the jurisdiction of the Trustees of the navigation?—Certainly a great deal of improvement might be effected if there were means for it; some of the rivers are in a disgraceful state, the banks are allowed to grow up, and the place is left like a morass.

783. Is there much land flooded in consequence of that?—Yes; there is a good deal of land overflowed by the floods, but that is in the winter months, and the lands are not very valuable; they are left in a half soddened state, and water logged, both from a wet winter and a wet summer; the people do not seem to value the lands much, and many of them are lammas lands.

784. That is to say, lands upon which the occupiers of adjoining land can put their cattle for a certain period during the year?—Yes, but those lands are getting gradually enclosed.

785. Do you know whether the effect upon the health of the people is marked or not?—The truth is that there are so few people who live in those water-logged parts that I cannot tell you, no one indeed lives there, they are neglected places.

786. Are the lands so injured by that condition of things that an improvement to the land would pay for an improvement to the river if it were placed under the jurisdiction of the Trustees of the Lee?—If the commons were enclosed it would; not otherwise, as long as they are commons and open lands there is not sufficient ownership in them to make it worth while. When they get enclosed you soon see an improvement take place; they make partial embankments and deep ditches, and so on. We have had a marsh in Nazing opposite to Broxbourne very much improved in the last few years; besides being enclosed it was drained. The surveyor laid out a drain at my suggestion through that marsh, which has very much improved the land altogether.

787. (*Chairman.*) I assume that all those marsh districts are considerably above the level of West Ham marshes?—Yes; they have got plenty of fall, all of them.

788. It would be simply a question of embanking and keeping the floods from them, and getting an outfall by a cut down to the lower district?—Yes.

789. You could drain any one of them?—Yes, and there is one very strong instance of that where I hope this will be carried out some day, and that is the large marsh which lies below Lee Bridge. That marsh ought to be enclosed and the river-course improved, and part might be laid out as a park for the people. I may mention that the marsh is very much frequented by the poorer orders of London during the summer time, and it would make as pretty a park as can be imagined, if properly laid out, with the river Lee like a lake in it.

790. Is that marsh now common land?—Yes, and it is in a most disgraceful state.

791. Who is the lord of the manor?—I do not know exactly; Mr. Tyssen is lord for part.

792. Is the valley of the Lee in any shape or way a manufacturing valley in any part of its area?—Not in that sense above Enfield. The powder mills can be scarcely called manufactories, at all events it is one of the cleanest and quietest manufactures that can be carried on, they occupy about three miles of the river; but below Enfield we are gradually getting manufactories. One has been lately established as large jute works at Ponders End, and a large floorcloth manufactory has been erected in Edmonton parish. There are also some manufactories at Tottenham that drain into the Lee below Tottenham lock.

793. Is jute Chinese grass?—It is a vegetable fibre that comes from the neighbourhood of Calcutta, an Indian fibre, and it is now forming the basis of everything; they say that they even adulterate silk with it. Nearly all the coal sacks and flour sacks are made of jute now; it looks like hemp, and it is a charming article, but it has one drawback, that it will not stand wet; wet causes it to rot immediately.

794. Are there any fords in the river in the valley of the Lee?—There are a few fords in the old part of the river, but all the main lines of communication are bridged over entirely, and the old fords have disappeared.

795. Has there been any extensive system of land drainage in any part of the valley, or does the subsoil not require it?—The subsoil does not require it, the river Lee valley is healthy for that reason; there is a wonderfully free percolation of the water through.

796. (*Mr. Harrison.*) In the upper parts of the basin which are chalk would agricultural drainage be at all affected if it were carried out?—There is no occasion for it, it drains so excessively freely in the valley of the Lee. The malt trade of the Lee arises from the fine free quality of the land, growing as it does such excellent barley, it was carted down to Hertford and Ware and made into malt, and then sent by water to London; that was the origin of the Ware trade in malt.

797. No agricultural drainage would diminish the volume of water coming into the river from that area?—No, nothing could be done to affect that.

798. (*Chairman.*) In the course of our inquiries we have had very strong opinions expressed by many persons that from some cause or other, our climate is altering, that drainage or clearing of the land is gradually reducing the rainfall, and diminishing the floods. Do you believe that that is based upon any reasonable foundation; for example, taking the valley of the Lee, is that as subject to floods now as it was in a former period?—I should think so. I believe that there is to some extent a popular error on the subject; floods will come occasionally in such a valley as the Lee, but a bad flood comes but rarely; there was a terrible one in the month of May 1824, and there was a very bad one in November 1852. Again there was flood that topped the one of May 1824 in October 1857, but since then we have had no flood at all that has been equal either to the one of November 1852, or the one in October 1857, so that I might say that now great floods seem to be disappearing, as we have had none for so long. I think people forget these things, and we might run on till such a period as has elapsed, as that between May 1824 and October 1857, before we get another. While the present elements of nature exist, I apprehend that we shall in this climate be subject to these irregular periods of drought, gradually merging into wet periods, which prevail according to something like a law. We got into a dry period in 1865, and no doubt we have run into a wet period again, we had a wet period in 1860 or 1861; the summer of 1861 was marked by floods through the summer.

799. In our first inquiries in Yorkshire, for the first 3 or 4 weeks every witness, without any exception, was quite satisfied that there would be no more floods, but before we had completed our inquiry there was destruction caused by a flood, such as the oldest inhabitant could not recollect?—Yes, and so it will be everywhere, people are apt to forget what has already passed. There is one point touching this inquiry to which I may refer, namely, that in a valley like the Lee which is so full of porous grounds it is a long time before dry weather loses its influence. I attribute the low state of the river in 1865 to be the excessively hot weather of 1864. The wet marshes were cracked open, so that it was dangerous to walk across them between July and September, 1864; you might have dropped an umbrella out of sight in some of the cracks, many of which did not close up all the next winter of 1864–65.

800. And very probably they never would be watertight?—The water certainly during all the next year did not appear as usual in the river; so that the cause of the river being so low in 1865 was the drought of 1864.

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801. (*Mr. Harrison.*) What is about the level of the water shed of the river Lee within range of the chalk hills, how much does it rise above the sea?—The top of the range is about 450 feet, and the general average of the county round Hatfield may be said to be a great plain, with deep river channels cut into it; this table-land is from about 300 to 350 feet above Trinity high-water mark.

802. At what depth below that do the springs appear?—About 150 feet, they begin to boil out at about 150 feet below that level, and they cease to boil out when you got to about 80 feet above Trinity high-water mark.

803. Is that cessation in the boiling in consequence of the London clay overlaying?—I think so; underlying the drift and London clay, you get too far from the sources of the water to give fall enough for the water to come up with the same force, and you get an additional depth of drift and mottled clays, and then the London clays, which keeps down any tendency the water might have to rise. The Lee is a filling valley down as far perhaps as the parallel of Cheshunt; below that there is not much feed into it, except land springs and flood water. The lower part of the valley has a great thickness of pure green sand reposing on the chalk; near Ponder's End there is 70 feet of this material; the whole depth to the chalk being about 100 feet. At Tottenham lock the London clay is close to the surface, and is many feet thick.

804. You gave us the minimum volume of the water you had recorded as passing after the abstraction of water for the New River Company at Hertford?—Yes, as passing over Feilde's weir.

805. Where is that?—At the junction of the Stort and the Lee.

806. That is after taking in all the springs intervening between Hoddesdon and Hertford?—Yes, with one exception; that gauging does not take in a large spring at Hoddesdon. Hoddesdon mill and other springs are not included in that gauging.

807. Do you know what they are?—Hoddesdon mill spring discharges about 300 cubic feet a minute; 2,700,000 gallons a day.

808. There is a large drainage south of Hatfield where you may see plenty of swallow holes; Have you examined that district?—Not much.

809. It is of very considerable extent, is it not?—Yes.

810. All the water passes away?—Yes. I think they are not so much swallow holes as vast beds of sand. There may be swallow holes underneath and the water gets away. The bed of the river below Hatfield park has swallow holes. The Marquis of Salisbury took me last year over the bed of a pond on the river course from which he had diverted the river. He made a dam across the pond and laid one part of it dry and the water was going through the bottom of the pond, which was of fine sand.

811. That water no doubt passes into the chalk and finds its way out below?—Yes, not far below.

812. It was suggested to us in a former inquiry by Mr. Bailey Denton, that advantage must be taken of the drainage of the clays in certain places by passing it into the chalk in that way so as to increase the perennial supplies to the springs in the river adjoining; do you think that it is at all impossible?—I think there may be places where it would be very possible, but I could not apply such a scheme to any part of the valley of the Lee.

813. Go to the valley of the Stort; do you know the geological character of that valley?—It has a very great deal more of clay. The river Stort quickly floods.

814. Is it from the Stort that the floods chiefly arise in the lower parts of the valley?—Not chiefly, but in a great deal larger proportion than from the other parts. The river Stort is very foul when it floods.

815. Does it fall down to a great extent in a dry summer season?—Certainly it falls off comparatively to nothing, and in that respect it shows its clayey character.

816. Is that the case with the Ash also?—Yes, the Ash is a steep river also. I do not think that the Ash has so much clay in it, but it is a steep river, and it falls off very much. It floods rapidly after a certain amount of rain. None of those other rivers flood after the first rains. We have a regular monsoon in this country as in India. For example, we have our first warning rains, and then in October we have a heavy rainfall; it is very rare that we do not have a flood in October, when whatever collection may have taken place in the ditches of the upper country gets washed out and the water comes down very foul for the first 24 hours, when a flood has got to its maximum it comes down foul, but after that the water soon becomes clear. I can mention an instance which has occurred in the last week. The river was in a high flood on the 7th of this month and the water was then foul, but on the 9th it got nearly back to a fine and clear condition. I was surprised on Sunday to see it a fine magnificent volume of water, nearly clear, although so shortly after a high flood.

817. In the river Thames from observations that have been made by Mr. Simpson, it would appear to take nearly 30 days after a heavy general flood before the river assumes the appearance you described just now, indicating the springs at its source?—Yes, but it is very different in the river Lee, because we are so much nearer the spring head and get so much larger a proportion of water from the springs.

818. And more rapidly passed into the river?—Yes, I can assure you that it is a matter of fact that on the 7th of this month the river was in a state of high flood, and on the afternoon of the 9th one half of the whole volume of water was spring water. I know it by former gaugings, we had only got volume enough in the river, but so small a volume was it reduced to that one half of it was spring water; the river was falling off to a wonderful extent.

819. Have you made any observations at Hertford so as to determine approximately the quantity of water that is evaporated from the surface above Hertford?—No, but I know a great deal about it from the gaugings made at Feilde's weir, and from comparing the quantity that flowed off with the quantity of rain that fell.

820. Will you be kind enough to state the result of your observations there?—I will, if you please, answer that question by referring you to the table, where taking the depth of rain actually run off at unity, the rain gauge showed 4·26 in 1851; 4·35 in 1852; 4·29 in 1856; and 4·74 in 1858. In other words for every inch available as water supply in 1851 there was 4·26 inches of loss and so forth. (*See end of the witness's evidence, Appendix No. 2.*)

821. I believe the New River Company take water not only from the river Lee at Hertford and from the Chadwell spring, but pump also from wells?—Yes, they have pumps near the springs but they pump very little.

822. You stated, I think, that there would be a difficulty in drawing a larger quantity of water from the wells for fear of having the sewage flow back through the chalk or gravel; do you anticipate that that would be an obstacle to your drawing a larger quantity from the wells than you do now?—If the water had to be taken in that way upon a large scale, that is if it were collected by culverts upon a large scale, I apprehend that at the same time you would take care to have a proper system of sewerage upon a large scale, and I think that the two things together would be liable to clash. I have always looked at that as one of the difficulties in foul draining the valley of the Lee, that you must lay main sewers where the fine water is most plentiful. Wherever you attempt to lay a sewer in the valley of the Lee you find yourself taking in beautiful spring water. Carrying on works as I have done, I have found that when I have attempted to pump the river out in order to construct locks, it has been the most difficult engineering operation to get

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rid of the water that comes from everywhere, it is in fact to pump the whole district round.

823. Do the East London Waterworks Company take the water from your navigation, or from the old river?—From the old river. Under their Act of 1852 they were empowered to cut the navigation off from the old river in several places so that the old river became the carrier of pure water for miles above their point of abstraction; consequently their supplies are not affected by the navigation at all until above Ponder's End.

824. Then the navigation above a certain point acts partly as as a subsiding pond for their water supply?—Yes; if it does take in the sewage and the stuff carried down by the floods, it settles in other parts of the navigation.

825. At the lower part of the river you stated that there were two miles and a half which were jointly under the jurisdiction of the river Lee Trustees and the Thames Conservators?—Yes, we call it technically the Bow creek.

826. To what height do the ordinary spring tides rise there?—The rise of the bed of the river between Blackwall and Bow Lock is about 7 feet at low water, and the tide at Bow Lock rises 13 feet.

827. What is the difference in the level between ordinary spring tides and ordinary neap tides?—About 3 feet 6 at high water.

828. Is there any large extent of surface of the bank and bed of the river that is exposed between those two points during neap tides?—Yes, there is a good deal of bank, and all the Lee waters ebb out, so that the river is a mere stream at the bottom of a large muddy creek.

829. Therefore for some days there would be a considerable area left without being covered at all with water during the 24 hours?—Yes.

830. Of what area do you suppose that must be?—In acreage perhaps 10 or 12 acres.

831. What is the condition of that surface?—It is ooze and mud with a few reeds growing in it; there is a good deal of reed shore above the influence of the neap tides, but below the spring tides.

832. Is there much sewage matter carried up from the metropolitan outfall and from the West Ham works into that portion of the river Lee?—Since the middle of August last we have been very much relieved of anything from the metropolis, for they have set a temporary pump to work at the West Ham station, and they pump it now under the Lee, but there are many outlets still which are not connected so that we still have sewage coming in. There is a very annoying place at Bow brewery; there is also a newspaper factory and a soapworks near Old Ford that cause a great deal of nuisance; on the whole, however, we are very much better than we were. West Ham drains into the tidal creek below Barking iron bridge, and that does not help to mend the creek by any means; when the Metropolitan Board's pumping engines set to work at the Abbey mills, the West Ham drainage ought to be dropped in there; their culvert goes close to it, and some arrangement, I think, must be made to send it down there, unless the West Ham local board make their own pumping station near Barking. There is this disadvantage, that when the tide returns up Bow creek, it brings up anything through our flood gates; it flows to Old Ford lock on one side, and towards Limehouse on the other; but bringing in the sewage from the Thames, and being locked in as it is at Limehouse and at the Bow gates, of course what sewage there is drops to the bottom of the river, which renders it unwholesome in hot weather.

833. Is it worse than it was before the completion of the sewerage works?—Yes, it has very much increassd in the last year or two. Then the Tottenham drainage also coming in deteriorates the quality of the water, and we suffered very much from it, both in 1864 and 1865, and last summer but in a less degree.

834. Was there a considerable nuisance caused by it then?—Very great, and that is a thing that will grow, although they have taken it away from the metropolis. If something is not done with the Tottenham sewage above, we shall be liable to have the same nuisance where, until the last few years, it was a very beautiful river; that is, above Lee Bridge. In my opinion, some large scheme ought to be devised to carry away the drainage of the valley then.

835. It would appear that London has removed its drainage to your neighbourhood, and that you feel the disadvantage of it?—Yes; now that London has got rid of its difficulties the suburbs are increasing and the evils are repeating themselves. I have prepared this map (*handing in the same*) for the purpose of explaining the new state of things; this map is a general sketch showing the state of the valley below Edmonton at the present time.

836. Are you sufficiently acquainted with these parts (*pointing to the map*), Poplar, Blackwall, and Limehouse, to say whether they are above or below the level of high water?—The greater portion of that district is below the level of high water. In addition to that there was no efficient system of sewerage carried out; the inhabitants were of a very low class, and very badly built houses existed all over that district.

837. I believe the low level sewer has been partly carried out?—It was, in fact, at the time of the breaking out of the cholera, complete throughout the district but they had no outlet at the end. They are making from the low level, or they have made, a deep sewer into the Poplar district, running under the Limehouse cut at Bromley lock, which is just completed; one was also contemplated under the Victoria park approach to drain the Isle of Dogs.

838. The condition of this district (*pointing to the map*) at the breaking out of the cholera would be very similar, would it not, to the condition of that district on the south side of London where it broke out on a former occasion?—No doubt of it; and there was quite enough to account, I think, for the breaking out of the cholera, in the filth of some of the places here (*pointing to the map*), without looking to abstract theories. The first cases of cholera that we heard of at Bow were those of a man and his wife who worked in a small factory by the side of St. Thomas's millstream. A great many people work there, and in a very small building; they had an abominably foul ditch by the side of the factory, and this ditch was cut off from the general West Ham sewerage district, and was in fact illegally fouled by this factory and by some other nuisances above. The street in which the cholera raged so badly in Bow was close behind Lloyd's paper works, and the smell from a brewery and the stuff from Lloyd's paper works occasionally was of the foulest description. About six weeks ago I had occasion to visit an enclosure close by the newspaper works at the end of this street (*pointing to the map*), and I was convinced that there was quite enough to account for the cholera appearing there.

839. Where does the discharge from the paper works find an outlet?—Into the river Lee, close below Bow bridge. There was a smell from Esparto grass in the tanks. There was a sort of faint smell from it that was dreadful, and the closeness of the place was something worse than I ever experienced in my life, that was where the cholera broke out.

840. Is the part you have referred to below the level of high water?—No; it is on the side of a hill facing the east.

841. Are you aware whether there was any obstruction to the free passage of the sewage from Poplar about that time consequent upon the flaps being out of order?—I do not know. I had a great many men at work at Limehouse at the time, and knowing that cholera was raging so badly I of course made my inquiries, and it appeared that at the time of the outbreak there was scarcely anybody who was not seized with diarrhœa. I do not believe we had a man among the 60 who were there employed who was not ill in that way.

842. Was the effluvium from the river, and in the district bad at that time?—The effluvium was very bad.

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843. (*Chairman.*) Do you know what the ordinary condition of Limehouse cut is?—The ordinary condition of Limehouse cut has been very fair during eight or nine months of the year; but it has been very bad in dry, hot, summer weather in the last four or five years, within which period factories have been increasing, and sewage has been increasing from the metropolitan area.

844. It has been literally, has it not, an open cesspit?—It has been a good deal like it.

845. Was it not so in the last spring?—I think from about June.

846. When the cholera broke out?—Yes.

847. An open continuous cesspit?—Yes, as foul as it could be.

848. Are you aware that a barge load of blue vitriol was sunk in the middle of it, which throughout its whole length entirely disinfected it?—Yes. It must be remembered that we labour under other difficulties which must be explained. All the fresh water that we have flowing down the river is divided into five parts, so that several of these streams (*pointing to the map*) also are water-logged, and get foul. Then there is a reservoir there (*pointing to the map*) that it would be very desirable to close up; it collects mud, and I think it ought to be closed up. An improvement might be made also in the drainage of this district and the cleanliness of it if there were means at hand. We can help ourselves in foul times by opening the gates at Bow locks into Bow creek. We do that, and we almost always do it on Sundays to clear it out and to draw the water off the land generally, but the collection of mud increasing in these other rivers (*pointing to the map*), there are dead ends to them that we cannot draw. Much good, however, might be done. We do all that we can to draw off the water from the surface, but the difficulty is this, when you get a very short water time and hot weather, the drawing off is no longer of any good, for the smell from the river that has been drawn is worse than when the river is kept up. The foul water that passes down Bow creek never gets away; it is pounded up, and comes back to us the next tide. During the past two summers I was obliged to keep the water up instead of drawing it off. When the autumn water comes, or we have had a wet summer, we can draw these places off, and they can be kept comparatively sweet.

849. (*Mr Harrison.*) Have the trustees any control over these branches (*pointing to the map*)?—No; they have no control over any but their own branch down to the Four mills. The others are private branches. One belongs to the East London Company, two to the city of London, and one to Christ's hospital. There are the means of getting a very great improvement made here (*pointing to the map*); this part might be very much improved if we could cut the river off there (*pointing to the map*) and turn part of this ground into a park. It is all open common now.

850. (*Chairman.*) Have you had any communication recently with the West Ham authorities relative to their sewerage?—The trustees of the river Lee have not had any communication with them, but the Essex Sewer Commissioners have had a communication with them. The Commissioners have offered to give them every facility they could, but nothing tangible has been done yet.

851. Had not the local board some understanding, or did they not obtain some sanction from you as engineer relative to their outlet?—Not the Trustees, but the Essex Sewer Commissioners sanctioned a new wall for passing the outfall through their embankment; beyond that they have had nothing to do with it. At Barking iron bridge the Commissioners also sanctioned the making of another outfall.

852. (*Mr. Harrison.*) Is that portion of the land (*pointing to the map*) water-logged or liable to be flooded?—It is not flooded at all, or very rarely; the West Ham sewers now underdrain it completely. There are still some islands above the Stratford road which are not connected with the West Ham sewerage, and they are more liable to be water-logged.

853. What is the substratum of this district (*pointing to the map*) which is marked "Poplar" and "Bow"?—It is a fine bed of gravel and sand.

854. How far does it extend from the river inland?—In all directions; to Hackney, Homerton, Victoria park, and Bow common. They are all on a great bed of gravel and sand.

855. (*Chairman.*) All this district (*pointing to the map*) is more or less peaty and compressible?—Yes. The district I have just spoken of is bounded by the Limehouse cut and the river Lee. When you get into Poplar you get to the marsh in the same part of the river, there the London clay does not exist, and you have drift, and peat, and gravel.

856. Have you ever had occasion to use the ordnance bench marks in this part of the district (*pointing to the map*)?—I have used them.

857. I wish distinctly to say that any person wishing to refer to ordinance bench marks, ought never to refer to them anywhere near where the metopolitan drainage works have been carried out, or anywhere within the area of West Ham, or the flat district where the sewers have been carried out; houses, streets, and bench marks have been lowered from 6 to 7 inches, and in some instances 12 inches by gradual subsidence from the draining of that site?—Your remark applies, I think, to the east of Bow creek. The West Ham sewerage drains that district very completely, and the only fault that it has is that it does not go far enough, it requires now to be carried farther; a new outfall is wanted now at Barking creek or somewhere else.

858. (*Mr. Harrison.*) Were you consulted at all when the outfall was made for the West Ham sewerage?—Yes, so far I was consulted that I advised both the Trustees of the river Lee and the Essex Sewer Commissioners that the outlets must be only looked upon as temporary only, inasmuch as the metropolitan drainage works were then being commenced, and it was only a question of a few years when proper relief would be obtained for the district, without throwing the sewage into Bow creek.

859. The outlet was made under those conditions?—Yes.

860. So that the West Ham board of health are now under an obligation to remove the present outlet, and discharge the sewage at some other place?—Yes, and they must do it; it cannot be deferred much longer.

861. I dare say you remember that Mr. Simpson mentioned at the Institution of Civil Engineers, some gauging which he had made on the river Churn above Cirencester, showing that the volume increased from the Seven springs down to a certain point, and diminished after that; so that at a certain distance below the source it was reduced to nearly the volume obtained at the Seven springs. Have you observed any such phenomenon on the river Lee as a loss in the volume of water below a certain point?—I have not in that sense, but I have no doubt that it does occur at Hatfield. I have no doubt that the river is lost to a certain extent and then comes out again above Hertford in the form of springs.

862. Can you say that from actual observation?—No.

863. Is there any stipulated volume of water for the use of the navigation?—Yes, that is all set out in the Act of 1855, the whole agreement in fact is embodied in that Act. The companies have their shares as between themselves, and with regard to the river Lee Trustees, a certain volume is set apart for the river Lee Trustees when they want it.

864. The volume which you have power to take is 3,500,000 gallons a day is it not?—The Trustees can take for the use of the navigation, from the upper reach above Feilde's weir 3,600,000 gallons per diem; between Feilde's weir and Waltham 4,500,000 gallons per diem; between Waltham and Old Ford 5,400,000 gallons per diem; below Old Ford lock, all the surplus water belongs to the navigation. By the River Lee Water Act 1855 the Trustees are bound to undertake

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new works for improving the water supply at the expense of the companies if they require such; if consumption of water in the navigation is to be reduced the Trustees may be called upon to execute the necessary works under similar conditions; but practically there is not much water wanted for navigation, compared with the resources of the river. If the companies wish to exercise their powers we can reduce the quantity of water consumed in the navigation to a very small quantity. The quantity of water which the New River Company could draw before 1855 was limited by the marble gauge, but the Act of 1855 removed all restrictions and divided the water in certain proportions to the New River Company and the East London Waterworks Company, and then after these certain proportions had been received they took half, foot for foot, each of them. Under the powers of that Act, the New River Company laid down pipes past the marble gauge, and they also put in a new balance engine; their supply was very much increased indeed, no restriction was put upon it, and a new balance engine was put in, the old legal quantity was removed, that is to say, the quantity mentioned in the reports and so often spoken of as going through the marble gauge was altered by the Act of 1855.

865. (*Chairman.*) What is the working establishment employed by the Trustees?—It varies.

866. There is a paid secretary, is there not?—Yes, and a paid engineer, also bankmen and dredgermen.

867. Are they paid out of the funds which the Trustees have at their disposal?—Yes.

868. I think you have stated that the Trustees are not paid?—Yes.

869. Do you know whether they have any capital account?—Yes; we have always been carrying out large works on borrowed money.

870. They mortgage their income to raise the money?—Yes.

871. And they pay interest upon their debt?—Yes.

872. What is the present amount of the debt?—The clerk will be better able to state that.

873. Since you have been engineer to the trust have they expended much money on new works?—Yes, a very large sum.

874. Can you state the amount in round figures?—I should think they have expended at least 160,000*l.*

875. In what number of years has it been laid out?—In 15 years.

876. Was the whole of that money borrowed?—Not entirely. Under the Act of 1855 the New River Company contributed 30,000*l.* towards the works; the money was laid out specifically in new locks and works. The New River Company paid it in aid of a better water supply for the metropolis.

877. Has the East London waterworks contributed anything for similar purposes?—Yes, they contribute in the form of income.

878. Do you mean for works which have been executed?—I mean generally towards the funds of the trustees.

879. What do they pay you now?—2,000*l.* a year.

880. Is that 2,000*l.* a year to be a perpetual mortgage upon the trustees for works accomplished, or will it cease at any time?—No, it is a perpetual income contributed towards the resources and for the purposes of the trust.

881. In consideration of certain sums of money laid out at some former period by the trustees?—It was generally in consideration of sums to be laid out.

882. In the event of any conservancy being set up, do you think it would be compatible with the constitution of the trustees that they should become conservators if the necessary powers were tendered to them for acceptance?—Do you mean that they should become conservators and drainage commissioners?

883. Yes. Conservators and drainage commissioners for the entire valley of the Lee?—My opinion is that it would not be convenient for them to become drainage commissioners anywhere above Hertford. I think that above that town it should be left to the different local parts, but I think there should be power given to prevent nuisances being committed, and that some such powers should be conferred upon them, as have been recently granted to the river Thames Conservators, that is to say, if the authorities in any town chose not to drain properly, the trustees should have the power to go in and execute the necessary works, and charge the town with the costs, and levy a tax upon them. I am strongly of opinion that something of that kind ought to be done. The great difficulty is to force people to do what is right; unquestionably something ought to be done with the drainage of Bishop's Stortford, but unless the whole navigation of the Stort was vested in the Trustees, which might be inconvenient at the present time, because it is private property, it might be difficult to deal with it. I think that parties who are at such a distance as Bishop's Stortford should be left to carry out their own drainage, but that the Trustees should have power to go in and do it compulsorily, if after a certain number of years notice they did not do it.

884. The river Lee Trustees holding in trust the main navigation in the lower part of the river do in a measure hold the key to the whole valley, do they not?—Certainly.

885. Would it in your opinion be a convenient arrangement to establish a new form of conservancy to have jurisdiction over that part of the valley where they would be liable to come into collision with the Trustees?—I certainly think there would be no objection to that on broad principles, the subject is of course quite new to me, and in what form it should be I am not prepared to say.

886. You think there would be no objection to a new conservancy?—No, I think not as to the lower part of the valley; to deal with, say, the valley drainage below Enfield or below Broxbourne, something of that kind is called for because the Trustees now only hold the position of objectors general to everything, and it would be more convenient for everybody if they could say "Very well, "if you will not put this place to rights we will do it "for you and tax you for doing it." It certainly is a case, I think, in which it is possible to form such a body.

887. The Trustees you have said are unpaid?—Yes.

888. Then by what interest are they moved or what is supposed to be their interest in the navigation?—To keep it sweet and pure, that is all.

889. Are they large riparian owners?—Some of them are; not all by any means. The members for Hertford, Essex, and Middlesex are *ex officio* members of the board, so that in fact the whole of the contributing area is represented on the board.

890. When you have board meetings, does anything like the whole number of the members attend?—No; the *ex officio* members do not attend the meetings much. We emanated originally almost from the city of London, the mayor, the corporation, and aldermen are members of the board, and sometimes they take a good deal of interest in the meetings.

891. Is it true that the great mass of the business is transacted by a very few members?—Yes, there is a working board; I think that that works better.

892. Is the work done by a committee selected from the entire board and appointed by them?—No, it is not done by a committee but by the board.

893. Do you mean that a certain number are nominated by the rest of the members?—No, there is no nomination. Notices are given to the whole body; we have no committee for the monthly meetings.

894. But I suppose there are some members whom you never see, and others whom you see frequently?—Yes.

895. In the event of the Government desiring to interfere with the valley of the Lee and with the present arrangements for sanitary purposes, do you think that a large or a small board would be most eligible?—I really have not formed any opinion upon the subject, but practically our board may be called a small board.

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896. Should a board having such duties to perform as those which are entrusted to it be, in your judgment, an unpaid or a paid board?—I think it would be rather better if there were a small payment.

897. Do you think it would come within the range of your duties to act as engineer for a conservancy board and at the ame time to act as engineer to the river Lee trust?—Certainly; the engineer of the river Lee could act much better and more effectually if he had the drainage under his control, and if there were funds to carry out improvements; the great thing is to have the sinews of war: you cannot deal otherwise with such a matter. The river Lee Trustees have no funds at present with which to deal with these things, and it is a great grievance, I think, to have perpetually to go to law for the purpose of restraining or punishing wrong doers.

898. Do you think that if the river was to be managed by a conservancy board for the benefit of the riparian owners and the towns on its banks; for the benefit also of the navigation and the different water companies, it would be an equitable and unobjectionable way of raising an income to levy a rate upon all persons who should be directly or indirectly benefited?—I cannot answer that question quite in the form in which it is put; my opinion is, however, that to a small extent taxation ought to be laid upon those towns that are drained into the river and who thereby compel the Trustees to incur expense in various ways. On the other hand the people might say, referring to the way in which you have put your question as to their being benefited, "We are not "benefited; it is true that our drainage is passed "into your river and you say that it may damage it, "but if you put us to any expense we shall not be "benefited." In the sense in which I have explained it I should be inclined to tax those persons whose drainage formed the very subject matter with which you had to deal.

899. Then you would take an area supposed to be directly or indirectly affected by the river and also benefited by the works which had been executed in it?—Yes, because the land to be benefited by mere drainage is practically *nil*. You could get no taxation out of any absolute benefit done to the land; you must take the broad principles as laid down in the Public Health Act and tax them broadly; not upon the old system, viz., that you could only tax parties whom a jury of 12 men would say were benefited; that is the essential difference between old sewer law and the new board of health law. The board of health takes a district; they do not look very minutely into the question of who is benefited, but they take a whole district, and they tax the people in that district.

900. From your knowledge of the valley of the Lee, do you think you could define a limit beyond which you should not go, but within which taxation should be imposed?—Not at the moment, but I think there would be no difficulty in doing so.

901. That will be a matter for consideration?—Yes.

902. The taxation you have suggested would be imposed under parliamentary authority?—Certainly, there should be taxation, but people should not be taxed by the Trustees direct, but a law should be passed as in the case of the county rate, to levy a certain amount of taxation on each district in a lump. The Trustees should not collect the money.

903. But do you mean it to be handed over to the fund in charge of the Trustees?—Yes.

904. To be expended by them, and that they should publish annually audited accounts?—Yes, I may say that the Trustees do that now, but no doubt there should be accounts published drawn out with great minuteness, and there should also be an annual report presented to Parliament.

905. For this purpose, of what do you think the establishment should consist in addition to a secretary an engineer and the staff which he might choose to appoint under him?—I should think not much more, there would of course be inspectors required, and they would act under the secretary or engineer. It would not require the machinery of a very extensive staff, but if such a plan were carried out there must be some very extensive works carried on in the neighbourhood between Tottenham and Stratford in order to get rid of some portion of the foul state of things which exists down there; that must be their work, and there must be a large outlay of capital if the works are to be completed, and a general system adopted; the mere working of the thing need not be an expensive matter.

906. In the event of any large works being devised and sanctioned by Parliament, or by some properly constituted authority, the engineer, I presume, would either let them by contract, or he would have power to call to his aid persons who were required to superintend and carry out the works?—Yes, the works would be planned and carried out and the capital expended. I thought that your first question applied to the annual expenditure.

907. Have you seen the scheme as drawn up by Mr. Bailey Denton called the Lee Valley and Ham Marshes Sewage Bill?—No.

908. How many lock-keepers have you at present? Have you a resident lock-keeper at each lock?—Yes, on the average we have quite one per mile.

909. I assume that the whole of their time is not occupied in the duty of lock-keeping?—Pretty much so; the work is too much for them to get away much from the lock.

910. Do you know how your income and expenditure balance at the present time?—I think that perhaps the clerk will answer that question better than I can, but they balance very fairly. On the whole we do very well. The trade very much increases.

911. Do you regulate your rates in proportion to your income, or are they fixed?—We should regulate them according to the income. We have practically a fixed amount, and if we find ourselves short of money, we try to economise in our work for a year, and not to do so much. Ever since I have had to do with the river we have always been improving, putting substantial works instead of old ones.

912. Is there anything which you think you can add to the evidence which you have so kindly given to us?—I may mention that the East London Company have deposited plans in the last month for diverting the future drainage from Waltham, Cheshunt, &c. I have not had an opportunity of seeing those plans, or knowing anything about them, but they would touch the question of the general conservancy of the river, and so on, and perhaps rather increase the desirability of having something done.

913. That question will come before Parliamentary Committees in the next session?—Yes.

914. Is there anything further which you would wish to add?—Nothing occurs to me now. I shall be most happy to state anything afterwards, if it should occur to me.

915. Are you also engineer for the New River?—No. I may say that the New River Company last year called upon the Trustees to execute a new work near Hertford in order to get the water better to London, and that was paid for by them in addition to the 30,000*l.*, and that is one of the works which either they or the East London Company could call upon the Trustees to execute under the powers in the Act of 1855.

The witness withdrew.

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APPENDIX No. 1 to the Evidence of N. BEARDMORE, Esq., C.E.

RAINFALL at FEILDE'S WEIR, HERTS.—(Height above Sea, 90 feet).

Extract from Manual of Hydrology, by Nathaniel Beardmore, Esq., Civil Engineer, (referred to supra, Question 701).

Years.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	Mean of 10 years.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
January	3·2	3·5	4·6	3·4	1·7	0·5	2·3	3·5	1·0	1·3	2·5
February	0·8	1·0	1·5	1·4	0·9	1·0	1·3	0·2	1·8	1·4	1·1
March	0·2	4·1	0·3	1·7	0·5	1·8	1·0	1·6	0·7	2·0	1·4
April	3·0	1·8	1·6	2·8	0·7	0·2	2·0	2·3	2·8	2·4	1·9
May	2·3	0 6	1·8	2·5	3·4	2·4	3·6	1·3	2·6	1·1	2·2
June	0·8	1·4	3·2	3·0	0·8	1·2	0·7	1·6	0·9	3·2	1·7
July	3·2	3·3	2·7	4·0	1·5	5·3	2·2	1·5	3·3	3·2	3·0
August	1·3	2·1	3·7	2·4	1·9	2·0	2·6	2·2	2·9	2·2	2·3
September	2·0	0·6	4·0	1·5	0·6	1·8	2·8	3·8	1·1	3·7	2·2
October	1·8	1·8	6·0	3·8	2·4	5·2	1·9	5·1	1·4	2·7	3·2
November	1·8	1·1	7·8	1·8	1·6	1·9	1·4	1·6	0·6	3·1	2·3
December	1·9	0·6	2·3	0·4	1·9	1·7	2·5	0·7	1·7	2·9	1·7
Total	22·3	21·9	39·5	28·7	17·9	25·0	24·3	25·4	20·8	29·2	25·5
Mean of 5 years			26·1					24·9			
Winter	7·8	8·2	7·8	14·9	4·1	5·0	7·2	7·6	5·1	5·0	7·4
Mean of 5 years			8·7					6·0			
Spring	6·3	7·9	6·9	10·0	5·4	5·6	7·3	6·8	7·0	8·7	7·2
Mean of 5 years			7·3					7·1			
Summer	8·3	7·8	16·4	11·7	6·4	14·3	9·5	12·6	8·7	11·8	10·8
Mean of 5 years			10·1					11·4			

Years.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	Mean of 7 Years.
	in.	in.	in.	in.	in.	in.	in.	in.
January	3·40	0·85	2·15	3·50	0·95	4·00	3·90	2·68
February	1·50	2·35	0·38	0·70	1·20	1·95	4·05	1·73
March	2·60	3·10	3·42	0·85	2·72	1·40	1·90	2·28
April	1·30	1·28	2·60	0·80	0·73	0·28	1·95	1·28
May	4·30	1·40	2·80	1·00	2·40	2·40	1·70	2·29
June	5·60	1·95	2·30	3·94	1·55	1·90	3·20	2·92
July	2·00	2·00	1·32	0·78	1·00	3·05	1·95	1·73
August	4·05	0·55	2·65	1·85	0·95	3·56	2·20	2·26
September	2·70	0·80	1·50	3·05	2·23	0·60	4·40	2.08
October	1·70	0·90	3·45	2·10	1·05	5·40	2·55	2·45
November	2·60	4·60	1·40	2·05	2·50	2·35	1·95	2·49
December	2·00	1·20	1·78	1·35	0·60	1·90	2·50	1·62
Total	33·75	20·98	25·75	21·97	17·88	28·79	32·25	25·81
Mean of 7 years				25·81				
Winter	10·90	7·80	8·33	7·38	5·55	9·05	12·20	
Mean of 7 years				8·74				
Spring	13·80	7·33	11·12	6·59	7·40	5·98	8·75	
Mean of 7 years				8·75				
Summer	10·45	4·25	8·92	7·78	5·23	12·61	11·10	
Mean of 7 years				8·62				

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APPENDIX No. 2 to the Evidence of N. BEARDMORE, Esq., C.E.

RIVER LEE, HERTFORDSHIRE. DISCHARGE OF THE VALLEY AT FEILDE'S WEIR (including all water taken into the New River above that place).

Drainage area 444 square miles; height of district from 80 feet to 500 above the sea; mean 240 feet. Length of main river 31 miles, of tributaries 92 miles above the weir; which is above 20 miles from the Thames at Blackwall.

Extract from "Manual of Hydrology," by Nathaniel Beardmore, Esq., Civil Engineer (referred to supra, Question 704).

Year 1851.

Month.	Mean temperature at Greenwich.	Rainfall. No. of days.	Rainfall. Maximum day's rain.	Rainfall. Total.	Discharge over Feilde's Weir. Maximum.	Discharge over Feilde's Weir. Minimum.	Discharge over Feilde's Weir. Mean.	Discharge per square Mile.	Depth run off district.	Proportion of depth run off to depth fallen.
	Deg. Fah.		In.	In.	Cubic feet. per min.	Cubic feet. per min.	Cubic feet. per min.	Cubic feet. per min.	In.	1 to
January	42·9	18	1·10	3·65	83,080	7,227	23,198	52·2	1·04	3·51
February	40·1	12	0·40	0·90	29,641	10,367	14,868	33·5	0·58	1·55
March	42·6	20	1·22	4·35	95,677	9,448	28,582	64·5	1·24	3·51
April	44·7	14	0·56	1·80	38,565	11,384	15,682	35·3	0·66	2·73
May	50·9	10	0·30	0·76	21,216	8,887	11,207	25·2	0·48	1·58
June	58·9	11	0·50	1·45	11,217	6,455	8,678	19·5	0·36	4·03
July	60·1	16	1·55	2·92	10,930	6,235	8,000	18·0	0·30	9·73
August	62·3	8	1·05	2·33	8,562	5,569	6,894	15·5	0·30	7·77
September	56·9	9	0·36	0·63	6,669	4,508	5,814	13·0	0·24	2·63
October	52·6	12	0·45	2·15	8,108	4,473	6,260	14·1	0·27	7·96
November	37·9	10	0·40	1·10	7,342	4,753	6,290	14·2	0·26	4·23
December	40·4	6	0·50	0·58	8,126	4,660	6,127	13·8	0·27	2·15
	49·2	146	1·55	22·62	95,677	4,473	11,800	26·6	6·00	4·26

Year 1852.

January	42·0	16	2·20	4·67	79,469	5,260	19,912	44·8	0·86	5·43
February	40·8	10	0·60	1·48	40,957	9,305	14,575	32·8	0·59	2·51
March	41·3	3	0·30	0·35	9,880	6,158	8,065	18·2	0·35	1·00
April	45·9	2	0·56	0·94	8,226	5,102	6,722	15·1	0·28	3·36
May	51·5	12	0·48	1·76	7,571	4,865	6,429	14·5	0·28	6·28
June	56·1	21	1·02	4·35	44,695	4,929	9,804	22·1	0·41	10·60
July	66·6	4	1·03	3·15	14,436	4,760	6,432	14·5	0·28	11·25
August	62·1	15	0·65	4·08	29,098	4,890	9,717	21·9	0·42	9·71
September	56·8	13	1·20	4·02	63,214	5,405	13,823	31·1	0·58	6·93
October	47·9	15	1·60	5·22	91,744	9,011	27,614	62·2	1·19	4·39
November*	48·9	22	1·80	7·30	106,795	18,699	55,341	124·6	2·32	3·15
December	47·6	19	0·55	2·39	66,707	23,323	36,273	81·7	1·57	1·53
	50·6	152	1·80	39·71	106,795	4,760	17,892	40·3	9·13	4·35

Year 1856.

January	39·4	18	0·55	2·35	69,428	9,225	24,345	54·8	1·05	2·24
February	42·0	10	0·45	1·30	60,420	10,060	16,829	37·9	0·68	1·91
March	38·7	6	0·70	1·00	15,167	8,669	10,246	23·1	0·44	2·27
April	46·8	13	0·60	2·00	22,935	7,555	9,944	22·4	0·42	4·76
May	49·5	18	0·77	3·60	47,031	7,533	12,235	27·5	0·53	6·80
June	55·2	7	0·30	0·65	13,963	7,399	9,264	20·9	0·39	1·66
July	61·1	13	0·72	2·25	8,792	6,009	7,529	16·9	0·32	7·03
August	63·6	10	0·80	2·60	6,047	5,266	5,759	13·0	0·25	10·40
September	55·2	7	1·05	2·80	11,312	4,119	5,851	13·2	0·24	11·66
October	51·7	10	0·25	1·90	12,030	4,958	6,634	14·9	0·29	6·55
November	40·7	10	0·40	1·40	20,056	5,969	7,849	17·7	0·33	4·24
December	40·2	12	0·40	2·05	64,902	6,242	14,500	32·6	0·63	3·25
	48·7	134	1·05	23·91	69,428	4,119	10,915	24·6	5·57	4·29

Furnished by Nathaniel Beardmore, Esq., Civil Engineer (referred to supra, Question 704).

Year 1858.

January	—	8	·20	1·00	12,396	7,101	9,932	22·37	·43	2·32
February	—	7	·50	1·80	92,383	9,470	18,718	42·16	·73	2·47
March	—	9	·14	·75	14,466	6,748	10,046	22·63	·49	1·58
April	—	8	·80	2·80	82,869	7,429	14,282	32·17	·60	4·67
May	—	16	1·45	2·60	32,568	6,527	10,268	23·12	·44	5·91
June	—	5	·50	·88	9,620	5,753	7,169	16·15	·30	2·93
July	—	14	·70	3·30	9,628	5,199	7,100	16·00	·31	10·64
August	—	10	·90	2·90	7,632	4,387	5,734	12·91	·25	11·20
September	—	11	·20	1·05	7,250	3,107	5,116	11·52	·21	5·00
October	—	12	·28	1·43	6,088	3,586	4,874	10·98	·21	6·81
November	—	8	·18	·60	5,665	3,546	4,746	10·69	·20	3·00
December	—	16	·42	1·75	9,058	4,121	5,392	12·14	·22	7·60
	—	124	1·45	20·86	92,383	3,107	8,614	19·40	4·39	4·74

* This month had the heaviest floods known all over the Eastern Counties, and basin of the Thames; they happened during the week of the funeral of the Duke of Wellington, and the flood is generally called after his name in consequence.

LONDON.

Mr. C. Greaves.

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Mr. CHARLES GREAVES (London) further examined.

916. (*Chairman.*) Have you anything to add to your former evidence?—There are one or two points which you asked about yesterday. I was asked the proportion of houses having watercloset arrangements. I am not able to furnish that information at all distinctly as to the whole district, because we have not before in going through our district counted up that particular distinction of closet fittings and no closet fittings, but in a survey which is at present in progress I have it partially done. I can give you an enumeration of two districts; in one or them out of 5,938 houses, 4,509 have closets and water supply fittings to the closets; in the other case 8,474 houses include 4,611 closets.

917. Do you think that those would be fair average proportions for the whole of your 90,000 houses?—I do not see why the proportion of the whole should differ from that, it is a large proportion.

918. (*Mr. Harrison.*) It is very nearly a closet for a house?—In the first case there is a larger proportion of closets than the second.

919. (*Chairman.*) Is there any other documentary evidence which you have to give?—I am not prepared with anything else.

920. (*Mr. Harrison.*) We have had evidence from Mr. Beardmore this morning as to the point to which the spring and the neap tides rise in the river. The difference of height he mentioned as being about 3 feet 6 between the ordinary spring tides and the ordinary neap tides, is that about correct?—I should think so.

921. He also stated that he thought that the banks exposed to the action of the sun during the neap tides would be about 8 acres; those are the banks at the tidal portion of the Lee?—That is a point upon which I can hardly make an estimate.

922. Do you think that it so much as that?—I should think quite that, because a very narrow strip over several miles of river would make eight acres.

923. Mr. Beardmore also mentioned that there was a considerable deposit upon that area so exposed, and that there was a considerable effluvium arising from it during the hot season and during neap tides, causing a nuisance in the neighbourhood?—There is no doubt that in hot summer weather the smell from the river is at times dreadfully offensive, but how to distinguish between the smell from the water itself and the smell from the banks is perhaps a fanciful thing to assert.

924. Is the smell as great when the tide is in at a full spring as at other times?—No.

925. Mr. Beardmore also stated that that nuisance had increased since the execution of the metropolitan sewerage?—Since the imperfect development of the main drainage.

926. Do you think there is a point up to which it attained a maximum, and that it has been diminishing since then?—Decidedly; because the public outcry throughout the whole of the eastern district against the discharge which was taking place from the unfinished main drainage system was sufficient to induce the metropolitan board to put up temporary pumping engines, by which the evil on that account was very much diminished, and they are now lifting a very large proportion of the low level sewage into the main drainage pumping station.

927. Are your old reservoirs on the banks of the tidal portion of the Lee?—They are.

928. And they are within the influence of this area so exposed during the neap tides?—Yes.

929. For what length of time has the water been stagnant in those old reservoirs?—We call them the uncovered reservoirs; I should say since they were disused, which is since 1855.

930. The water has not been replaced by a fresh supply?—Only in a small way, not by any emptying and filling again, or anything of that kind.

931. From whence do they receive the supply to replace evaporation?—At present they have neither inlet nor outlet; but, as I described in my evidence yesterday, they were connected with the disused canal coming down to Lee Bridge, and if they lost more than we could otherwise supply it was within our power to fill them up again from that source if they did not get filled by the overflow from the filtered water aperture.

932. Do you think that those reservoirs adjoining the Lee, and subject for that number of years to the gases arising from the waters of the Lee, would imbibe a portion of those gases, and would become foul from that cause?—I never thought so, nor is there any evidence that they are so excessively foul. No doubt the deposit in the bottom is not so sweet and clean as the water in the upper part, but they are generally bright, and sometimes very bright.

933. Do they vary in appearance at the surface?—Sometimes they are a little cloudy, and sometimes they are excessively bright, because warm weather will cause water to become cloudy by producing vegetation in it.

934. In your opinion does the brightness of the water at all determine the purity of the water?—Not altogether.

935. (*Chairman.*) I think that Mr. Harrison has put the question whether the evaporations and the emanations from the surface in the spring of this very year were not very foul through the open ditches, the open cuts, the open river, the mud banks, and in the case of all the surface evaporations in that district, which give off foul gases?—I do not know that that state of things was particularly prevalent in the spring of this year, but the discharge of sewage from the incomplete main drainage works reached the culminating point in this year, and the local member of the metropolitan board strenuously urged the damage which this was doing to general health, and induced that board to establish a pumping engine to lift the sewage from the special low level branch sewer which takes up the Hackney district, anticipating what will be done for the whole of the low level sewer when the pumping station is complete.

936. How long does your filtered water remain in the low-water reservoir as a rule before it is used? If it is filtered to-day is it in the services on the same day; have you not a very large storage of pure water?—No, but I do not withdraw from the storage which I have, more than one-third of its depth on any day. I am not speaking exactly to figures, but that is nearly about the proportion.

937. Are you pumping the fresh filtered water as it is filled?—No, the pure water reservoir holds three times what is taken out of it in the course of a day.

938. Is that the upper or the lower pure-water reservoir?—I am speaking of the Old Ford covered reservoir, it holds three times what I draw out of it in the course of a day, the one third which I draw out I fill up again in the course of the following night, and therefore, it is as if you took a bottle and drew out one third of its quantity and filled it up again.

939. Then very little of that water is exposed to the evaporations, contaminations, and deleterious influences of which we have been speaking?—Very little; I should say that there is no contamination.

940. If you have an open reservoir of several acres in which the water, however bright, has been standing for several weeks, that water has been exposed very much longer than the other water to any deteriorating influences, if they have any action upon water?—Decidedly, that is clear.

941. Do you know chemically that water has a powerful affinity for various gases?—Yes.

942. And that a very bright sparkling water may surcharge itself to a very great extent with gases?—Yes.

943. Ammonia for instance?—Yes.

944. It may absorb many times its own volume, that is to say, that a cubic foot of water may absorb many feet of ammonia gas?—I am aware that the quantity is large.

945. You are aware that in a soda-water bottle the gas is in volume many times the quantity of the water in the bottle, it being under pressure?—Yes.

946. Then it is possible that the water in the open reservoirs, although apparently bright, may be in a very different condition to the water supplied to your customers?—Yes.

947. (*Mr. Harrison.*) In consequence of the length of time that it has been stagnant in the river Lee?—I think that that is a fair conclusion.

948. You mentioned to us yesterday that you had known a case where gas had mixed itself with the water supply?—There was a sort of inhaling of the gas just by the fracture of both gas pipe and water pipe. The water running away drew the bulk of the gas into the pipe. The two pipes were broken and the breaks were near one another, and as the water-pipe emptied itself by the water running away it filled itself with gas, then the supply of water coming in at the other end pushed the gas forward and made it burn at the tap.

949. Considering your intermittent system of water supply is not such an accident as the fracture of a gas pipe, and a leakage into your water pipe, a case likely to occur?—It is so rare that it could not be considered as one of the accidents to which pipes are liable.

950. You have put in a number of reports for the last few months. At page 277 there is this observation, "One of these reservoirs was recently emptied and was "filled again. These old reservoirs are not used, the "covered reservoirs containing the only water fit for "use." Can you say whether or not there is any truth in that statement?—There is no question that the larger of the two uncovered reservoirs was emptied by special steam power into the Pudding Mill stream.

951. When was that?—At the beginning of this year, in the spring, when we had under consideration an abandoned notion of extending the covered reservoirs at Old Ford.

952. How was that reservoir filled again?—Partly by rain, and partly by the leakage from the adjoining reservoir, which was full.

953. Can the water soak from the adjoining reservoir into this reservoir?—It appears that it did. The northern reservoir was full, and the southern reservoir was empty.

954. How far were they apart?—Only about the breadth of this room, and there was no substantial barrier between them; in fact, only one, which having been damaged, it had not been thought necessary to repair.

955. Did you observe at the time how the reservoir was filled again?—I stated that opinion myself to Dr. Frankland, not exactly in those words, but that it had acquired water again by rainfall and by soakage from the adjoining reservoir.

956. What period did it take?—Some weeks. We never had it full. There has been more made of the fact than was right, but there is no question that the bottom of that reservoir is not tight.

957. What is the subsoil under that reservoir?—More gravel than anything else.

958. In a case of that sort there is a communication between that gravel and the reservoir, so that the reservoir can be filled from the gravel below it?—I suppose so.

959. Does that gravel bed pass under the river Lee adjoining?—I do not quite know where the division of the strata takes place, but there is a considerable difference in the character of the sub-strata on the line of the river there.

960. What is the level of the water in the open reservoir when full, as compared with high-water in the river Lee?—I should think that it was rather above Trinity, but tides of course rise above Trinity.

961. Then do you think that the water in the reservoir would be nearly level with spring tide Trinity?—Yes.

962. What is the depth of the reservoir?—It is 10 feet deep.

963. Then might not the leakage be from the river as well as from the adjoining reservoir?—When water rises in a soil which is permeable, it is of course difficult to say where it comes from.

964. The point from which you take your supply I think is some distance above the tidal influence altogether?—A long way, not only in distance, but in height. There are two locks, and two mill-falls between.

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965. You are now, I think, authorized to take 23,000,000 gallons a day?—That is not the proper definition of the quantity which we are authorized to take.

966. Is that about it?—No, I cannot say that it is. The New River Company are entitled to take 2,500 cubic feet a minute at the first cut out of the river up at Hertford; then the East London Company are entitled to take a similar quantity. That is the way in which the priority stands. We hold the whole river. The river is committed to us, barring a certain quantity which is given to the Trustees for the purposes of navigation only. We divide the river between us, but there is a certain priority which has arisen out of the old standing of the New River Company, and their better position as to level, being higher up the river.

967. At present you have about 20,400,000 gallons, that is, of clean water in fact?—Yes.

968. Mr. Beardmore has said that you take your supply from the river proper, and not from the canal?—Yes.

969. You mentioned yesterday that the water is carried in a channel of 100 square feet down to the settling reservoirs?—Yes.

970. How frequently is the channel cleared out?—Two or three times in a year.

971. Is the water let off, and is the mud cleaned out?—We get it out pretty clean, but we send it forward; we open the sluice and send it down.

972. You send it into the river Lee below?—Yes.

973. Then you get it clean in that way?—We wash out all the mud, and we can get it cleaner in that way than in almost any other possible way.

974, How many settling reservoirs have you into which the water from that channel is conducted?—The whole area of the reservoirs which may be called settling, or storage reservoirs, is divided into fiv

975. So that you can cleanse each of them alternately?—I could do so, but they are of recent construction, and their cleansing is not a point which has become necessary yet; they could not be emptied without steam power.

976. Can you empty one part of this storage area and leave the remainder?—The five I could empty in three sections.

977. And you could leave the others in action?—Yes, not precisely, but to some extent I think. Reservoirs of that kind acquire a very small amount of sediment on the bottom.

978. How many years have they been in operation?—Only since 1863.

979. Have you any knowledge of the deposit which now exists?—There is no appreciable measurement of it.

980. Do you find any effects during hot weather, or during a change of weather from the condition of the water arising from that deposit?—Not arising from the deposit.

981. Do you find any effects from any circumstances?—The water changes its appearance and character on the surface, with changes of weather. It has at times an apparent tendency to vegetation in the warm weather; you see something preparing to start into life upon the surface.

982. What do you think that that arises from?—It is very difficult to trace the progress of these seeds of vegetation, or where they start from, or how they are disseminated.

983. Do you find that as the summer advances that vegetation disappears or increases?—That is the green weed which Mr. Harrison was speaking of yesterday. It acquires a full development and then disappears.

984. Where does it go?—It sinks down and goes away, and it becomes diminished in magnitude. All these water weeds are of very small body, and after

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they have ripened into full vegetation they seem to be gone until the next season.

985. Would not the deposit in those reservoirs be to a great extent sewage matter?—No, it would be weed, and clay and fine silica.

986. Did you ever clean out any of your reservoirs so as to ascertain that point?—It is mostly of a mineral character. The basins which we have been talking of as the covered basins were cleaned out thoroughly before they were covered. There was a great deal of mud in them then, but there was nothing particularly offensive in it. Of course, mud has always a bad name, and no doubt it had a certain amount of vegetable matter in it, but it was mostly fine clay and chalk and silica.

987. I think that you stated yesterday to the chairman that you could not tell exactly what volume of water the filter-beds would pass through them per square yard, or per hundred square yards, and that the quantity passing varied at different times according to the condition of the water?—According to the condition of the water and to the condition of the beds.

988. You said that sometimes the water in the filter-beds was very nearly level, and that at other times there was a considerable difference in level?—The more you choke the surface of the beds at times of course the more retentive they are, and the difference of level increases.

989. Do you find that at different periods of the year that difference is very marked?—Yes.

990. When do you find the filter-beds acting worst?—The two periods which give most trouble are, one due to excessive vegetation in the commencement of the summer, and the other due to an excessive deposit of clay in the winter. I cannot draw a comparison between the two.

991. Have you ever on any occasion such an obstruction arising from those causes as to prevent your filtering arrangements being carried out satisfactorily?—Never such as to prevent their being carried out, but certainly to prevent their being carried out satisfactorily. We have had to clean filter-beds on the Sunday, and to do things of that sort, but it never went to such an extent as to interrupt the filtering.

992. The water from the filter-beds passes covered into the tanks, both of the upper and of the lower pumping stations?—Yes.

993. So that evidently the water which you pump from those sources in each case would be identical?—Yes.

994. Are there any means of pumping water from the open reservoirs at the upper stations?—No.

995. There is no communication between your pumps and the upper reservoirs?—No communication.

996. Have you any wells from which you draw water at all?—We have a chalk bore which we have not yet put into use.

997. At the lower pumping engines have you any wells?—None at all.

998. Have you a communication with the closed tank, the one which is now stopped, the uncovered reservoir?—Yes.

999. In saying that your Waterworks Acts are properly carried out, is there any Government inspector, or any person authorized to look into the matter, and to see that the conditions of the Acts are fulfilled?—None beyond what is on your table.

1000. You have obtained certain powers, and you have carried out those powers?—Yes, an inspection was made by order of the Board of Trade, and Mr. Austin, Mr. Ranger, and Mr. Dickens came down.

1001. That was a special case?—Yes, there is no continuous examination.

1002. In supplying the tenements in the district which you supply with water, what is the size of the tap from which the persons in each tenement can draw?—Half an inch for constant supply as a general practice, and three-quarters for daily supply.

1003. Have you observed what quantity of water per minute or per hour can be drawn from a three-quarter-inch tap under the pressure which you apply in different parts of your district?—I cannot give it to you in gallons, but it is a matter of common daily experience with the subordinate officers of the company. In all waterworks certain pipes are sufficient for the supply as required.

1004. What quantity of water would a pipe three-quarter-inch bore deliver at the highest and lowest point of your delivery, when the supply is intermittent?—I do not think that it could be given in any figure, because the length and position of the pipe are various; a three-quarter-inch pipe is ample.

1005. Supposing that it is pretty close to your main, what quantity of water per minute will a three-quarter-inch pipe deliver with the pressure which you maintain; I understand that you maintain a constant pressure?—We maintain a constant pressure, but the pressure and flow do not always match one another.

1006. Do you not think that it is a point of importance to you to know what quantity of water a three-quarter-inch pipe will deliver at any point?—It is difficult to know it with precision in the different cases which arise. We know that a three-quarter-inch pipe and a half-inch pipe are more than enough.

1007. Cannot you give any figures as to the discharge from a three-quarter-inch pipe in your district under the pressure which you apply?—I may have had them, but I have not them by me; they are not figures of any value so as for me to keep them.

1008. For what period in the day do you supply water to the tenements under the intermittent system?—The average is about 20 minutes.

1009. I observe that in these reports there are two districts mentioned, in one of which the period is 10 minutes, and in the other it is 15 minutes?—Yes.

1010. And complaints are made of the shortness of that time?—Yes.

1011. Complaints are made to the medical officers of the two districts?—Yes, that is one of the difficulties. There are hundreds and thousands of cases in which houses could get their supply in 10 minutes, but we are obliged to give it to longer than the 10 minutes, because they are not prepared to receive it.

1012. What notice is given to the people occupying these premises that the water is going to be turned on?—It is a uniform period every day.

1013. So that the people know exactly when the water is coming?—They ought to be prepared; there is no excuse for not knowing.

1014. As the time is so limited it is of great importance that the quantity of water which can be discharged in the time should be well known?—Quite so, but it is now practically known.

1015. May there not be some persons who are so engaged that they cannot afford to obtain a supply?—I have no doubt that there are cases in that position, but if the water company are to give way to case after case of that kind they may give up altogether.

1016. Have you any poor districts where the supply is constant?—Yes, very large districts.

1017. What amount do you find practically that they take per head per day in such districts?—I myself am not indisposed to a constant supply, and I believe that if a more arbitrary power could be given for carrying out a constant supply, and if that power was exercised, a constant supply would be no more distressing to the water company than an intermittent supply.

1018. What quantity do they actually take in a poor district where there is a constant supply?—It varies, I suppose, from 60 to 120 gallons per house per day.

1019. For how many people would that be?—Taking our district through, I believe that the population is about eight to a house.

1020. So that it would be from 10 to 15 gallons a head?—Yes.

1021. The poor would take considerably more than the rich?—I suppose not, because the way in which the greater quantity of the water goes is by the water-closet arrangement. One of our great difficulties throughout the poorer and inferior districts is the difficulty of having fittings in the houses competent to receive the water. We know that the proportion of houses having nothing better than an 18 gallon tub amounts to 20 or 25 per cent of the whole population.

1022. I asked you yesterday as to the number of pumps and wells in the district which you supply; you could not give me any exact information upon the subject, but I found last night that there were reports upon the subject to the Registrar-General, and among others, there is one from Dr. Letheby who reports that the districts in which he acts include the City, East London, and West London, and that there are 35 pumps in the city; and he gives the quantity of organic matter, which is very much larger than either that from your company or from the New River Company?—Yes; those are public pumps I imagine, which had been erected as charitable erections in former years, and they stand by cab stands and kerbs of the pavement.

1023. He says that in most cases the constituents are remarkably indicative of the source and nature of the pollution, he seems to say that they are very polluted?—None of the old sewers were made with tight bottoms, and therefore the pumps and other things must draw water which is polluted.

1024. Besides Dr. Letheby's reports there are the reports of the Registrar-General in August and September 1866, which mention the number of pumps and wells. There is a report from Dr. Adams, the medical officer of health for Shoreditch; he says, "I have long "taken pains to suppress pumps and wells, and I "believe that the company's water is now almost ex-"clusively used." Dr. Liddle the medical officer of the board of health for Whitechapel, states, "I have had no "experience as to the effects upon health from pump "water, but the water from many of the pumps "recently became so foul that it was deemed advisable "to prevent the further use of them"?—Yes; we have had that information from time to time.

1025. Mr. Orton, the medical officer of Limehouse, states, "There are no public wells in use;" Dr. Woodforde, of Bow, says, "We have neither pumps, wells, "nor springs in use for the supply of drinking water." The medical officer of Poplar states, "There are not "any pumps or wells in my district"?—That I suppose means public pumps.

1026. There would not appear to be any great number of pumps or wells within the district, and those which there are appear to be very bad?—Yes.

1027. Do you know the quantity of water which is daily taken by the five water companies from the river Thames?—It is stated in the monthly reports.

1028. It is 48,375,000 gallons, and the two water companies take from the Lee about 43,300,000 gallons?—Yes.

1029. So that from the river Lee you take very nearly as much as is taken from the Thames?—Yes.

1030. The area of the Thames above the point of water supply is how many square miles?—I should think about 3,500.

1031. And the area of the Lee above your water supply is what?—It is about 450 or rather more; it is not more, taking into consideration the excluded district.

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1032. So that the volume in your case is taken from a much less total area, although your take is nearly as much as a whole?—Yes.

1033. Can you state the volume of water taken from the Lee in 1850 by the New River Company and by the East London Company, as compared with what it is now in 1866?—I do not think that I can state the New River quantity in 1850; the East London quantity was about 11,000,000 gallons a day.

1034. And at present it is what?—Nearly 20,000,000 gallons.

1035. I believe that in 1850 the New River Company had 12,000,000 gallons from the river, and now take about 16,000,000 gallons directly from the river?—Yes; and all that they took from springs would have gone into the river.

1036. So that the amount taken direct from the river was in 1850, 22,000,000 gallons; and is now about 37,000,000 gallons?—Yes, altogether.

1037. Have you an intimate knowledge of the district of Poplar and that neighbourhood?—I think so; I am well acquainted with the whole district.

1038. Were you acquainted with the condition of the sewerage of that district from the commencement of this year and until Midsummer?—There is no doubt that the sewerage of that district was in a very imperfect condition.

1039. Was the lower level sewer of the metropolitan drainage being carried out through that district?—Yes.

1040. It was not completed?—It is not completed yet.

1041. Was the sewerage of that low-lying district up to a recent period improved as compared with former years?—Quite unimproved, and in fact I should think that it would be a very fair thing to say that it was very much deteriorated, because by the discharge which was taking place into the river Lee and passing down the river Lee by various channels, the atmosphere was tainted more than independently of that nuisance it would be. There is no doubt that that was an imported nuisance, it was brought down to that low-lying district.

1042. The sewer which has lately been formed through the district is part of the low level sewer?—Yes.

1043. (*Professor Way.*) Nothing has been discharged into that sewer from the upper district of London, has there?—We do not precisely know what has been done, but it is quite evident that more sewage has been turned into the Lee than would be turned into it in a natural way.

1044. Was that in overflow times when the mid-level and the low-level sewer were made?—It was not only in overflow times but at other times.

1045. The low-level sewer has not been made through London?—No.

1046. (*Mr. Harrison.*) Do you know that more sewage was brought down to this district on account of the partial completion of that low-level sewer than was due to the district itself?—I should say so.

1047. Has it had any influence in the Limehouse cut and that part of the river Lee?—It has had a decidedly damaging influence.

1048. At present a pumping engine is placed at the terminus and the sewage is being pumped into the high-level sewer?—A certain quantity of it.

1049. Is there anything which you wish to add?—I think not.

The witness withdrew.

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Mr. J. Muir.

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Mr. JAMES MUIR (London) examined.

1050. (*Mr. Harrison.*) I believe that you are the engineer to the New River Company?—I am.

1051. That is one of the oldest established companies in existence?—It is.

1052. Whence does it derive its water supply?—It derives its water supply from the river Lee at a point between Hertford and Ware, and also from the Chadwell spring.

1053. Was the Chadwell spring its original source of supply?—It was.

1054. What volume of water does it deliver?—A varying volume, but the average is 400 cubic feet a minute.

1055. That would be 3,600,000 gallons a day?—Yes. Some gaugings which were made at the beginning of this year showed it to be very nearly 700 cubic feet a minute.

1056. That is 6,300,000 gallons a day?—Yes.

1057. What is the minimum flow which you have ever recorded?—The minimum which I have gauged is about 290 cubic feet a minute; that is a very rare occurrence indeed.

1058. When did you record the minimum?—I think that the minimum may be taken as having occurred in the year 1864.

1059. Was the quantity then less than in September 1865?—I think so, but I did not gauge it in September 1865; there was not the same reason for gauging then.

1060. You have not kept a periodical gauge at any time?—I have not.

1061. You also take water from the river Lee?—Yes.

1062. That is under an Act of Parliament?—Under an Act of Parliament, under which a quantity is now taken from the river Lee; it is the River Lee Act of 1855.

1063. What volume of water are you empowered by that Act to take daily?—It is stated in the Act to be 2,500 cubic feet a minute, and that is about 22,500,000 gallons a day.

1064. Do you take a volume to that extent?—No. Up to this day of this year I think that we have taken 18,000,000 gallons and a little over on an average.

1065. We understood Mr. Beardmore to say that that river is derived almost entirely from chalk spring water?—Yes; the drainage district is almost entirely chalk, and the water which it yields may be called spring water.

1066. Do you know the volume which passes down the river at the point at which you abstract the water?—I can only know it approximately by knowing what has been drawn through our own gauge, and by taking into account what the navigation may have used, and what may have been used by the mill in the immediate neighbourhood of us.

1067. And what is that?—I cannot give the average, but I think that the minimum is something rather less than 3,000 cubic feet a minute.

1068. That would be about 27,000,000 gallons a day?—Yes.

1069. What is the population within the drainage area above the point from which you take your supply?—The populations of Hertford and Luton amount to about 22,000; the population of Luton, from the census returns is, 15,329, and of Hertford 6,769.

1070. Are there any other large towns besides those two?—No.

1071. Are there villages to any extent?—Not to any great extent. I think that the most populous villages are on the river Rib and its tributary, the Quin; and I think that the population of that valley may be taken as about 7,187. These populations are taken at principal places on the tributaries. The population on the Lee, omitting Luton and Hertford, is 3,431; on the Mimram it is 2,212, and on the Beane it is 1,687.

1072. Making a total population above the point of supply of how many?—36,600, including Hertford, the drainage of which is carried below the Company's intake.

1073. You have not included Hatfield in that?—No, there is no direct drainage into the Lee from Hatfield, and in regard to Hertford and Luton I have kept them apart because they are dealt with by sewage works; the population not dealt with by sewage works is 14,500.

1074. Has Luton carried out a system of purification, or of irrigation?—Of purification.

1075. After the purification does the effluent water pass into the Lee?—It does.

1076. Have you had it examined as to its condition?—I have.

1077. What is its condition?—On some occasions its condition may be described as tolerably good; on other occasions complaints have been made at the instigation of the New River Company, some years ago. These complaints were brought before the Board of Health. The first complaints made issued in the town authorities carrying on this work of deodorization, and when the complaint was afterwards renewed they added to their works, and since the addition there has been no ground of complaint.

1078. As to the sewage of Hertford, have you yourselves taken steps to remove the sewage to a point below that at which you abstract your supply?—We have.

1079. And have you taken steps to deodorize that water before it passes into the river?—Yes.

1080. What are those steps?—They are described in the Hertford Sewage Act of 1854, in which it is enacted that the sewage after being collected shall be dealt with by Higgs's process, namely, precipitation by lime.

1081. (*Professor Way.*) The same as at Tottenham?—Yes.

1082. (*Mr. Harrison.*) Does the effluent water after that process pass in a pure state?—Yes, in a tolerably clear state. It is white from the application of the lime, and it is passed at a point below that at which the New River Company obtain their supply.

1083. Have you had that effluent water analyzed?—Yes. The sewage itself as it comes to the works is in a very diluted condition.

1084. Is that in consequence of the large introduction of spring water into the sewer?—Yes; the whole amount of suspended matter in the sewage is only about 6 grains and $\frac{3}{10}$ths per gallon.

1085. And what is the condition of the effluent water?—I cannot give that from the note which I have here. I must consult other memoranda.

1086. Perhaps you will give us an analysis of the water?—I will do so. (*The witness subsequently furnished copy of analysis, and it will be found printed at the end of his evidence, Appendix No. 1.*)

1087. Besides those two sources of supply, do you derive water from wells?—Yes.

1088. Where are they situated?—There is one well at Ware which has not been used for many years.

1089. Why did you cease using the water at that point?—One reason was that it was not required, and another reason was that it was supposed to affect wells in the town of Ware—wells in the gravel. Means have been taken to prevent that, and a bore is being carried down into the chalk so that it may not affect any portion of the town of Ware.

1090. To what depth have you sunk?—About 300 feet.

1091. Did you find water throughout the whole of that depth?—Yes, but all the gravel water is now shut out; it is cylindered to a considerable distance into the chalk.

1092. What is the diameter of your bore?—The well has a diameter of 7 feet at the top, reduced to 6 feet 6 in the lower cylinder. The bore is 2 feet in diameter.

1093. Do you know what supply that will give you?—About 2,500,000 gallons a day.

1094. What volume used you to draw from the wells before?—It is so long since we worked that well that I do not know what quantity it yielded. There is a second well at Amwell hill.

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1095. Do you take water from it now?—Very occasionally.

1096. With what volume will that supply you?—2,458,876 gallons in 24 hours.

1097. You do not take it because it is not required?—Yes; it is merely a means to fall back upon.

1098. What are the other wells from which you obtain water?—There is a well at Chesthunt capable of yielding 699,972 gallons in the course of the day. There is another well at Hoddesdon, not yet finished, but I suppose that it will yield about 2,500,000 gallons a day from the experience of pumping which we have already had.

1099. Your experience is that the water passes into your sewer pretty freely; do you find that by pumping water in large quantities from those wells you get it at all contaminated by sewage matter?—Not at all.

1100. Is that from the depth?—Yes, and the distance. The water which enters the sewers is entirely water from the gravel.

1101. Do you now use any subsiding reservoirs and filters?—Yes, our subsiding reservoirs are in Stoke Newington.

1102. Of what extent are they?—Of about 40 acres.

1103. When were they constructed?—About 1832.

1104. Have you any filters adjoining them?—Yes.

1105. How long have they been in operation?—Since 1856.

1106. Have you had occasion at any time to clean out the subsiding reservoirs?—They were cleaned out about 10 years ago.

1107. How long was it previous to that that they were cleaned out?—I believe not from the time of their construction.

1108. How many years would that be?—From 1832.

1109. What depth of deposit did you find after that long period of subsidence?—I was not engineer-in-chief then, but Mr. Mylne was, and I have heard him say that it consisted chiefly of mineral matter, clay which had been brought down by the stream and deposited there.

1110. What was the depth of it?—It varied.

1111. Can you state the average?—I forget it. I should add that there are also subsiding reservoirs at Hornsey, and filtering beds in connexion with them.

1112. What is the extent of those filtering beds?—Two acres at Hornsey, 5 acres at Stoke Newington, and $2\frac{1}{4}$ acres at the New River head.

1113. Are those the whole of the reservoirs?—Those are all the filtering beds which we have, excepting what are in course of construction, and those will add 2 acres to the area which I have given.

1114. Have you large impounding reservoirs?—No, not in addition. We have the subsiding reservoirs, which I have described, 40 acres at Stoke Newington and about 8 acres at Hornsey.

1115. What volume of water will those two sets of reservoirs hold?—I do not know that I can give that off-hand. The depth is very varying, but I think about 15 feet is the average depth in one of the Stoke Newington reservoirs and about 12 feet in another, and the area is 40 acres.

1116. How many days' supply will they afford to the district which you supply with water?—If they were pumped, which we have not the means of doing, they would afford a supply for 10 days or a fortnight, but we use them only for the purpose of subsiding; they are drawn down for a few feet and then are filled again.

1117. Will you describe your filter beds?—They are made in the usual way with brick sides and a brick bottom, and covered with coarse gravel, a finer gravel thereon, and then from 2 to 3 feet of fine sand on the surface.

1118. What quantity of water per 100 square yards will those filters pass through per day?—By pumping hard in the wells, so as to reduce the level of the water much below the level in the bed, a very large volume can be got through, but it is a bad treatment of the bed; a proper pressure will deliver between 600 and 700 gallons per square yard in the course of the 24 hours. To deliver the requisite quantity two-thirds of our area would suffice.

1119. Do you find much deposit from your filter beds?—Not a great deal; the deposit is chiefly after heavy rains. Nothing is so troublesome as the growth of weed under a bright hot sun; that weed falls down upon the sand and stops it up; the bed is then run off and the surface scraped.

1120. Mr. Beardmore mentioned that the rivers from which you are supplied are very little subject to floods?—Very little indeed.

1121. So that there would not be much surface abrasion carried down?—Comparatively little. In comparing the amount of filtering area which the East London Company provide and the amount of filtering area which we find sufficient, I attribute the difference very much to that cause, namely, that we are not so much affected by flood or mud being brought into our beds as they are.

1122. They have a much larger area in proportion to the amount which they deliver than you have?—Yes, much larger. I am now constructing beds, making an additional area of two acres.

1123. (*Chairman.*) Would you think that a filter bed was being distressed if it filtered one gallon per square inch in the 24 hours?—That would represent a very high pressure. A great deal would depend upon the coarseness or fineness of the sand; coarse sand will allow filtration to take place rapidly, but it will not be nearly so effective.

1124. That would be about 1,326 gallons per square yard instead of 600?—Yes, that is just about double what I mentioned as the proper thing.

1125. In your filtering beds have you any animal charcoal?—No; that has been the subject of a good deal of anxious consideration, especially since the hint was thrown out last summer by Dr. Frankland that the company should proceed at once to use animal charcoal. I procured animal charcoal, sold at 15*l.* a ton, and I experimented with it, but I found the thing not immediately applicable whatever might be afterwards done with it; that was as bone black.

1126. In what form would the charcoal be as bone black?—Very much as ordinary charcoal.

1127. Do you think that that is not a case which Dr. Frankland ever contemplated?—I do not know; he spoke of it as bone black. I took his directions; I took what he recommended.

1128. (*Professor Way.*) It is the same as the sugar bakers would use?—Yes.

1129. (*Chairman.*) Have you made any experiments with it?—I made some small experiment at the time, but the result was not very satisfactory. I filtered through it without having any sand superimposed, and the rate of filtration was 41 times greater than that which we find a proper and suitable rate of filtration with sand.

1130. Do you not think that in the construction of the filter the best arrangement would be to let it come below the sand, and not to be influenced by the sand?—Precisely. I only made this experiment because we had filtering boxes recommended. I found that they could not be arranged for, and that that exceedingly rapid filtration was worse than useless. The material sold at 15*l.* a ton was so impure that I found that it added to the impurities of the water.

1131. (*Professor Way.*) That would be the failure of an attempt under pressure of time and circumstances?—Yes.

1132. Therefore that does not settle the matter definitely?—No. There is no doubt that animal charcoal is one of the best of purifiers, and would be effective if placed under sand, say 6 inches in thickness; but the cost of it would be very great; there is the removal of the sand, the putting down of 6 inches of charcoal,

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and the replacing the sand removed. I find that the cost to the New River Company would be about 94,000*l.*

1133. You have assumed a certain thickness of the charcoal over your filters?—Yes, under the sand; 6 inches.

1134. One element of the calculation would be the time that this charcoal would act?—Yes, it would become inert and would require to be taken out and reburnt.

1135. Is it a question of days or months, so far as you know?—We have not experience enough for me to say. We are now making inquiries upon that very subject. Dr. Frankland threw out a suggestion that it might last three or six months; six is his maximum period, and the expense of it would be a thing recurring every six months, and of course, enormous. As the water requiring to be purified is a very small amount of the company's supply we are in a difficulty. The water supplied for waterclosets and so on would have to be passed through the same expensive process.

1136. Still you have not by any means negatived the possibility of it?—No.

1137. And you think that it would be desirable to bear it in mind as a means of purification?—Yes.

1138. You are quite aware that the sand-filters, if they do anything in purifying the liquid water from the solid suspended matters, do not perform that process as as you would wish it to be performed?—If it is carefully conducted I think that the sand process takes out the whole of the suspended matter, but of course there are matters in chemical combination which it takes out imperfectly.

1139. Therefore it is highly desirable that an improvement should take place in the purification of water?—There is no great complaint to be made of organic impurity in the New River Company's supply. We have had two analyses every month, made specially by Dr. Letheby. It would seem to me that the average is hardly four-tenths of a grain of organic matter per gallon.

1140. You are aware that the analyses which have been made of waters of late years have gradually reduced the quantity of organic matter by greater manipulation?—Yes, I believe that there are some analyses, for instance, Dr. Frankland's, in which, are enumerated under the head of organic matter, things which are not actually organic matter. I think that there is a difference between his analyses and Dr. Letheby's on that account.

1141. You, I believe, claim that New River water is as pure or purer than the water from any other source in the district?—It comes from a chalk district, described to you to-day as supplying almost all spring water and we pour into it a very large volume of pure spring water, and the analyses of Dr. Frankland shows that the New River water is the purest water, so far as organic matter is concerned.

1142. (*Mr. Harrison.*) Is there much tendency to growth in the tributaries above the point where you derive your supply?—Yes, there are weeds, and I should rather call them beneficial than otherwise.

1143. Are they beneficial when they decay in the autumn?—No, not when they decay.

1144. Do you find a difference in the analysis of the water then as compared with other times?—The first difference in this year took place this month from the heavy rains.

1145. Bringing down decayed vegetable matter?—And mineral matter also.

1146. (*Professor Way.*) Do you know of any supply of water to London which would not be mixed more or less with hard water?—No, unless in the case of the supply from the Bagshot sands, which was proposed some years ago.

1147. That might be sufficient for drinking purposes?—Yes.

1148. Do you know the supply of water in Glasgow?—Yes.

1149. Should you prefer water in its ordinary state, as supplied to Glasgow, to the water of the New River?—I think not. I think that the water as supplied to London is a more tempting water as a beverage than the very soft water of Loch Katrine. There is no doubt that Loch Katrine water is pleasant for washing from its excessive softness, but I think that there are decided advantages in a water not so soft for drinking.

1150. I suppose that the quantity of water used for drinking purposes is extremely small as compared with the quantity of water used for washing purposes?—Yes.

1151. Do you not think that some advantage might be gained if you could get a water for drinking purpurposes less hard than the water of the Thames or the Lee, but still not so soft as the water of Loch Katrine?—I think that the hardness of the London water—namely, the Thames, the Lee, and the New River is very much reduced by boiling, and that it therefore cannot leave a great deal to be desired, and that the result said to attend the use of softer water is rather astonishing. The complaints which have been made as to the use of the harder water proceed to some extent upon a fallacy.

1152. Is all the water which is used for washing boiled?—No.

1153. Is a large proportion of it boiled; in scrubbing you cannot put your hands into boiling water?—No; the quantity of soap destroyed in washing will not be measured by the quantity of water in the basin in which you wash. Take a basin of cold water; the hands are washed. The quantity of water in that basin will not measure the quantity of soap destroyed by the process.

1154. Do not you think that that arises from the fact that it is hard water? You wash out of the basin when you have hard water and you wash in the basin when you have soft water?—A good deal is used merely to remove the lather which you have made.

1155. A soft water uses less soap than a hard water?—Yes, but the estimate made of the quantity of soap destroyed by the quantity of water used would be a fallacious one.

1156. Do you know Dr. Clarke's process for softening water?—Yes.

1157. Have you seen it tried on a large scale?—No.

1158. Have you seen it tried on an experimental scale?—Yes.

1159. I suppose you are aware that he can satisfactorily soften the Thames water from 14 or 15 degrees of hardness to three or four degrees?—Yes.

1160. Do you know that that process has been tried upon a very considerable body of water, and is in use at this moment?—I believe that it has, and I believe that a difficulty has been found in working with it, chiefly arising from the deposit in the pipes which convey this softened water. I believe that it is not merely the mechanical deposit of the fine chalk which the process throws off, but that crystalization takes place.

1161. Is it in use at North Woolwich?—It was, but I believe that it has been discontinued.

1162. What you describe would arise from the remains of the carbonate of lime, which had not gone out of solution?—I suppose so.

1163. Has the question of softening the water by Dr. Clarke's process come at all under the attention of your board?—It has been matter of conversation, but it has never been very distinctly before them, so as to be a subject of resolution.

1164. Can we ascertain the fact that the water does choke the pipes?—I understood that that was one of the difficulties in its use at Plumstead, but I have not seen it.

1165. Do you think that it is barely possible that the use of the lime process might do away with the necessity of filtration?—To a great extent, no doubt, it would be so.

1166. Where lime is used in the case of the sewage at Hertford it saves the necessity of filtration?—At Hertford the precipitation is followed up by filtration.

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1167. You say that Mr. Higgs' process is carried out at Hertford?—Yes.

1168. He had the process at Tottenham?—Yes.

1169. Is that process continued still?—No, it is discontinued.

(*Mr. Beardmore.*) It is nine years since it was used.

1170. (*To Mr. Muir.*) Was there any difference in that process from the one which was usually known as the lime process?—I think not. The patent, of which we bought from Mr. Higgs the right of using, was simply for precipitation by lime. I found it necessary to add chloride of lime, which had a powerful effect in stopping vegetation.

1171. You know that the lime process has been used in many places without success?—It has.

1172. And that even where it has been most successful, and has had the most chance of success, such as at Leicester, where the tanks were made to stop the valuable material, and not merely to clarify the water, but to produce a satisfactory result, they are giving it up?—It is not a commercial success, but it is as good a process of deodorizing as we can well use.

1173. Short of application to the land?—Yes. This particular process is prescribed in the company's Act as the one which they are to use, or (it is added) the one considered best, and we must wait to know what is the best process in order to apply it.

1174. Have you had at all under consideration the application of sewage to land?—It has crossed my mind, but the directors have not taken up the matter. I consulted Dr. Letheby not very long ago as to the application of the sewage of Hertford, and he thought that we could not do better than carry on the lime precipitation. Dr. Letheby said that we could not do better than increase the quantity of lime which Mr. Higgs prescribed, and I make it now, I think, three times what Mr. Higgs in the first instance prescribed.

1175. (*Chairman.*) Have you any means by which you could test Dr. Clark's lime process upon any considerable volume of your water without putting you to large expense?—I think that it must be attended with considerable expense if applied to any of our reservoirs.

1176. I mean any temporary reservoir, such as 2,000 or 3,000 gallons?—That would be a matter easily done.

1177. You could make a small tank and lime it with a due proportion of caustic lime, and make the experiment yourself?—Quite well.

1178. And you could try it upon different characters of water; upon the water when it was turbid, and upon the water when it was at the brightest?—Quite well.

1179. (*Professor Way.*) Mr. Simpson, some years ago, made an experiment at the Chelsea waterworks on 1,000,000 gallons in one quantity?—Yes.

1180. The experiment was very beautiful and very successful?—Yes. The difficulty in practice is giving time for the settling of the very fine impalpable chalk.

1181. Suppose that it could be shown that that process would dispense with filtration?—Then I am told that there would be a deposit in the pipes.

1182. (*Chairman.*) What volume of water per day have your company at command for supply to customers?—I think that we have now at command, including the various wells which we fall back upon if there is necessity, some 35,000,000 gallons per day.

1183. What number of customers do you supply in your district?—We have now more than 112,000 houses supplied.

1184. Then you are supplying by far the larger portion of the metropolis as compared with any other company?—Yes.

1185. What volume are you now giving to those 112,000 houses?—I think this month about 22,500,000 gallons per day.

1186. Have you any idea how many of those houses have waterclosets?—A great proportion.

1187. Nearly the whole of them?—Yes, excepting the very poorest places. There may be courts without separate waterclosets.

1188. Is your district an essentially watercloset district?—Yes.

1189. What is the population?—It is nearly 7½ per house.

1190. I think that the average for the whole of the metropolis is 8½ per house?—I thought that it was hardly so high.

1191. Yours is you think 7½?—Yes.

1192. What volume are you supplying for trade purposes?—It is difficult to say, because many trades are carried on in a small way in connexion with domestic consumption.

1193. When you supply for trade purposes do you supply by bargain or by meter?—In a great many cases by meter.

1194. What meter do you use?—Siemens's meter is the most convenient. I do not say that it is the most accurate, but it is very easily placed, and the customers do not object to it. They always object to a more accurate piston meter from its great bulk.

1195. Do you think that Siemens's meter is as fair to you as to the customer?—No.

1196. Would not Siemens's meter, if the supply was intermittent, register rather against the consumer than against the supplier?—I think not; but almost all our mains have constant supply where a meter is furnished.

1197. Have you any idea how many meters there are on that system?—There are 720 meters in use in the New River Company's district.

1198. You can also give about the average consumption?—Yes. Those meters together measure about 2,300,000 gallons a day on an average.

1199. What is the price?—It varies according to the scale of the Act of Parliament of 1852.

1200. Your Act of 1852 gives the scale?—Yes.

1201. Do you charge the maximum amount allowed in that scale?—Yes.

1202. Do you make any allowances?—We do in some cases.

1203. How many fire hydrants have you upon your services?—There have been some recently placed upon the mains in Cheapside for the purpose of washing the surface, but, generally speaking, all the fire supply is through the old plug. The cost of a plug, or the cost of a hydrant is a thing which by law should fall upon the parish. We have not required the comparatively inexpensive plug to be found by the parish, but we have found it ourselves, but the more expensive hydrant, costing 6*l.* or 7*l.*, the parishes or Metropolitan Board of Works must find.

1204. Is the water supply for fire gratuitous so far as you are concerned?—Quite.

1205. Do you supply any water gratuitously for baths, or hospitals, or fountains?—At reduced rates baths have been supplied, and practically you may say that there has been a cheaper supply to hospitals, though not nominally, for the full rent is put down, and the company make a donation.

1206. Do you supply any water by agreement or by meter, for ornamental purposes, in your district for fountains or for garden purposes?—Yes. We rather object to provide fountain supplies to parks and houses where the water may go to waste.

1207. You discourage it?—Yes.

1208. Would you discourage it if the supply was by meter?—We should not have the same objection then.

1209. Is a portion of the supply of your district intermittent?—Yes.

1210. What number out of the 112,000 houses which are supplied would be upon the constant system, and what number upon the intermittent one?—I think that only about 1,200 or 1,300 are now on a

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constant supply, and all the rest are on an intermittent supply.

1211. Is the intermittent supply on each day or on alternate days, or in what way?—Every house has a supply every working day in the week, and some of the houses have a Sunday supply.

1212. What is that supply?—It varies; but the rule is, that the supply in every case is to be left on by the turncock so as to fill the cistern, whatever it may be.

1213. In all cases are there cisterns or tubs for the intermittent supply to the poorer class of tenants?—In some of the poorest houses they have no tubs supplied by the landlords.

1214. Then if they miss the supply by being out, or anything of that sort, they miss the supply for that day?—Yes, or get it from some other place.

1215. Have you any byelaw which would enable you to prosecute a person for taking water otherwise than from the company's supply?—Yes.

1216. You would apply the term stealing to taking water without arrangement, or without paying for it?—Yes; that clause, I believe, is in the General Waterworks Clauses Act.

1217. Have you any estimate as to what volume is supplied to those poor tenants, or is it merely haphazard?—We cannot separate that supply.

1218. (*Mr. Harrison.*) You have said that you keep it on in the different parts of your district a sufficient length of time to afford the requisite supply to each tenement?—Yes; in every case, it is found out what time is requisite to supply the cisterns in all the houses.

1219. What quantity will those cisterns hold?—It varies. One house in a street may have a large cistern, and the water is left on long enough to supply that cistern, and all the other houses get the benefit of it, whether they have such cisterns or not.

1220. Then the largest sized cistern governs the supply for the whole district?—Yes, if it is of a reasonable size.

1221. What should you call a reasonable size for the whole district?—From experiments which I made some years ago in model lodging-houses I found that their actual requirements, allowing them to take as much as they required, did not amount to more than seven gallons per head per day, but rather less; a great deal more than that is allowed them.

1222. (*Chairman.*) I presume that you are not responsible for the private arrangements and storage for domestic and other purposes in the case of the poor tenants?—Not in the least.

1223. Is it or is it not a fact within your knowledge that those arrangements in many instances are of a very wretched character?—Very.

1224. And that consequently, without casting any stigma upon your company, the supply may bear the title of being wretched and inefficient?—Quite so.

1225. Would you consider that before London, in its poorer districts, can be said to be supplied with water some imperative regulation should be brought into force to compel the owners of that property to make sufficient arrangements to receive the water which you are ready and willing to give?—There is no question of it. The company have done all they can to urge the thing upon the landlords; they have driven pipes to the doors of the houses where the supply was wanted, and yet in some cases the landlord will not go to any expense in making provision for laying on the water.

1226. Have you a difficulty in collecting the rates from that class of property?—I think not.

1227. Do you know whether you make many bad debts?—I think not.

1228. But I suppose that you would not wish to lead this Commission to believe that, although you are prepared to give and can give an abundant supply; London in its poorer parts is abundantly and well supplied with water?—It is not, but through no fault of the company.

1229. Therefore if there are complaints very loud, and very angry, there is some ground for them?—Yes.

1230. And it is necessary before London can be considered to be properly supplied that some additional regulations should be put in force for receiving, storing, and economising the water which you are prepared to give to every customer who applies to you?—It is most necessary.

1231. Supposing that under the present wretched arrangements your supply were to be constant in the 24 hours, what would be the consequences to you?—With present arrangements the thing would be impossible. I do not say that if all the arrangements in the houses were made as they ought to be, to receive a constant supply, we could not accomplish what is said to be accomplished elsewhere, namely, a reduction of the consumption to something like 15 gallons a head; that would be a boon to us and the public, but the preparation for such a supply would throw such an enormous expense upon the landlords that I do not think that they would make it.

1232. Do you think that it would really and truly be a large cost to the landlords to arrange for a proper supply; do you know what would be the cost of a three-eighths pipe per yard, and a three-eighths service cock, which would be quite sufficient upon the constant system for any single cottage-house in this metropolis?—Yes, with cottage property I think that there would be less difficulty.

1233. A half-inch pipe and a three-eighths tap, or a quater of an inch tap, according to the pressure, would be quite enough?—I do not think that the difficulty would arise so much with respect to cottage property so supplied if you could compel the landlords to do it; the expense must be trifling, but I still hesitate about leaving that class of property without the means of storing water at all on those occasions when mains have to be shut off for repair.

1234. Supposing that a service tank were made for a court which could be made of good cast-iron or wrought-iron, to contain 1,000 gallons, the cost would not be a very large one?—I have recommended it again and again, but landlords will not adopt it.

1235. You could arrange it by having an air valve on the top so as to prevent the water from wasting, and you could fill it every day, and each person could draw from it within his own house?—Yes, we are perfectly ready to supply under that arrangement, but landlords in most cases which I have tried will not adopt it.

1236. Are there many complaints made to you of defective supplies?—No, very few.

1237. Have you a complaint book at your office?—Yes.

1238. Would you object to let the Commission see that complaint book?—Not at all.

1239. What is the largest main which you have in your service?—We have 48-inch mains in connexion with the river supply. The largest pumping mains which we have under heavier pressure are 36 inches.

1240. What are the largest service mains in the city proper?—They range from 36 inches down to 3 inches.

1241. Do you know at what date your company began to use cast-iron, because I assume that the New River Company was established at a time when cast-iron had not been brought into use for services?—All their pipes originally were wood.

1242. How were the joints made?—The end of one pipe was sharpened and driven into the end of the other pipe, which was slightly widened.

1243. Was it luted with white lead?—I think not.

1244. Was there a wrought-iron strap?—I have sometimes seen a wrought-iron hoop to prevent the wood from being split.

1245. When did you begin to supersede the old wooden services?—I can give that date, but not from recollection.

1246. Were the first pipes flange pipes?—A number of them were.

1247. Are there any flange pipes in use now?—No, all the flange pipes have been taken up in consequence of the trouble which they gave from leakage by the contraction and expansion.

1248. What kind of joints have you now?—An ordinary socket run with lead.

1249. What form of socket do you generally adopt?—About 4½ inches in depth.

1250. What depth of lead would you give for the 4½?—Nearly the whole depth according to the plan adopted now; a ring of cold lead with molten lead run on it, so that the joint is made solid.

1251. You give the first caulking with cold lead, and the outer caulking with hot lead?—Yes.

1252. And you find that the best form?—Yes.

1253. Have you ever examined an old joint to see what has been the action of it?—I have examined many of them.

1254. Have you ever examined one under a microscope?—No.

1255. Are any of your mains laid so near the surface that the frost has at any time affected them?—I have known cases in the outlying districts where a small iron pipe has been frozen.

1256. How near would the top of the pipe be to the surface?—Probably 2 feet; the depth which is now always prescribed is 2 feet 6 inches from the top of the pipe to the surface of the road.

1257. Have you any prescribed distance at which you keep your water mains from gas mains?—There is a prescribed distance as regards the gas mains; they are required to be kept 4 feet from water mains, but that distance in the streets of London cannot always be kept.

1258. Are any of your mains interlaced with the gas mains?—Yes, in some of the more crowded places.

1259. Have you ever found inconvenience from the back draught of gas into your mains?—That has been an occasional accident, but only occasional.

1260. What do you consider the life of one of your cast-iron pipes?—Some of the very oldest I have found as good as on the day when they were laid.

1261. What number of years had they been in?—I should think 60 years.

1262. And they were sound then?—Quite sound.

1263. Do you varnish your pipes by Dr. Angus Smith's process?—I have tried it as matter of experiment, though it is hardly needful, inasmuch as all the pipes through which the New River passes become coated with the finest possible coating of lime which does not increase.

1264. It combines with the oxide of the iron and forms an enamel?—Yes.

1265. Do you cleanse and limewash your pipes before putting them down?—Yes, we hot lime them throughout.

1266. What are your service pipes made of?—The tenants communication pipes are almost all of lead; we recommend lead.

1267. Have you ever tried wrought-iron?—Yes, but it does not answer; corrosion takes place. I have known a wrought-iron pipe only last five years.

1268. Is the corrosion external or internal?—Apparently both.

1269. Has your water in any case to your knowledge any action upon lead?—Not the least.

1270. Neither in the cistern nor in the pipe?—Not the least.

1271. Have you many dead ends upon your service?—Yes.

1272. Have you any means of cleansing the water from the dead ends?—Yes, in all of them there are plugs on purpose.

1273. Have you an accurate plan of all your mains and services?—Yes, laid down upon the ordnance plan.

1274. So that if you wish to interfere with any section of your mains you can shut down your valves and isolate?—Yes.

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1275. Have you much leakage upon your system?—I think not; because from very careful inspection, if leakage occurs, it is immediately discovered, if there is any leakage on the surface of course it is seen, and we have a periodical examination of the sewers, and by that means we some years ago managed to check a great deal of leakage. If you look at the tables of consumption returned from time to time by the New River Company you will find that our consumption has not very much increased, and that it is rather less now than it was some years ago, and it is entirely due to the stopping of leakage and waste.

1276. Your present mode of discovering leakage would be that when it comes to daylight you can see it, and if you have any suspicion of it you gauge the sewers?—Yes; it is not so much by gauging as by the men who enter the sewers, seeing where the leakage occurs and reporting it; and by paying them a small reward we have no difficulty in that respect.

1277. I think that the workmen themselves have a ruder method of trying whether a valve leaks by holding a bar to the ear?—Yes.

1278. What is the largest sluice valve which you use?—It depends upon the size of the pipe.

1279. Have you any arrangement for easing the friction of the larger valve?—No; a 36-inch valve is the largest under pressure, and we have had no difficulty in that case.

1280. To what height will the water rise from a fire-plug in the best portion of your district, that is to say, where the water would rise the highest and the freest?—The pressure in the mains is a very varying thing. I have seen the water go freely 70 feet, and in certain places it may be got higher.

1281. At points, such as that the intervention of a fire-engine would not be requisite?—It would not.

1282. That is not the condition of things over the whole of your services?—No.

1283. There are districts I daresay where you could not get 6 feet from the surface?—I should say none.

1284. In Victoria Street, where we are now sitting, there is a pressure of 150 or 200 feet, but I will guarantee that you could not get 3 feet from the surface?—Then it must be a very small main. If the water is not brought up by a proper jet pipe or nozzle in all probability you will not get it to rise a sufficient height, but if you have a proper jet pipe from which it can issue it will rise for some great distance.

1285. It must necessarily depend upon the length of the main and the distance which it is from the head, and the junctions which it has to pass, and the draught upon it?—Yes and the size of the main.

1286. And the number of branches?—Yes.

1287. In fact there are innumerable conditions to be taken into account?—Yes.

1288. Of what length is the New River in its entire length?—It is now about 28 miles.

1289. What is its cross section?—An average of 75 square feet.

1290. What is its fall per mile?—Its fall is from 99 feet to 82 feet in the whole distance.

1291. Do you find that in reality you are obliged to reduce the river into a series, as it were, of level branches?—Yes, we have to check it; we have too much fall.

1292. And therefore you put a series of small weirs?—Yes.

1293. And it regulates itself in that manner?—Yes.

1294. I suppose that practically that fall would not be more than about one in 10,000; about 6 inches per mile, that is to say, a surface fall of water?—Hardly so much as that.

1295. Then if you made a conduit to work without

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check it would not do to give a much greater fall than that?—No.

1296. Or you must give vertical checks as you now do?—Yes.

1297. Is the bed of the New River pitched in any way?—No.

1298. Is it in the same condition as Sir Hugh Myddelton left it?—In a great portion of its length it is.

1299. Is it of the same sectional area?—It is increased. In 1852 the company obtained an Act giving them power to improve their river from end to end by widening and straightening it. Its original length was about 38 miles, and it was reduced to 28. We have reduced it by cutting off loops, and in one case by a tunnel, and also by embankments.

1300. What is the average velocity of the flow?—I think that it is something like four-tenths of a mile per hour. That is what we require with the present consumption. We can increase that velocity as the demands in town increase.

1301. That, taken with the sectional area, gives you a volume with an adequate delivery?—Yes.

1302. What is that volume?—It is now 22,500,000 gallons per day.

1303. (*Mr. Harrison.*) And you say that you have the means of providing, if necessary, about 37,000,000 gallons a day?—I should think so.

1304. Would the aqueduct, as at present existing, pass that volume of water?—Quite easily.

1305. (*Chairman.*) What is the capital of the company; is the money capitalised?—There was an investigation in Parliament in 1852, the result of which was that the capital was fixed at about 1,500,000*l.*, or rather more, and the company were allowed to add a million to their capital by borrowing.

1306. Making it now 2,500,000*l.*?—Yes, and last session they obtained power to add a fresh capital of 500,000*l.*

1307. That would make a capital of 3,000,000*l.*?—Yes.

1308. Are you restricted in your dividend?—Only by the General Waterworks Clauses Act, to 10 per cent.

1309. What are you paying now?—I believe something like six per cent., or a little over.

1310. Have you fish in the river?—Yes.

1311. Have you any fishing rights retained for the company?—We retain in the New River itself all the fishing rights.

1312. Have the riparian owners through whose lands the river passes any fishing rights?—It has always been the custom of the company to allow persons having property on the banks to fish without hindrance. We are very particular as to strangers.

1313. Is the soil of the conduit vested in the New River Company?—Yes; the New River Company have by purchase acquired the banks of the river in a great many places, but in other places they have only vested in them that which the water covers.

1314. Do pollutions of any kind find their way into the river?—Not into the New River.

1315. Did they at any time?—Formerly they did. Drainage came into the river, but all that has been very carefully diverted and passed under or over.

1316. How many years ago was that done?—15 years.

1317. Can you say that now, as a fact, no sewage contaminates the water of the New River either from towns, villages, or single houses?—None.

1318. Then, as regards sewage contamination, the New River is as pure as it can be?—Yes, excepting the water now drawn out of the Lee. My answer to your last question had merely reference to the New River itself.

1319. As regards the New River itself your company have power enough and have accomplished the purification of the channel of the New River?—Yes.

1320. But as regards some of the water which you are compelled to take the pollution may take place before the water comes into your possession?—It may.

1321. Do you think that it would be advisable that that pollution, whatever it may be, should be utterly prevented?—Most advisable. The anxiety of the company to accomplish that freedom of the river from pollution is manifest from what they have done at Hertford. The works there cost more than 22,000*l.* They have drained the whole of Hertford, and have erected deodorising works, and in the carrying on of those works the outlay may be about 600*l.* a year.

1322. Is that entirely done by the New River Company?—Yes.

1323. They having no interest in the matter but to obtain pure water?—Yes, and it is an advantage in which the East London Company lower down participate.

1324. Do the East London Company pay any portion of that expense?—None at all; but we having done it for ourselves they get the benefit of it.

1325. (*Mr. Harrison.*) The East London Company have carried out similar works to some extent?—The New River Company, together with them, have done so; they contributed more than 8,000*l.* to the expense, and we have also done what we could to accomplish the purification of the sewage at Luton.

1326. (*Chairman.*) Then may this Commission assume that your company would give any assistance to Government to carry out a measure which should be an equitable one for the purification of the entire valley of the river Lee?—I am sure that it is a thing in which they would most heartily co-operate. Of course when the amount of contribution came to be settled a number of things would require to be taken into consideration, and I think among other things what the New River Company have already done to the same end; they have largely contributed to works for the purification of the streams.

1327. If they were called upon to do anything further they must see that it would be advantageous to themselves and to their customers?—Just so.

1328. (*Mr. Harrison.*) Did they not gain any benefit in being allowed to take a larger volume of water from the Lee, when they engaged to pay so much towards the improvement of the navigation below?—Yes.

1329. They had *a quid pro quo*?—Yes. I quite grant that they had more water on condition of their making a payment of I think 42,000*l.* towards the navigation works.

1330. What are the poor parts of London which you supply with water; do you supply St. Giles's?—Yes.

1331. Do you supply the neighbourhood of Covent Garden?—Yes. Our district is bounded on the south by the Thames, and by a line drawn from Charing Cross up to Hampstead Heath on the west, and by a line from St. Katherine's Docks up to Tottenham Church on the east.

1332. And following the Lee after that up to Hertford?—Yes; we have power to supply the intervening parishes of Edmonton and Enfield, and so on.

1333. Was there much cholera lately in the poor districts of St. Giles's and Covent Garden?—I think not; considering the kind of population, and the way in which they are housed, the amount of cholera was very small indeed.

1334. Have the metropolitan sewage works been thoroughly carried out in that district, in St. Giles's, for instance?—The upper and middle main level sewers have been constructed through those districts; the lower level sewer is not yet undertaken.

1335. (*Chairman.*) Are you rated to the sewers?—Yes.

1336. Are you within the metropolitan area for rating purposes?—Yes.

1337. Have you any idea what number of additional houses you could supply before you would get to the limit of your capacity?—We have of late years, I fancy, added about 1,700 houses annually to the number supplied.

1338. Is that increase going on now?—Yes.

1339. (*Mr. Harrison.*) And that is coincident with an actual diminution in the volume which you supply consequent upon the care which you take as to leakage?—At the date to which I refer there was a considerable saving in leakage. We now supply very nearly 30 gallons a head, taking the whole district.

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1340. (*Chairman.*) What volume of the whole 22,500,000 gallons do you pump, and what volume do you supply by gravity?—I think that we are now pumping between 18,000,000 and 19,000,000 gallons.

1341. Do you know about what is your annual consumption of coal or slack?—I should think very nearly 9,000 tons.

1342. Is it the same material as the East London Company use, the Newcastle slack?—No, we have found the Welsh coal upon the whole answer better. We are in a district surrounded by nice houses, and the least appearance of smoke would be objectionable.

1343. What does that coal cost you per ton?—I have had it as low as 15*s.* per ton, but now the price is much higher. At our chief pumping station I should think that it may be 19*s.*

1344. Where is the chief pumping station?—At Stoke Newington.

1345. What number of boilers have you in use?—At that station we have 18, generally half on and half off. I should think that they are about 30 feet long and not quite so much as 6 feet in diameter; they have internal flues.

1346. Have you any ventilating apparatus?—Nothing but the sliding down.

1347. Have you any arrangement as to the mode in which your men fire?—Yes; they are carefully instructed in that respect.

1348. Have you double bridges?—No, a single bridge.

1349. Are the men instructed to fire to the front?—Yes.

1350. Have you any difficulty in getting your firemen to fire in that way?—No great difficulty; some men are slower than others in taking up the idea.

1351. Have you any patent in use?—No; there is no appearance of smoke at all during the greater part of the day, except just when the men are raking up.

1352. At what pressure do you use your steam?—About 35 lbs.

1353. You work expansively?—Yes.

1354. Do you give any bonus or extra wages to your men for accomplishing smoke burning?—At the end of the quarter we give them a bonus if they have behaved very well.

1355. You hold it out as an encouragement for care?—Yes.

1356. What are their wages?—The stokers, I think, have from 21*s.* to 25*s.*

1357. Do you find them residences?—In some cases.

1358. And firing?—Yes, in the case of those who live on the company's ground.

1359. You have no difficulty in consuming or preventing smoke by ordinary firing without the intervention of any special patent?—None whatever. By the use of Welsh coal it is almost impossible to make smoke.

1360. Is it anthracite coal?—It is the Merthyr coal.

1361. Do you think that you could fire with the Newcastle, slack in the same way and not make smoke?—I think not; it requires so much more care that we could not always depend upon it.

1362. Are any of your works near Hertford?—The sewage works and also the gauge which might be an interesting matter. I have drawings which I can show you.

1363. Perhaps you have also some documentary evidence which you might wish to put in upon points as to which we have not asked you. Have you kept a rain gauge?—We have.

1364. Will you let us have a copy of the rain guagings?—Yes. (*The witness subsequently furnished the same, and it will be found printed at the end of his evidence, Appendix No. 2.*)

1365. Have you any evaporation gauge?—No. (*The witness produced some plans and explained them to the Commissioners.*)

1366. Is there anything else which you wish to mention to us?—I am not aware that there is.

The witness withdrew.

Adjourned to to-morrow at 10 o'clock at Luton.

APPENDIX No. 1.

To the evidence of James Muir, Esq., Engineer-in-Chief, (referred to supra, Question 1086).

ANALYSIS OF HERTFORD SEWAGE.

College Laboratory, London Hospital,
Dec. 27th, 1866.

MY DEAR SIR,

I HAVE to report to you the results of the examination of the two samples of Hertford sewage which you sent here on the 15th inst.

They were contained in stoneware gallon bottles, and were labelled as follows:—

No. 1. Sample of undeodorized sewage. Dec. 13, 1866, 11 a.m.

No. 2. Sample of deodorized sewage. Dec. 13, 1866, 11.25 a.m.

Both the samples were somewhat turbid, No. 1 being most turbid; and they had the peculiar odour of sewage, although it was not very strongly marked in sample No. 2.

Their constituents per imperial gallon were as follow:—

	No. 1.	No. 2.
Soluble matter per gallon	30·33	27·00
Consisting of organic matter	5·35	2·51
„ „ mineral matter	24·98	24·49
Suspended matter per gallon	5·39	0·74
Consisting of organic matter	0·71	0·24
„ „ mineral matter	4·68	0·50
Total organic matter per gallon	6·06	2·75
Total mineral ditto	29.66	24·99
Total per gallon	35·72	27·74

It is evident from this that at first the sewage is largely diluted with water, and that after deodorization and filtration it is almost innocuous.

I remain, &c.,

James Muir, Esq. (Signed) HY. LETHEBY.

APPENDIX No. 2.

NEW RIVER WATERWORKS COMPANY.

To the evidence of James Muir, Esq., Engineer-in-Chief, New River Waterworks Company (referred to supra, Question 1364).

RAIN GAUGINGS—HODDESDON.

1860.	
January	3·400
February	1·500
March	2·200
April	1·300
May	4·003
June	5·550
July	2·000
August	4·005
September	2·700
October	1·700
November	2·400
December	1·600
	32·358
1861.	
January	·850
February	2·300
March	3·005
April	1·280
May	1·330
June	1·950
July	1·950
August	·550
September	1·800
October	·700
November	4·600
December	1·200
	21·515

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RAIN GAUGINGS—HODDESDON—*cont.*

	1862.	1863.	1864.	1865.	1866.
January	2·000	3·430	·900	3·650	3·600
February	·380	·700	·730	1·880	4·005
March	3·400	·850	2·600	1·350	1·750
April	2·600	·750	·730	·280	1·950
May	2·800	1·000	2·200	2·400	1·150
June	2·300	3·940	1·550	1·500	2·220
July	1·320	·780	1·000	2·200	1·650
August	2·650	1·800	·730	3·560	2·200
September	1·480	2·800	2·230	·600	4·400
October	3·450	2·100	1·005	5·350	2·550
November	1·400	2·005	2·130	2·300	1·950
December	1·750	1·350	·600	1·000	2·500
	25·530	21·505	16·405	26·070	29·925

RAIN GAUGINGS—ENFIELD.

	1860.	1861.	1862.	1863.	1864.
January	3·370	·550	2·380	3·395	·895
February	1·490	2·060	·385	·615	1·170
March	2·450	2·820	4·125	·925	2·715
April	1·830	·795	2·070	·795	·650
May	4·340	1·195	3·180	1·400	2·110
June	5·770	1·810	2·635	4·485	1·325
July	2·020	2·945	1·475	·995	·620
August	4·930	·630	2·390	1·985	1·250
September	3·010	1·875	2·030	3·560	3·165
October	2·130	1·015	4·955	2·010	1·245
November	3·370	4·740	1·300	2·350	2·810
December	2·415	1·285	2·085	1·430	·535
	37·125	21·720	29·010	23·955	18·490

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RAIN GAUGINGS—ENFIELD—*cont.*

	1865.
January	3·810
February	2·235
March	1·650
April	·345
May	3·266
June	1·430
July	2·485
August	5·650
September	·680
October	7·075
November	2·600
December	1·570
	32·796

RAIN GAUGINGS.—HORNSEY.

	1866.
January	3·375
February	2·980
March	1·490
April	1·890
May	2·020
June	4·440
July	1·420
August	2·090
September	4·200
October	2·220
November	1·630
December	2·460
	30·215

RAIN GAUGINGS.—NEW RIVER HEAD.

	1866.
January	4·630
February	4·080
March	1·430
April	2·245
May	1·540
June	3·150
July	2·350
August	2·340
September	4·440
October	2·540
November	2·160
December	2·776
	33·681

	1866.
January	2·440
February	3·390
March	1·510
April	1·730
May	2·008
June	3·650
July	1·280
August	1·910
September	2·550
October	2·100
November	1·500
December	1·980
	26·048

Luton, Wednesday, 12th December 1866.

PRESENT:

ROBERT RAWLINSON, ESQ., C.B., IN THE CHAIR.

JOHN THORNHILL HARRISON, Esq. | Professor JOHN THOMAS WAY.

LUTON.

Mr. W. T. Pledge.

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Mr. WILLIAM THOMPSON PLEDGE (Luton) examined.

1367. (*Chairman.*) Are you chairman of the Local Board of Health?—Yes.

1368. When was the Act applied to Luton?—In 1849.

1369. Who made the first report?—Mr. Creasy.

1370. Then you adopted the Act very early?—Yes.

1371. What is the population of Luton?—It is now upwards of 20,000.

1372. Is Luton a growing place?—Very much so, indeed; we have built in the last seven years 900 houses within the township.

1373. Do you know what the rateable value of the township is?—About 40,000*l.*

1374. Have you carried out any main sewage in Luton?—Yes.

1375. Has the town a water supply?—We have not a water company; it is supplied from wells; there are about 1,200 wells in the town.

1376. Your water supply is from wells?—Yes.

1377. Do you know what the main sewerage you have carried out has cost you?—No, but the clerk will tell you that.

1378. What trade is carried on in Luton?—The staple trade of the town is the manufacture of straw bonnets and hats.

1379. Does the river Lee, which supplies part of London with water, flow near to your town?—It flows through the town, and it rises about three miles from here.

1380. So far as you know is there or not any amount of pollution turned into it from this town?—I think not. We deodorize all the sewage before it goes into the Lee, beyond that there is no pollution of the water.

1381. What form of deodorization do you use?—We use chloride of lime and lime. The sewage passes through several filtering beds, and after that it is turned into the Lee pure.

1382. In what condition is the sewage after it has been so chemically treated?—I cannot speak to that.

1383. When you speak of it as being purer I assume you mean that it looks brighter?—Yes.

1384. Would you be surprised to hear that it was no purer then than before you treated it chemically?—Yes, I should be.

1385. I mean the liquid part of it?—Yes.

1386. Assuming that a chemist would tell you that all the ingredients of sewage are still in it, should you not then consider that it would pollute the river?—I should like to have some evidence of it before I gave an answer to that question.

1387. If there is pollution in the sewage, and the sewage goes into the river, does not the rest follow?—Yes, if it goes into the water.

1388. If the sewage which has been treated by you chemically is turned into the Lee, and it has still impurity in it, that also must go into the Lee?—Yes.

1389. It follows that the amount of impurity or the amount of pollution depends upon the chemical condition of the water after it passes from your works?—Exactly so.

1390. Did you clarify the sewage when you first carried out your sewers?—The sewerage was carried out before I became a member of the board, and I cannot speak to that.

1391. Before the board existed, or any works were executed, what arrangement had you with regard to privies, or waterclosets, or cesspits?—None whatever; all the sewage then passed into the Lee from any closets and surface drainage. We had no provision until we made an intercepting sewer.

1392. Were there any privies at that time built over the watercourse?—I believe there were some on

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the margin of the river, but I cannot speak to that as a fact.

1393. How long have you lived in Luton?—24 years.

1394. Do you know whether any privies or closets stand now on the margin of the river?—I do not know of any. I do not believe there are any in the township. I have paid much attention to this subject, and in my survey of the town I have seen none.

1395. Do you know anything of the district towards the sources of the river?—I do not.

1396. Or towards Dunstable?—No.

1397. Do you know anything of Dunstable?—No.

1398. (*Mr. Harrison.*) Can you give the population of Luton in successive decennial periods?—I cannot give you that information.

1399. Does any pollution arise from the manufactures that are carried on in the town?—We are rather troubled now with the dyeworks, although we appear to take a large amount of pollution out of the spent dye liquor, we are rather troubled with the colour that is left in it; it will not sink, otherwise I believe that the pollution in the sewage is completely taken away.

1400. Is there any other business carried on in Luton besides the dyeworks which pollutes the river?—No; I believe that the bleaching of the plait does not do so.

1401. Is the refuse from the bleaching and the dyeworks carried into your sewer?—Yes, into the intercepting sewer.

1402. No refuse passes direct into the Lee?—None is allowed to go into the Lee without going first into the intercepting sewer.

1403. Has your board ever contemplated the application of the sewage to land?—Yes, but not by way of irrigation.

1404. Have you heard that sewage elsewhere is successfully applied to land?—I have heard so.

1405. In your elevated position here I suppose there would be no difficulty in applying it to land by gravitation without pumping?—I think we could not do it without pumping.

1406. Is there any land in this neighbourhood which is suitable for its application?—I do not know.

1407. When you carried out your system of purification did you receive any sum of money from the New River Company to assist you in doing it?—I believe not.

1408. Did they assist you in any way?—Not at all, I believe.

1409. Can you give us any information as to the health of the town?—The health of the town stands rather high, and I believe it is in a tolerably satisfactory state.

1410. Do you know what the death rate of the town is?—I do not.

1411. (*Professor Way.*) Your principal manufacture here, I believe, is straw plait?—Not the manufacture of straw plait that is carried on in the villages; here it is bleached and dyed and manufactured into bonnets and hats.

1412. All the dyeing is done here?—Yes.

1413. What quantity of plait do you imagine is dyed or bleached in Luton in a year?—I am unable to speak to that.

1414. Do you know what method is adopted in bleaching the plait?—I do not.

1415. With regard to the question of sewage precipitation, which the chairman brought before you, you are aware that the evils of sewage lie in two forms: objectionable matter in a state of suspension, and objectionable matter in a state of solution?—Yes.

1416. The chemical process which you use for deodorizing is the lime process?—Yes.

1417. Are you aware that that simply removes the matter in suspension?—I am not aware of that.

1418. It enables you to send away a clear liquid without the solid parts into the river, and consequently you so far improve the condition of the sewage; but by that process, as the chairman wished to point out to you, you do not take anything out that is dissolved in the liquid, and therefore that must add to the impurity of the river?—Yes.

1419. (*Chairman.*) Is there anything further that you wish to add?—No.

The witness withdrew.

Mr. W. D. Sandoe.

Mr. William David Sandoe (Luton) examined.

1420. (*Chairman.*) How long have you been surveyor to Luton?—About four years.

1421. How long has the present system of sewerage been carried out?—For something like eight or nine years, I believe.

1422. Who devised them?—I believe Mr. Evans, who was then the surveyor to the board of health.

1423. Do you know what size the outlet sewer is?—3 feet by 2 feet 6 inches.

1424. Do you know what length of main sewer there is altogether?—The intercepting sewer is about a mile in length.

1425. What size is it?—3 feet by 2 feet 6 inches.

1426. What length of tributaries are there, do you know?—Not the total.

1427. Do you know what number of houses you have drained?—The whole of the houses are drained in the township.

1428. What sized drain do you generally use for single houses?—6 inches.

1429. Are they of earthenware pipes?—Yes.

1430. Are the main sewers ventilated?—Yes; that is to say, the intercepting sewer, but not the others.

1431. Not the sewers in the town?—No.

1432. Have you ever heard any complaints made by any persons of foul smells issuing from the gully holes or the sinks?—Very rarely. I have occasionally when the gullies have been emptied, and when the water was out, but no other complaint.

1433. Are the down spouts from the eaves of the houses connected with the drains?—There are a few.

1434. Have you any idea what number of water-closets there are in use in the town?—Somewhere from 1,000, to 1,500.

1435. If you have no water supply other than from pumps, what arrangement have you for flushing the closets?—It is chiefly done by rain water in addition to the pumps.

1436. Have the closets cisterns?—Yes; the majority of them.

1437. And are they filled with rain water?—Yes.

1438. And in addition there are pumps attached to force the water up?—Yes.

1439. Have you anything to do with the management of the closets if they get out of order; for instance, do you expect the parties to put them in repair?—Occasionally I have been called in to suggest any alteration that might be required.

1440. Are soil-pans used in the dwellings of the working classes?—A few, not a great many; they have open privies chiefly, which are constructed with proper emptying holes.

1441. You mean with a cesspit?—Yes.

1442. How many of those do you suppose there are in the town?—Somewhere about from 2,000 to 3,000 altogether.

1443. How are they emptied?—The board of health have lately adopted a plan of doing it by night-carts.

1444. Are they emptied at the cost of the owner of the house, or at the cost of the ratepayers?—We make a charge for the men's time; there is no further charge; we charge 2*s.* for the emptying of each closet, which covers the expense.

1445. Is the refuse sold to the farmers?—Yes; we are mixing it now with the refuse from the deodorizing works and the ashpits.

1446. Has the practice of emptying those places by the local board come into operation recently?—Yes, within the last six months.

1447. Then you have not had much experience of the working of that plan?—Not at present.

1448. Before that who emptied the cesspits?—The contents were taken away by farmers in the neighbourhood chiefly.

1449. Was that operation a nuisance?—Many complaints were made to the Local Board of the way in which the closets were emptied, which induced them to adopt the present plan.

1450. How long have the precipitating works been in operation where the sewage is treated by lime?—Ever since the construction of the main sewerage; it was carried out under the same contract.

1451. Do you know what amount of lime you use now in each month or year?—We used something like on an average, previous to the last six months, 80 quarters in a month, or about 20 quarters in a week, eight bushels to the quarter. Since that time we have used something like 7½ quarters, and in addition to that we use something like 40 lbs. of chloride of lime per day.

1452. What does that cost you?—About 19*s.* a hundredweight.

1453. What does it cost a day?—About 8*s.* or 9*s.*, exclusive of the wages of the men.

1454. What number of men do you employ?—Five.

1455. What do they cost you?—About 4*l.* 10*s.* 0*d.* a week.

1456. What do you estimate the present cost per annum of your outlet works?—From 400*l.* to 500*l.* a year.

1457. What volume of water have you to deal with from the sewers?—Something like about 240 gallons a minute, but that includes a large quantity of spring water. I should say that there is not more than a fifth of that actual sewage matter.

1458. There is a large amount of spring water which percolates into the sewers and drains from the subsoil?—Yes.

1459. And to deal with that water you say it costs the local board at present from 400*l.* to 500*l.* a year?—Yes.

1460. Does that include any portion of your own salary?—No, it does not; that is the actual cost of the labour at the works.

1461. What weight of solid matter do you take out of the depositing tanks per week, month, or year?—We take out something like 2,000 square yards per annum.

1462. You mean cube yards, do you not?—Yes.

1463. What weight do you think a cube yard would be—a ton?—Rather more; it is about a ton when we cart it away in a dry state.

1464. Do you actually take out of the depositing tanks 2,000 tons a year?—Yes, as nearly as possible, exclusive of the ashes and the sewage matter that we take from the cesspools.

1465. (*Professor Way.*) How do you bring it into a dry state?—We have separate settling beds which we pump the sewage from, in a semi-fluid state to the other side of the river on to some land which belongs to the Board of Health, it lies there in large beds a foot thick for about a month or five weeks, and when it is solid we wheel it out into large heaps for the farmers to cart away.

1466. It is not dry; is it not in a cheesy state?—It is very nearly dry when the farmers get it.

1467. (*Chairman.*) You say that you take out upon the average nearly seven tons a day, reckoning six working days in the week?—Yes, I think that is nearly it.

1468. Where do you suppose that comes from?—From the various closets, and there is a great deal of road refuse also that goes into the sewers.

1469. Road grit that washes through the gully holes into the sewers?—Yes.

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1470. Then a great portion of that weight will be road grit?—Yes.

1471. Have you any difficulty in getting rid of that matter for agricultural purposes?—Yes, we have had great difficulty in getting rid of it up to the present time, until we mixed the nightsoil with the street sweepings; but I apprehend from the applications that I have had for the manure, and taking into account what has been actually sold, that we shall have no difficulty with it now.

1472. What price do you get per load for it, or what have you got?—At the present time we sell it at 2*s.* 6*d.* a load, which is a cube yard.

1473. About a two-horse load?—Yes, very little more than a ton, or a ton and a quarter.

1474. How far do the farmers take it?—Some of the manure that I have sold lately has been taken a distance perhaps of three miles.

1475. Have you any difficulty at any time of the year in getting rid of the accumulation?—No, other than what I have mentioned. The farmers at one time had a prejudice against it, thinking that the manurial properties were destroyed by too much water, or the quantity of lime that was then used.

1476. Do not you find it more easy to get rid of it when the farmers are not engaged either in sowing or in reaping?—Yes, that is the case certainly.

1477. Have you any accumulation on hand to any extent?—We have had a large accumulation, something like from 2,000 to 3,000 yards on hand.

1478. Do you know what the outlet works cost?—The whole of them from 10,000*l.* to 15,000*l.*

1479. Including the sewers?—Yes.

1480. Have you any plan of the outlet works?—There is one.

1481. How far are the works from here?—About half a mile.

1482. Has it never occurred to you that it would be advisable that you should permanently ventilate your main sewers?—Yes, it has; I think it is very advisable to do so.

1483. Do you ever find any smell, or have any persons complained of it when the ground has been opened to make a junction?—Not much; I have never had any serious complaint made.

1484. Do you know the difference between the condition of the sewage water before and after it has been limed?—No, I do not know that.

1485. Has your board had any analysis made of the water in those two conditions?—I believe it has been done, but not lately; not since I have been Surveyor.

1486. Has it ever been intimated to you that the liming process simply enables you to take out the solids?—It has.

1487. However bright the water is after that process, it is in reality the same sewage afterwards as it was before?—I always understood that there were certain portions in the water which could not be taken out by any known process.

1488. Would you be surprised to hear that the liming process and the use of chloride have no effect whatever, except to brighten the water and to take out the solids, or those particles which are suspended?—I am not surprised to hear that, because it seems to me feasible.

1489. Have you visited any places where sewage is applied to land for irrigation purposes?—I have not.

1490. I assume that the valley below your outlet is principally chalk?—Not the valley; the hills are all chalk, but not the valley, unless you go to a very great depth.

1491. The valley I suppose will consist of gravel or lime?—It is chiefly bog, loose bog, and gravel at the bottom.

1492. Is there any brick earth in it?—I do not know of any. I think that that would be further down than I have any knowledge of. I have heard of the

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success at Croydon from applying the sewage to land for irrigation.

1493. Do you think it would be advisable, if your board could save their 500*l.* a year and get rid of the nuisance altogether, to try that process?—I should think it would be.

1494. If in this district you could so apply that sewage to the land as to produce 50 or 60 tons of green crops per annum off each acre, do you not think it would be advisable to do so?—I have no doubt that it would be a great advantage to apply the sewage in a liquid state.

1495. You are expending at the present time 500*l.* a year apparently without any use or advantage, and if a chemist will tell you that his experience enables him to say that you have made no alteration in the sewage which you have subjected to your process, except taking out the solids, and that is still sewage after that treatment, is not that an additional reason why something more should be done, and that you should purify the water before it flows on to London to be drank?—Yes.

1496. Especially if that could be done at a less cost to the board than it has now to bear?—Yes.

1497. (*Mr. Harrison.*) The town of Luton is situated on both sides of the river, is it not?—Yes.

1498. Has the system of sewerage been extended to both sides?—Yes.

1499. Has it been carried under the river in order to be connected with your main sewer?—Yes, under the Lee.

1500. You have stated that there are about 1,000 waterclosets and about 2,000 cesspits in the town?—Yes.

1501. For a population of 20,000 persons?—Yes.

1502. Are the waterclosets chiefly in the houses which are occupied by the wealthier inhabitants of the town?—Yes.

1503. How are the cesspits situated with respect to the houses generally?—The majority of them are something like seven or eight yards from the houses.

1504. Are any of them close to the houses?—Some of them are.

1505. Are any of them placed under the houses?—Not one that I know of.

1506. In the case of those which are near to the houses, have you ever known them to be the cause of ill health?—No; but I have had some complaints as to those which have been close to the houses, and I have recommended that they should be filled up, and that waterclosets should be substituted.

1507. Are they generally closed over the top?—Not generally so; there are some that are closed, but it is not the general rule.

1508. Are ashes thrown into them in any cases?—I have found a good many which have been altered within the last 12 months. We altered them so far as making proper emptying holes and cesspits awayfrom the ashes and closing the cesspits on the outside.

1509. These are the steps you have taken to separate the ashes coming from the houses entirely from the watercloset refuse?—Yes.

1510. Then there are ashpits and cesspits?—Yes.

1511. The cesspits you have had covered?—Yes.

1512. Are those cesspits sunk into the ground?—Yes, about 3 feet down is the usual depth.

1513. What is the character of the soil in which they are made?—The principal portion of the town is upon chalk.

1514. What steps are taken in constructing those cesspits to prevent the matters contained in them escaping into the chalk?—They are steined inside with brickwork, and in some cases brickwork in cement, but not in all.

1515. Are those cesspits water-tight?—Those that have brickwork in cement would be water-tight, but not the others.

1516. Where are the wells situate from which you say the inhabitants obtain their water with reference to the cesspits?—The cesspits are generally at a distance from the wells, from 7 to 10 yards; we have the wells now at the greatest distance we can from those places.

1517. Do you think that any such care as that will prevent the water from the wells and the refuse from the cesspits meeting together in the chalk subsoil, especially as you are withdrawing in your main sewer and your branch sewers so considerable a quantity of water through the chalk?—No, there is no doubt that it must be the case.

1518. That the cesspits do pollute the wells?—Yes, to a certain extent, there is no doubt of it.

1519. Do you think that that can be a satisfactory or safe water supply for the town under such circumstances?—I do not think it is.

1520. Do you not think that that is a point that ought to be brought under the notice of your local board so as to prevent the continuance of such a system?—This matter has been brought to the notice of the board, and in addition to that there was a water company started sometime since which it was contemplated would entirely obviate the difficulty then, but the works have not yet been carried out. I believe they are in progress, at least I have heard so.

1521. Have the medical men of the town on any occasion complained of the water that was supplied to the inhabitants for drinking purposes?—In one or two instances I have heard a complaint, but no general complaint has been made.

1522. What steps, if any, have you taken in those cases to prevent the continuance of the evil?—In any case where I have found any mischief arising from a drain, (I have not heard of a case arising from a closet) I have altered it at once.

1523. How far is the outlet of the main sewer from the town?—About half a mile.

1524. You say that you take the solid refuse and convey it into large shallow tanks?—Yes.

1525. You then, I suppose, allow the water to evaporate from the surface until the solid matter becomes of a certain consistency?—Yes.

1526. Does any smell arise from the tanks during that operation?—We do not find that there is any unpleasant smell.

1527. That is in consequence, I suppose, of your applying chloride of lime?—Yes.

1528. You applied that in consequence of finding that there was something objectionable?—No; the principal reason why I recommended it to the board was on account of the dyeing.

1529. Did you find that the effect of using chloride of lime was to diminish the pollution of the water by the dyeing process?—Yes, very much so.

1530. What was the effect?—It took the colour out.

1531. (*Chairman.*) Where could water be obtained if works were established for supplying the town?—From an artesian well, I imagine.

1532. And by the use of steam power?—Yes; I believe there would not be a sufficient supply of water from the river.

1533. Do you know what estimate has been made for the purpose of carrying out such works?—No; I have not heard.

1534. (*Professor Way.*) In your liming process, how is the lime applied?—By Higgs' patent; simply by mixing it in pans, and forming a kind of thin cream.

1535. How is that apportioned to the sewage?—It is managed by a tap which either flows with more or less water, as is required for the quantity of sewage coming in.

1536. Is it passed into the conduit that brings in the sewage?—Yes, and it is mixed with stirrers, which are worked by a water-wheel.

1537. Is it any distance above the subsiding reservoirs?—No, close to them.

1538. Have you more than one subsiding reservoir?—Yes.

1539. Is one filling while the other is subsiding?—They are all working regularly round; there are three large beds something like 1,000 yards square.

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1540. Is there much collection of matter at the top of the reservoirs?—Not on the surface of the water.

1541. In running off the liquid do you run it through an opening a little distance above the bottom of the tank?—They are always running off.

1542. Is that from the surface outfall?—Yes, it is over the surface in working the water-wheel.

1543. I am speaking of running the liquid out of the tanks; how does the liquid overflow?—It works on a level; all the beds work on one level.

1544. In flowing into the outfall does it flow from the top?—Yes.

1545. Is there any plank to keep back the solid refuse which collects at the top?—Yes.

1546. (*Chairman.*) Do you use a skimmer?—No, we do not require anything of the kind.

1547. (*Mr. Harrison.*) Is the water which is pumped from your wells very bright?—Yes, it is very clear water.

1548. Are you aware that sometimes water is even more agreeable to the taste after it has been polluted by the drainage of cesspits?—I have read such an account.

1549. If so, do you not think it would be well to look into the condition of the water in this case, and not merely be guided by its appearance or its taste?—I should think it would.

1550. (*Professor Way.*) I daresay you have heard that lately in the city of London numerous wells have been shut up on the authority of a report made by Dr. Letheby?—I have.

1551. (*Chairman.*) Have you any idea what volume of dye water passes into the sewers from the intercepting one?—I have not.

1552. What number of dyeworks are there in the town?—I do not know.

1553. Do the dyers themselves attempt by any means to clarify the water or to take out any solids before they pass it into the sewers?—I do not think that that is the case; it may be so in one or two instances.

1554. You do not, perhaps, know the substances which are used in dyeing?—No.

1555. Are there any breweries in the town?—Yes.

1556. Are they large ones?—One is a tolerably-sized brewery.

1557. Do you know whether the brewers pass any washings of barrels or spent hops, or anything of that description, into the sewers?—I believe they pass the washings of barrels and those things into them.

1558. Any spent hops or spent grains?—I think not.

1559. Are there any malting places in the town?—None that are at work.

1560. Are there any mills above or below the town immediately on the river?—There is one immediately below the town, not above.

1561. What length of highways have you under your charge?—Somewhere about 30 miles.

1562. Of what are the street surfaces generally formed in Luton?—They are made of macadam.

1563. Are they all macadamised?—Yes, all of them.

1564. Have you any idea what weight of stone or flint is put on to the streets in a year?—It is from 2,000 to 3,000 cubic yards.

1565. Does that nearly correspond with the quantity of material that is taken out of your settling tanks. I think you said that you take about 2,000 tons out and you put about 3,000 tons on to the roads?—Yes, but there are a great many roads that do not wash into our sewers.

1566. The whole of the material which you put on is ground up by the action of the traffic over the roads during a year?—Yes.

1567. How much does it cost per cube yard to dress a road; is it flint?—Yes; the flint we use costs us about 5*s.* 6*d.* per cube yard.

1568. Do you use anything besides flint?—We put granite down upon some of the principal streets.

1569. What does that cost you per cube yard?—About 12*s.* 10*d.*, delivered at Luton.

1570. How many square yards of road do you repair out of one cube yard of material?—About six yards, that is to say I mean six yards across the road; it would be about 30 or 36 yards, not more than two inches thick.

1571. Are your side channels paved, or are they generally macadamised?—They are generally paved.

1572. After you have had a heavy fall of rain the grit washes into the channel and washes from the channel into the sewer?—Yes; but we have gully pans which take a certain portion of it.

1573. How much will a gully pan hold?—Not so much as half a cube yard, not more than a quarter.

1574. If you have a heavy rainfall will the gully pan be filled in a few seconds?—That depends upon the situation a great deal; at the bottom of the hill it would no doubt be the case.

1575. It would not last for many minutes?—Not in the lower part of the town.

1576. For any intercepting purposes it is a mere delusion?—It does not stop a great deal.

1577. Do the drains choke at any point?—No.

1578. Can you flush them artificially?—No.

1579. Have you never had occasion to resort to artificial flushing?—No.

1580. And the ordinary action of the water is sufficient to keep your drains in operation?—Yes, just so.

1581. To flush out all that weight of material that there is towards the outlet?—Yes.

1582. What is the fall towards the outlet?—I cannot tell.

1583. Have you often had occasion to open drains in order to put in connexions?—Very often.

1584. Have you noticed the condition of the drain when you have opened it; have you found any deposit in it?—Very rarely; in some situations, but the drains are generally pretty clean.

1585. Of what sizes are the tributary drains?—From 2 feet down to 9 inches.

1586. What are the 2 feet drains made of, brick or earthenware pipe?—They are made of brick, 4½ inches.

1587. Are they circular or egg-shaped?—Some are circular; they are chiefly egg-shaped.

1588. Of what material are the 18-inch and 12-inch drains made?—They are earthenware pipes.

1589. I suppose it is in fact the large volume of subsoil water that is constantly running through your sewers and drains that keeps them clean?—Yes.

1590. If you had less of that water there would be more impurity in the drains?—Yes.

1591. That spring water is a sort of safety valve carrying off what would be deadly for want of ventilation?—Yes.

1592. If ventilation is a benefit under any conditions, do not you think it would be a great benefit, although your sewers may not be so foul as in other places, to have them fully ventilated?—Yes.

1593. (*Mr. Harrison.*) Have there been on any occasion any complaints made in the upper parts of the town of bad smells arising from the drains?—I have occasionally heard a few complaints made when the house drains have not been properly trapped.

1594. (*Chairman.*) If there is a foul smell before, what do you think becomes of the gas when they are trapped?—It must remain in the sewer.

1595. But will it remain there; if you do not control its coming out it will come out in its own way, and if your sewers are not properly ventilated I am afraid they will do as much harm as good?—No doubt they ought to be ventilated.

1596. (*Professor Way.*) You stated I think that you had considered the question of applying the sewage direct to the land?—Yes.

1597. Has the subject been taken up at all by the local board of health?—No, it has not.

1598. In considering that matter, probably the quantity of water would have something to do with it?—Yes.

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1599. Are you aware that at Croydon, where the sewage is applied to the land, the quantity of water, as in your case, which passes into the sewers is from two and a half to four times as much as the bulk of the sewage itself?—Yes, there is no doubt of that; that is the case to a certain extent here, but I think the difficulty here will be the land.

1600. (*Chairman.*) Is there anything further which you wish to add?—I think not.

The witness withdrew.

Mr. G. Bailey.

Mr. George Bailey (Luton) examined.

1601. (*Chairman.*) You are clerk to the local board of Luton?—Yes.

1602. How long have you held that appointment?—Since July 1851.

1603. Were you appointed upon the first formation of the board?—Almost; the board was formed about May 1850.

1604. Immediately upon the formation of the board, or was it after your appointment, that they began to carry out a system of main sewerage?—The board commenced immediately to make sewers, but the first sewers that were made were not upon a well defined system although they were well laid out. In 1856 a scheme was devised by Mr. Evans, who was a civil engineer, and the whole of that scheme was carried out under the superintendence, in the first instance, of Mr. Bazalgette and subsequently of Mr. Page; those gentlemen frequently came down to look

1605. Had the local board any special reason for carrying out a system of sewerage at that time; was any pressure put upon them by official authority?—A suit was commenced against us in 1856 or the end of 1855. A bill was filed in Chancery by the Attorney-General at the relation of John Shaw Leigh, the owner of Luton Park, and the information and bill of complaint were filed on the 13th December 1855. Evidence was given upon the occasion. I was present and gave evidence with numerous other persons, but the evidence was given by affidavit. The result of the suit was an injunction, a copy of which I hold in my hand, and, with your permission, I will just read the end of the bill of complaint—"Prayer. The infor-" mant and plaintiff pray as follows: 1. That the " township of Luton local board of health may be " restrained, by the order and injunction of this " honourable court, from causing or permitting any " sewers or drains, or the filth and matter coming " therefrom, to empty themselves or run into the " river Lee, and from otherwise polluting and injur-" ing the said river, or keeping the same sewers and " drains so as to be a nuisance or injurious to public " health. And also from opening any new drains or " sewers communicating with or discharging them-" selves into the said river, or any openings in sewers " already communicating with the said river, by " means of which openings additional sewage would " be brought into such sewers, and from in any manner " increasing the sewage passing into the said river. " 2. That the defendants may pay the costs of this " suit." I may say that we never paid the costs. I do not know the reason why, but they were never pressed for. What the New River Company had to do with it I do not know.

1606. Were your intercepting sewers and your disinfecting works devised in order to comply with the terms of the injunction?—Yes. After that we had a correspondence with Mr. Higgs, a gentleman who seemed very ingenious in his ideas; he had invented a system of deodorizing the sewage and he had taken out a patent. I do not think I have a copy of it, but it can be obtained. The result of the communication or of my interviews was this, that the board of health purchased the patent for 700*l.*

1607. They gave Mr. Higgs 700*l.* for his invention?—Yes; and we were compelled to use the process. I believe that it has been a great saving to the town, and has prevented litigation, probably many thousands of pounds, and we have lived in peace.

1608. (*Mr. Harrison.*) Does Mr. Higgs in that agreement undertake to purify the water so as to prevent your being further interfered with by parties below?—No; but the suit has this effect, that so long as we use his patent properly the court have no power over us.

1609. (*Chairman.*) You have complied with the order of the court?—Yes; it says, after stating that it shall not flow into the river, "except such sewage " water or matter shall have been previously subjected " to the process for purification, known as Higgs' " process." I believe Mr. Higgs has been dead for some time.

1610. I suppose the patent has expired?—I do not know.

1611. (*Professor Way.*) Were affidavits referring to the nature of the patent put in?—No. The fact was, I believe, that Messrs. Baxter, Rose, and Norton were concerned for the informant or the plaintiff. I believe that Mr. Baxter was very much interested in this patent, and he came down to Luton, and so long as we carried out the patent everything appeared quiet and agreeable. I have been informed since that he was interested in it.

1612. Have you carried out the same system since that time?—Yes.

1613. And it is being carried out now?—Yes.

1614. At a cost of something like 500*l.* a year?—I believe that is correct.

1615. Have the board discussed at any time the propriety or otherwise of applying the sewage to land for irrigation purposes?—They have; the surveyor has stated the contrary, but I do not think he was present at the time. It has been in contemplation, although I do not think there has been any formal resolution upon it. I have gone a little into the subject myself, and I have an idea that about 500 acres of land would receive the whole contents of the sewers from this town.

1616. What is agricultural land worth in the valley below the town?—I think about 30*s.* an acre per annum.

1617. Do you think it would be possible either to lease or rent 150 or 200 acres?—Mr. Leigh owns the territory here, or Mr. Crawley; they own an immense quantity of land.

1618. Have you ever talked over with the board the propriety of providing a water supply for the town?—Yes. I have been an advocate for that all along, although there have been opponents to it on the board; but to the credit of the present board I may say that the whole of them consider it is a most important thing to have waterworks in their own hands. A company was started some years ago, but they have done nothing; they have had every encouragement, and they obtained an Act of Parliament, but it is a dead letter.

1619. If you could afford to supply any small tenement, or cottage dwelling, with as much water as they required from Monday morning to Saturday night for 1*s.* a quarter, do you not think it is very desirable to do so?—I should imagine that it could be done for that price.

1620. Then the poorest person would be extravagant to use a pump, and it would be dangerous to keep the pump in existence?—Yes.

1621. The Public Health Act gives you power to acquire a site upon which to erect waterworks; also the power of borrowing money and repaying it by annual instalments; it further gives you a compulsory power to supply every house within the district at a certain price?—Yes, if it does not exceed 2*d.* a week.

1622. (*Mr. Harrison.*) From the evidence of the surveyor as to the volume of water coming out of the sewers you have constructed it would appear that the subsoil of the valley must be saturated with water?—I think it is.

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1623. He stated that there were about 2,000,000 of gallons a day collected by the sewers; if that is the character of the chalk in the district I should imagine that by careful examination of the district higher up the valley there would be no great difficulty in conveying such a draught through the subsoil and collecting the water at such a height as to supply this town without any difficulty, and without pumping?—Yes, I should say so.

1624. The 2,000,000 of gallons a day which are delivered from your culvert close below Luton would be a water supply for a town a mile or two lower down at the rate of 100 gallons a day for your present population?—Yes.

1625. (*Chairman.*) Are there any gasworks in Luton?—Yes.

1626. Do they belong to the board of health, or to a company?—They belong to a company. I am a shareholder in it, and they have been very successful.

1627. Have you contemplated that they might be acquired by the local board?—Yes; and there has been a conversation upon that subject.

1628. Does the local board possess any property of any kind?—They only possess their own board room, which they purchased about eight or nine years ago. I suppose that that is worth about 800*l.* or 900*l.*; they also possess and occupy the land where the deodorizing works are erected, and which cost them about 950*l.*; they bought the land very cheap at the southern end of the town; it is valuable land; they possess the deodorizing works and the intercepting sewers which have been made.

1629. Have you, as a local board, any interest in the tolls taken at markets or fairs?—The board of health this year have purchased the lease of the tolls for 75 years, from Mr. Leigh, the lord of the manor, at a rental of 150*l.* a year.

1630. Will that enable you to construct a new market or regulate the markets which exist?—Yes; we have at the present time that matter under consideration; it is going on actively.

1631. Will it produce a larger income to your board if properly managed?—Yes, I am sure of that.

1632. Have you any baths or wash-houses for the use of the public?—We have not. There are in the town some public baths, which have been erected by a private individual, and they are just completed.

1633. Have the local board a public library?—No, they have not.

1634. Would not the Libraries Act enable you to establish a library?—I am of opinion that it would.

1635. What number of members constitute your board?—Nine.

1636. Is that number considered sufficient?—It is; but I think it is very small, comparing this town with other towns, for in some towns of equal size I apprehend there would be 15 or 16 members, and perhaps 20.

1637. What is the area within the jurisdiction of the local board in acres?—I do not know that, but Davis's "History of Luton" will, I think, give it.

1638. Did you attend the inquiry that was made by the inspector in the first instance?—Yes, I did, when Mr. Cresy came down.

1639. (*Mr. Harrison.*) Were the New River Company at all interested in the suit in chancery?—I could not say; but I have no doubt they were. I think the least they could do was not to press the costs upon us, and they did not. I am of opinion that it would be very much to their advantage if they would take this question up. I know that in London there is an idea that the water of that company is not good. I have read many chemical accounts about it; what may be the cause I do not know; we do our duty and we are satisfied.

1640. Have they assisted you in any way?—No; but I think they are bound morally to do so; they use the water; it goes on to Hertford, and then it goes into the river there. The river now is better than it ever was, and we strictly carry out the injunction.

1641. (*Chairman.*) You are acting within the four walls of the law, and you strive to do your best?—Yes; and we have done it.

1642. You are willing to do better if you can, but hardly know how to do it without incurring extra cost to the town?—I think the board would be willing to incur the cost if it was not an extravagant one.

1643. (*Professor Way.*) You have 500*l.* a year now to pay?—Yes.

The witness withdrew.

Mr. K. Tomson.

Mr. Kitt Tomson (Luton) examined.

1644. (*Chairman.*) Are you a surgeon residing in Luton?—I am.

1645. How long have you resided here?—For 20 years.

1646. Have you been in practice as a surgeon during that time?—Yes.

1647. Do you hold any public appointment?—I am medical officer to the board of guardians for the parish of Luton.

1648. What number of acres does that cover?—Nearly 16,000.

1649. Are you the sole medical officer for the parish?—Part of the hamlet has been taken off within the last week or two, but before that I was the sole medical officer.

1650. Have you anything to do with the town proper?—Yes, with the whole of the parish of Luton.

1651. Are you at all connected with the local board?—Only very occasionally.

1652. What type of disease is most prevalent in this parish?—We have every autumn sometimes more and sometimes less of typhoid fever.

1653. What should you, as a surgeon, say was the origin of typhoid fever?—It is partly owing to atmospheric influences, and chiefly owing to the quality of the water. I have stated this before.

1654. I suppose that over-crowded tenements, bad food, and exposure to bad weather, all conduce to it?—Yes; but typhoid fever has generally been found in my experience, which has been very great, and I have had it twice myself, principally in connexion with the drinking of impure water.

1655. Do you believe that that poisons the blood?—Yes; in fact, I believe that it introduces the poison itself.

1656. Typhoid fever is a blood disease?—Yes.

1657. The blood gets into a sort of ferment?—Yes. I believe that the poison acts as yeast does in beer.

1658. It is a zymotic disease?—Yes; at the present time I have amongst many isolated cases two which, to my mind, rather illustrate my position. There are in the town two blocks of houses separated by walls from any other houses, and the inhabitants of all those houses drink water obtained from the same well, and almost every inhabitant of those houses is suffering from fever at the present time. I have seen the water frequently, and I have observed repeatedly that after the slightest shower it becomes perfectly thick and unfit for human consumption. I have brought here a sample, obtained under favourable circumstances, of the water taken from one of those wells (*handing in the same*). I obtained it last night. I have not submitted it to analysis, but at the bottom of it you will perceive that there is a slight deposit.

1659. Having these fever cases under your care, and believing that the water is the cause of the disease, do you not think that this is a case into which those who have charge of the public health ought seriously to look?—I do.

LUTON.

Mr. K. Tomson.

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1660. Do you know the condition of the cesspits and the wells generally throughout Luton?—I believe that lately, when new buildings have been erected, the board of health has used every precaution, it is sometimes impossible to construct privies and waterclosets, and to provide the necessary ashpits, and so on, without the well water being affected. I believe that they have been exceedingly careful of late in doing that, but from the limited space they have to do it in it is sometimes very difficult.

1661. Do you know how near the well from which you have obtained the sample of water is to an adjoining cesspit or privy?—There is a large drain that conveys all the refuse from the house, and I think it is two feet away perhaps, not much more. The drain is just against the house; the yard is on an incline and slopes towards it; the ashpit is just at the top of the incline and the privy also.

1662. (*Mr. Harrison.*) How far are they from the well?—I think about as far as from here to that bench (*describing*).

1663. (*Chairman.*) Is it a pipe drain or a brick drain?—I do not know.

1664. Your opinion is that there is a communication of some kind between them?—Yes. I conclude that all the surface matter is washed into the well; there is leakage into the well in that case as in other instances.

1665. Are those wells at any time cleaned out?—I am not aware of any instance where they have been cleaned out, except where they have required to be deepened, which in dry seasons is sometimes the case.

1666. When the water falls off they sometimes deepen them?—Yes, and then a large quantity of muck is taken out that you could hardly stand by; two years ago I saw that done.

1667. Of what depth are those wells?—They vary according to the position of the town, but the well to which I have referred would be about 40 feet deep.

1668. Is a pump used to empty it, or is it drawn up by buckets?—It is drawn up by buckets.

1669. Is the top of the well open?—Yes. They have wooden lids.

1670. I suppose the water is slopped about at the top and may soak back again into the well?—Yes.

1671. (*Mr. Harrison.*) At what depth below the surface would the water be in a dry season?—Sometimes it is all gone; in the last dry season that we had nearly half of the wells in the town were empty.

1672. At what depth below the surface is the bottom of the well?—That varies; but from 6 feet to 60 feet or 70 feet, according to the position of the well in the town: it varies very much indeed.

1673. In what particular districts of the town, or can you give the names where there is generally the most fever?—During the greater part of this year it has been just beyond the township, at a place called Brown Brick; it adjoins, but it is beyond the town; it is just by the deodorizing works.

1674. Can you refer to any disturbing influences which exist there?—I should say it is from the same cause, the impurity of the water. The board of health have no jurisdiction there at all, and therefore all the disturbing causes are perfectly uninfluenced.

1675. Have not the parish authorities any jurisdiction there?—They have, and they employ an inspector of nuisances, who is very active; but, with the greatest respect to him, the fact is that he does not possess that amount of scientific knowledge which would enable him to detect impurities and so forth. As far as local nuisances are concerned he has been very active in the discharge of his duties, and has done a great deal of good in the last year.

1676. Within the town are there any places to which you can point where fever prevails?—I may allude to a spot where that water was obtained (*pointing to the sample*); there they have had fever for the last three months, and in fact it has never been out of the place. That is Queen's Square, which is nearly opposite the national schools, in the south-western part of the town. We had it about two years ago in the north-eastern part of the town, but that was a remarkable instance, that was before that part was drained. In one street almost every house had fever, but we have not had a case since the place has been drained. Most of those streets are admirably fitted for drainage, being almost all upon an incline. I may mention that we have been very much indebted to the wet seasons, which have flushed our sewers for us, and we have had less sickness rather in wet than in dry seasons. With regard to the ventilation of the sewers, I cannot quite agree with the surveyor, as the odour from the gully holes is in my opinion most offensive. I often go out at night when the influence of the sun has gone, and the smell from the gully holes is most offensive in a dry season. They are more so at night, especially along George Street. I frequently have the smell in my own scullery, which is connected with a main sewer, and I often have to pour down carbolic acid, and many other things.

1677. What material is used for bleaching the plait?—I will give you a list of them. The bleaching materials consist of oxalic acid, salts of tartar, salts of sorrel, pearl ash, and brimstone—all these are used in bleaching. In dyeing the two principal articles used are logwood and sulphate of iron. For the black they principally use cuba fustic, yellow wood, and camwood. Most of these are dyes obtained from the West Indies or South America, and are vegetable dyes. They use Brazil wood and indigo, blue paste, which is sulphate of indigo, and they use a small quantity of sulphate of copper; shumach is also used, and madder.

1678. (*Chairman.*) These materials when expended, we have been told by the surveyor, pass into the drains, and then into the outlet sewer. May they not filter in their course into some of the wells?—They may do that, and no doubt they do.

1679. Are any of those ingredients poisonous?—Yes, oxalic acid is a most powerful irritant poison, and also sulphate of copper, that is poison in very small doses. They use sulphate of iron principally, and sulphate of copper in a less degree.

1680. (*Professor Way.*) Do they not use chromate of potash?—I think not; I am not aware that they do.

1681. (*Mr. Harrison.*) Can you say whether the well you have spoken of, in the south-east part of the town, and from which you took the water, is dried up in the manner you have represented in the summer time?—I have a strong impression that it is, but I cannot state certainly. The greater part of the wells were dried up in the summer two years ago.

1682. Is there any information you can give us as to the health of the town of Luton at the present time as compared with its state in past years?—Yes. I may say that I have no doubt that what the board of health have done, both paving and sewering has very much improved the condition of the town; at the same time there is a great deal more to do. We are very much indebted to the board of health for what they have done. I may say that the state of the public health, in my opinion, would not be so well discovered in the actual mortality as in the condition of the health of the people, and the health of the people generally is of a higher tone, excepting in very bad seasons when many of them are very poor. In good seasons, however, their health has very much improved, and they are not so susceptible to all those little ailments which, in my judgment, are more characteristic of the general health of the town than the mortality, nor so susceptible to any of the more severe epidemics.

1683. (*Professor Way.*) The death rate is not an absolute guide?—I do not think it is; I think that that is rather too much insisted upon.

The witness withdrew.

LUTON.

Mr. W. D. Sandoe.

12 Dec. 1866.

Mr. W. D. Sandoe further examined.

1684. (*Mr. Harrison.*) Have you heard the evidence that has been given by Mr. Tomson?—Yes.

1685. You have supposed the volume of water issuing from your works to be about 2,000,000 gallons a day?—Yes.

1686. Do you find that that varies very much in different seasons of the year?—Yes, it does; that is the calculation now just at this moment; it has been a very wet time.

1687. What was the volume of water that passed out of your sewer during the dry seasons of 1864 and 1865?—I should say about half the quantity.

1688. Was it half the quantity?—I think so; our intercepting sewer, passing as it does through a very large portion of the valley, and cutting through several very strong springs, would, I think, be calculated to keep up a supply of water in our sewers more than would be found even in many of the wells of the town, on account of their being so shallow.

1689. Is there any considerable rise from the river up towards the town?—Some of the higher parts of the town are something like 70 or 80 feet above.

1690. Mr. Tomson stated just now that the wells in many parts of the town were sunk to the depth of 60 or 80 feet?—Yes, and some of them down to 90.

1691. When there is an abundance of water to what height would it rise in those wells?—Six feet is the outside quantity at that great depth.

1692. Do you think your sewers collect water from the chalk at all in the neighbourhood, or such wells as those spoken of?—No; the greater part of our water is nearer to our works, that is, the lower portion.

1693. The answer that you gave to the question put as to the flushing of the sewers by the large volume of water that is discharged through them is not, I suppose, applicable to the branch sewers leading to the upper parts of the town?—It is not.

1694. In those parts of the town where you have opened out the sewers to put in branches, what have you found to be the condition of the sewers?—They have been invariably clean on account of the rapid fall; they have all of them excellent falls in the upper part of the town.

1695. (*Professor Way.*) They get flushed by the rain, do they not, to a considerable extent?—Yes; and it must be understood that there is a very large quantity of water used in washing and bleaching and dyeing the plait, which would of course add very materially to the cleansing of those upper sewers; in many parts of Luton very many of these small dyeing places are to be found where a very large quantity of water is used.

1696. Your sewer evidently lets in a large quantity of water in the lower parts, but is it equally well constructed to let out water in other parts?—It must be understood that in the portion which I allude to especially, very great engineering difficulties were encountered at the time of making it, and that very strong springs were cut through, which, as I may say, formed the upper side of the sewer, or the hill side; the lower side was nearer to the river.

1697. The springs, as I understand you, were so violent in some cases that there was a difficulty in making the sewer so complete and so water-tight as in other places?—Yes, that was the case.

1698. May not the sewage water escape in the dryer parts of the town from your sewer into the subsoil, and so reach the well?—I do not think that that would be so in the upper parts of the town, because the difficulties which I have spoken of were not encountered there, and therefore the sewer would be better.

1699. Were earthenware pipes generally laid there?—Yes, in the upper part of the town.

1700. You can make pipe drains more water-tight than brick drains?—Yes, and I should recommend them in all cases.

1701. (*Chairman.*) Do the larger sewers or drains ever choke during a thunderstorm from there being too much water?—We have found that to be the case; but of late, or within the last two years, we have made a very large storm-water bed, which would cover something like an acre of ground, and that takes in the overflow and relieves our sewers very materially; we therefore do not suffer from flooding now.

1702. You have ventilators in your outlet sewer I believe?—Yes.

1703. How are those ventilators formed; are they mere openings at the surface?—Yes.

1704. Up to the open air?—Yes, with open gratings.

1705. Are you acquainted with the ventilators used in London, and which you may see on the surfaces of the streets?—Yes.

1706. Are yours of that kind; is there a cast-iron grating on the top?—Yes.

1707. In the ventilation of sewers are you aware that it is the upper ends of the sewers that require ventilating more than the lower ends?—Yes.

1708. That is to say, that gas runs up hill with the same facility that water runs down, and reaches the higher points?—Yes.

1709. Did you hear what Mr. Tomson stated about the sewers smelling most offensively in the night time?—Yes; but I have only heard one or two complaints of that. I do not wish at all to contradict what he said, but I only know that no official complaint has been made to me on that point.

1710. Are you inspector of nuisances as well as surveyor?—Yes.

1711. In what part of the town do you find the greatest number of nuisances?—In the outer portions of the town; in the south-east direction there are more I should say than in any other part.

1712. Do you know the locality where typhoid fever, as Mr. Tomson stated, is prevailing?—Yes, I know the part alluded to.

1713. In your inspections in places where fever has been prevailing, have you ever seen anything that, in your judgment, might account for it in any way; any accumulation of foul matter or contamination of the water?—Where I have seen anything of that kind I have ordered its immediate removal in all cases; I have sent our own cart at once to remove any nuisance that I might have found.

1714. Has it ever occurred to you that an empty cesspit might for the time being be more injurious than a full one?—Yes, and I have always taken the precaution to use disinfecting powder; we have used chemical disinfectants in very large quantities during this year to sprinkle over the surface, and prevent the smell which sets up, whenever a place like that is emptied. Another precaution that I have taken has been to send men with the disinfecting powder to sprinkle in the various yards in the town.

1715. You have done that during the last summer?—Yes.

1716. Was it done at any time before the last summer?—The board of health did not take this matter in hand until the present year.

1717. Have there been any cases of cholera in Luton?—Not that I am aware of.

The witness withdrew.

LUTON.

Mr. W. Willis.

12 Dec. 1866.

Mr. WILLIAM WILLIS (Luton) examined.

1718. (*Chairman.*) What business are you engaged in?—I am a straw hat manufacturer.

1719. Where are your works situate?—The largest works in the town are situated in Castle Street. We have some small places about the town.

1720. What number of hands do you employ?—In the town of Luton I employ about 300.

1721. Do you bleach and dye the plait?—We bleach nearly all of it, and we dye it occasionally.

1722. What materials do you use in your manufacture?—In the bleaching part of it we use oxalic acid, and salts of sorrel, and salts of tartar.

1723. Does that list (*handing the same to the witness*) contain all the ingredients that you use?—Yes, I think this enumerates nearly the whole of them; we use oxalic acid and salts of sorrel to a large extent.

1724. About what weight of these materials do you use in the course of twelve months?—From one to two tons a year of oxalic acid and salts of tartar besides brimstone; that is a very heavy item.

1725. About what weight of straw do you deal with annually?—We bleach about 8,000 scores a week.

1726. Of what weight is a score?—I cannot say.

1727. What does a score mean?—It means 20 yards in length of plait.

1728. I suppose it varies in breadth, thickness, and width?—Yes; if it is of a light and single make the weight is lighter, if it is a heavy make of plait and double straw it is considerably heavier.

1729. About what weight of dyeing materials do you use?—We are but small dyers, but we have a large quantity of plait dyed in various parts of the town; we only dye to keep the men employed when they are not bleaching. I think that we use the weight I have given you in acids and salts of sorrel.

1730. What weight of brimstone do you use?—I cannot state at the moment.

1731. (*Professor Way.*) Is the brimstone burnt in order to bleach?—Yes.

1732. Do you burn the sulphur into sulphurus acid?—Yes; it is that which destroys the alkali in the plait and turns it white. I think I may say that we use half a hundredweight a week of brimstone; perhaps two tons weight of brimstone in a year.

1733. (*Chairman.*) Do you attempt to separate the solid portions of the bleaching and dyeing materials before the refuse is passed into the drains or sewers?—No, it goes off as refuse after it is done with altogether; they are all mixed together in a tub, a certain quantity of acid, a certain quantity of tartar, a certain quantity of sorrel are all mixed together when the plait is passed through it ready for the brimstone to be put to it; it all passes away into the sewers.

1734. (*Professor Way.*) What is the nature of that liquid, what is its appearance as it passes away?—The appearance of it would be a very dark brown colour.

1735. Irrespectively of the dye?—I do not speak of the dyeing, I confine myself exclusively to the bleaching. It probably depends upon the nature of the plait which passes through it, but there is always a very thick mud. Soap and soda are used in washing the plait, and after it has been cleansed it passes through the bleaching liquid to destroy the effect which the soap has had upon it in cleansing; it would be injurious if it remained in the plait; the final operation is the brimstone being ignited.

1736. (*Chairman.*) What volume of water do you use in the whole of your factories?—We pump it up by a steam-engine of three-horse power.

1737. What volume of water a day do you use?—It is purely a mere guess; we pump about four times a day for about three quarters of an hour as fast as we can pump, and I suppose we empty the cistern about twice a day.

1738. What is the size of the cistern?—I think we use perhaps 1,000 gallons of water a day.

1739. Does it all become refuse?—No, certainly not, a great part of it passes away as pure as water; the only refuse would be when we are dyeing or bleaching, such as the liquid which is used to cleanse the plait and the liquid which is used to put the bleach on. The wash which passes away from the closets and stables is the refuse, the other passes away, a great part of it, in an impure state and not at all diluted.

1740. What quantity of the 1,000 gallons would be polluted as you have mentioned?—I have no such calculation with me, but perhaps 300 gallons a day passes away, having been used for the purposes of bleaching.

1741. (*Professor Way.*) Is there anything in it that would make it worth your while to extract; is there any value in it?—No, it is not worth the trouble.

1742. Do you use much soap in your manufacture?—Yes, we use a large quantity of soap. You asked what was the colour of the refuse water. When we begin to use it it is very clear, but when they have finished it is not so.

1743. What arrangement in the shape of privy accommodation have you made for your workpeople?—Very bad indeed.

1744. Have you introduced waterclosets?—Yes, at the top of the building, and they are served by pumps. We cannot get the cistern high enough to supply them. We supply the cistern with a force pump and the labour of a man, but unless they are very much looked after there is a great deficiency, and a great nuisance is the result.

1745. You have to manage your own engine, supply your own labour, sink your own well, and do everything?—Yes.

1746. Do you think that the local board could perform that operation better than you would do it yourself?—Yes, very much better, and very much cheaper, and immensely to the advantage of our workpeople. The same remarks apply as to the number of the workpeople and the water, where there is a scanty supply, as applies to the houses where it is very difficult to get at it, and there is no doubt that that is one of the things which we so much need in Luton, where it forms the staple article of our bleaching operations.

1747. If you could be supplied with water as economically as a properly devised water company could supply to you, would you take it from them in preference to sinking for water yourself?—I should consider it one of the greatest advantages that we could have to be able to treat with a company or the local board to-morrow for a full supply of water to our premises at an additional cost of about 20*l.* or 30*l.* a year beyond what we pay now.

1748. And if you could obtain it at half the cost of your present supply it would be all the more satisfactory to you and do no one any harm?—Yes; it is always best to put these cases as strongly as justice will allow them to be put.

1749. (*Mr. Harrison.*) Can you give us any idea of the extent of your own manufacture as compared with the total amount of the straw hat manufacture in the town?—No, I cannot; it would be so very small as compared with the trade of the whole town that it would bear no comparison. Such is the extent of it all over Luton and everywhere.

1750. (*Chairman.*) Have you no idea what number of persons are employed in the straw plait trade, say within 1,000?—No; but there is a very large number of persons so employed, more than half the population; that is the best approximation I can make.

LUTON.

Mr. W. Willis.

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1751. Do you think that the refuse as it passes from your premises, and as it must go from others, containing ingredients like those which you have mentioned, should be carried into the river to pass on to London, and there to be distributed for drinking purposes?—No.

1752. Even after it has undergone the deodorizing process?—I do not care what process it undergoes, it comes from a population of 22,000 inhabitants. There is an immense quantity of logwood and all kinds of acids and other refuse from a town like this, and I say that it never ought to be allowed to pass into any stream, not even into a drain, much less into a small stream like the Lee, which sometimes has not five inches of water in it. Although we do not use it for domestic purposes, perhaps there are parties living within two or three miles of this place who do use it, and it must be, I should think, highly injurious to the health of the people in the neighbourhood.

1753. Are there among the chemical ingredients which are used for dyeing and bleaching certain poisons which remain so although they are diluted?—Yes.

1754. The poisonous character is not destroyed by the dilution?—No.

1755. (*Professor Way.*) I think you stated that dyeing was not carried on in large establishments, but that there were many small ones?—Yes. I should say that our dyeing is perhaps larger than in almost any other house in Luton; but dyeing is carried on by Mr. Leye, Mr. Tierney, and some five or six large dyers. We send it out, but there are many other small makers, such as would use 1,000 or 1,500 score of plait, and dye it at home; for instance, where a man and woman manage their own trade, if they dyed their own plait they might save a sovereign by doing it, and all these things help to make up an income during a week. Therefore there is a great quantity of dyeing done all over Luton, and I think that it exceeds the bleaching considerably, especially for several months in the year. You may have observed places of business in George Street, but scarcely any of them dye. All their goods are dyed at various parts of the town. The plait is bought in its rough state on a Monday, the parties work it up, and bring the hats down to the market to sell them. We keep a large number of hands, and we send our plait off to be dyed; but we do it ourselves for a few weeks in the summer when we have no bleaching going on, just to employ our bleachers.

1756. If it were possible in your manufactory to do anything to purify the refuse before it was sent into the sewers it might not be possible to do so in very many small places?—I think not; it is not as if these operations were confined to particular parts of the town where you could deal with them in bulk.

1757. (*Chairman.*) Where does the plait which you make in Luton go to to be used?—The best plait is not made in the town. Some little is made in the neighbourhood, but most of it is made 10, 15, or 40 miles away from Luton; it is brought here from Dunstable and other places to go through the process of bleaching and dyeing, and then to be manufactured into white or black hats, or white bonnets, or black bonnets. There is a large market here on Monday morning, when we buy the materials that are brought to Luton to be made into the manufactured article.

1758. It is used in England?—The manufactured article is used all over the world; it is sent abroad and goes to every place on the continent of Europe; to the United States, Valparaiso, Chili, Brazil, and everywhere else wherever there are ladies.

1759. Do you know, as a manufacturer, whether the same kind of material is imported from any other part of the world into England?—Yes, we import very large quantities, and so do our neighbours the French, from Saxony and Switzerland, and the Duke of Baden's estates. I mean not the manufactured, but the raw material, the straw.

1760. The plait?—Yes.

1761. Is there any importation of manufactured articles, hats or bonnets, from any part of the world into England?—Very few are imported. Sometimes a few from France and Belgium, but there are more bonnets come from France. From Belgium they are very limited. These are bought in this country more to ascertain the style of the article made in those countries, and when we have got that we can beat them by half the price.

1762. Shall we be right in saying that England is a straw bonnet making country in this part of it?—Quite so, and that it beats all other countries in the world.

1763. What is the youngest age of the children who come into the business?—That question must be divided into two parts; first, as to the age at which we as large manufacturers should be disposed to take them, and, secondly, the age at which large numbers are employed in small houses all over the town.

1764. And all over the county, or the straw plait district?—Yes, that is a very different affair. I should never think of taking a young child. The boys come to us at 10 or 12 years of age, and then we have no objection to take them; but there is no doubt that very large numbers of children are employed at a very tender age in the making of straw hats in various parts of Luton and in the counties adjoining.

1765. At as early an age as the little fingers can do any work?—I should certainly say from eight years upwards.

1766. Is the business at all under Government inspection?—No; for this reason, that the Government seldom interfere but where masters bring large numbers of workpeople together on their premises; they have seldom interfered where a woman having two daughters of her own may choose to engage two or three more persons to work in her own house; that, I think, is one reason why we are not under Government inspection.

1767. Have you any regulation with regard to what are called half timers or scholars?—While I lament that persons so young should be engaged in any manufacture, or in any employment at all, instead of their youthful days being devoted to education and to those advantages which they can only have in early life, I do not think that this employment is injurious to their health, because they are allowed to go out very frequently and to walk about; they are not in heated rooms; they would suffer considerably more in rooms of that character, where large numbers are brought together, than they do in those houses. I express my regret that they are employed at all, but in justice to the parties who do employ them, I am bound to say that I think that considering the pure air which they get in going to and fro and often running about the yards, the employment is not so injurious as if they were brought in large numbers into one building.

1768. I assume that the making of straw plaits is, during a considerable portion of the year, carried on even by the children in the open air?—It is.

1769. And therefore they breathe the fresh air?—Yes, and I do not think that it is so injurious to their health as we should suppose at first sight. My objection is that which I have stated.

1770. Therefore they do not come under the same range of objections as factory children confined from early infancy within the four walls of a building?—No. I must make one more observation, namely, that there is a great alteration as to the time for which the people work here. In the large manufacturing districts there are fixed hours; persons must be there from 6 o'clock to 6 o'clock, and another party comes on and remains till the others return; the way in which the business is conducted here is, our young people come at 9 or half-past 9 or 10 o'clock, and they go away at a quarter to 12, stay away two hours, go to and fro, except on particular occasions, and do as they please.

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1771. (*Mr. Harrison.*) It is all piece work?—It is all piece work.

1772. And there is no machinery standing?—No; and there is none of the noise made by clogs which there is in the north of England.

1773. I presume that in the manufacture of plait there is some advantage in early teaching?—There is an advantage, but we must not purchase any advantage at the expense of one's whole life afterwards.

1774. (*Professor Way.*) Perhaps it is an advantage to the proprietor rather than to the people?—Yes; it is not an advantage to the younger children. You will find within four or five miles of this place that which I think is more injurious, namely, 18 or 20 young children brought into a woman's house, and in a very small room, where the cooking and so on is going on, and she perhaps gets 2*d.* a week for each of those children from their mothers, and extracts from them a certain quantity of plait every day. I think that the plaiting children suffer considerably more than the children do who are employed in various parts of the town in making up the hats.

1775. (*Mr. Harrison.*) Instead of being educated they are at work?—Yes, and that is my great objection. At the same time I cannot but think that it is highly injurious to bring 20 little children into the first floor of a small cottage, and for them to sit there until 9 o'clock in the evening, at the tender ages of eight to 11, making a certain quantity of plait. If we had Government inspection in this neighbourhood I think that the plaiters would need it more than the straw hat makers.

1776. (*Chairman.*) I gather from your remark relative to the clogs in the north that you have heard them?—Yes; they wear thin shoes here, slippers and all sorts of things.

1777. (*Mr. Harrison.*) You have given us a description of the materials which you use, you have also stated the number of people whom you employ in your manufacture, and the volume of water which you use; can you give us the weights of those different materials which you use per annum in bleaching?—I can do it, and will enclose it to the Commissioners.

1778. With respect to Dunstable I wish to ask you a question?—We have a factory there.

1779. Is the manufacture there of a similiar character to that at Luton?—No, it is altogether different.

1780. What is the difference?—There it is principally, if not wholly, confined to manufacturers, and it is not carried on, as it is here, to a very large extent by small makers.

1781. Is the straw there bleached and dyed in the same way as it is at Luton?—Yes, if it is bleached and dyed at all, but large quantities are dyed here and taken to Dunstable and various other parts; bleaching and dyeing is carried on to a very limited extent in the town of Dunstable.

1782. Dunstable is not so happily situated as Luton for a good supply of water or for getting rid of the refuse which you mention as the result of the manufacture at Luton?—We are bad, but they are worse.

1783. (*Chairman.*) With regard to Hitchin, what branch of the business is carried on there?—We have a small factory there of 50 hands, and there may be a few besides; there are, perhaps, not more than 100 hands in the whole place; therefore it is what we should call a large market town, situated in an agricultural district; it is a very large straw plait market in the raw material. I am speaking now so far as the conversion of that straw plait into the manufactured article is concerned.

1784. Where is the straw principally grown?—Throughout the counties of Hertfordshire and Bedfordshire, some in Buckinghamshire, and immense quantities in the counties of Essex and Suffolk.

1785. What is the straw?—It is the wheat straw; it is much superior in this part to any other, and although an immense quantity is used in the county of Essex, immense quantities of that straw are sent down there for the plaiters to use, because it is of a softer kind. I know not what is the cause, but the neighbourhood of Tring, Biggleswade, and the county of Berks are very excellent districts for the wheat straw, which in times of scarcity is brought here.

1786. (*Mr. Harrison.*) Is it generally grown upon the chalk formation?—Yes. Biggleswade and this county is a very excellent neighbourhood for straw.

1787. (*Chairman.*) Is the straw which is purposed to be used for plait reaped in the same way as ordinary wheat, or with more care?—If a farmer has a small quantity where he thinks the straw is very superior, it is to his interest to be very careful in cutting it; we do not like straw which has been mown; it should be reaped, and if reaped it may be reaped in the usual way, and then it goes into a machine. Persons come and buy a stack of wheat and give the farmer money, according to its value, for the stack of wheat; that is taken into a machine; the parties there are cautious to draw the straw out and they put it up into small bundles; they cut off the ear, bringing the other part away.

1788. The wheat is not thrashed as ordinary wheat upon the floor or in a thrashing machine?—No.

1789. But the ear is cut off?—Yes; if you buy 1 or 2 cwt. it is all weighed together, and you leave the wheat behind and any refuse; if the straw was at all broken it would not be at all suitable for making straw plait.

1790. (*Professor Way.*) Is not that the way in which the harvest is reaped in America?—I have so little knowledge of that democratic country that I cannot speak as to that.

1791. (*Chairman.*) Do you know of your own knowledge whether the straw of wheat which has been grown under good and improved cultivation is better in quality for your straw plait than neglected or poor wheat?—The neglected wheat is better for our straw because it is finer; if the cultivation is too much improved, and the crop is too heavy, the straw is too coarse for us, and therefore we get the light straw from the poorest parts, and sometimes from the poorest farmers.

1792. (*Mr. Harrison.*) I think that the character of the chalk straw would generally be short, fine, and white, which are your essentials?—Yes.

1793. (*Chairman.*) In your opinion would the straw of Russia, or of the great wheat-bearing districts of the continent, from which we mostly get our corn, be equally available if sorted for your purposes?—No plait is made in Russia, and therefore I cannot speak to that; but you get straw in Belgium quite equal to our own, and some kinds of straw in Switzerland quite equal to our own, and in Saxony also.

1794. And in Spain?—I know very little of that country.

1795. Did you ever see any Australian wheat or Australian straw?—I have not seen Australian straw I have seen Australian wheat.

1796. Of course it would not be worth while to import straw from Australia?—No, it would not pay if you gave it to us. When our trade is brisk the beauty of it is that it is all labour. If I showed you a lady's bonnet, worth 7*s.* or 8*s.*, the straw in a farmer's yard would not be worth a penny, and therefore all that is labour.

1797. (*Mr. Harrison.*) There is labour and profit?—Yes.

1798. Is the Leghorn straw plait made from wheat straw?—I suppose that it would be a wheat straw, but it is differently prepared, which gives it a different colour.

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1799. Are Luton and Dunstable the centres of the straw manufacture?—Luton and Dunstable are the emporium of the manufacture of straw hats and bonnets.

1800. What is the extent of country over which the manufacture of straw spreads?—About a radius of 25 miles round Luton I should think would be engaged in the manufacture of straw plait and straw goods.

1801. (*Chairman.*) Have you any idea what would be the gross sum, within a few thousands per annum, which is turned over in this straw plait trade?—No; it is more than 1,000,000*l.* per annum. There are single houses which do more than 100,000*l.*

1802. Then it is a very important trade for this part of the country?—I think so. If I said 2,000,000*l.* I should not have any doubt about it, but I should not like to say, because when persons speak with that minuteness they are apt to form their judgment in detail and pass their criticisms upon men who know more about the matter than themselves.

1803. But you think that the gross sums dealt with may be taken at from 1,000,000*l.* to 2,000,000*l.*?—Yes.

1804. Is it an increasing or a decreasing trade?—A largely increasing one. You may fairly take it for granted without any mistake that the amount is between 1,000,000*l.* and 2,000,000*l.*, and, in the opinion of a gentleman who has just spoken to me, considerably nearer the latter than the former.

1805. (*Mr. Harrison.*) Can you give any idea of the total weight of straw which is used in the manufacture?—No, I could not approximate it at all.

1806. (*Chairman.*) Is there anything you wish to add?—No.

The witness withdrew.

Mr. J. Cumberland.

Mr. John Cumberland (Luton) examined.

1807. (*Chairman.*) You are a land surveyor?—Yes.

1808. Were you at any time surveyor to the local board of health?—I was surveyor on its first introduction into the town about 16 years ago. I was surveyor to it for five years.

1808*a.* Had you anything to do with devising the system of sewers?—Yes, I laid out several new sewers.

1809. When you were first surveyor?—Yes.

1810. In what condition did you find the town upon your appointment as regarded sewerage and drainage?—The whole of the new streets were entirely without sewers. There was an old sewer down George Street and Park Street.

1811. Of what shape in section were the old sewers?—They were near the surface of the ground, and they were 12-inch sewers, except the one in George Street, which was 15 inches.

1812. Were they square on section, or circular?—Circular.

1813. Were they made of brick?—Yes.

1814. I suppose that they had been made by the highway surveyors for carrying away the surface water?—Yes.

1815. Did they at that time drain any of the houses?—Yes, the surface water, but not the cellars or underground kitchens.

1816. Were the contents of any waterclosets at that time turned into those old drains?—There might be a few, but I think not 20 in the town.

1817. Where did the old drains empty?—Into the river Lee or into the ditches which went into it.

1818. How long have you known the Lee?—25 years well, and longer.

1819. Do you know where it rises?—I think that I know every point of it.

1820. Does it rise principally in springs?—Yes, in a series of springs at Leagrave Marsh.

1821. Have those springs been at all interfered with within your knowledge by any parties?—Yes.

1822. Who has interfered with them?—The farmers from time to time have filled in the springs as they ran into the land and interfered with cultivation; they have filled them up and then ploughed over them.

1823. They would not stop the water by filling them up?—They would divert it.

1824. When a spring goes into daylight, if they filled it up it would go out of daylight?—Yes.

1825. Have you seen any land irrigation anywhere?—No, not sewage irrigation.

1826. Have you seen any water irrigation?—Yes; I was on Lord Dacre's estate as a pupil.

1827. From your knowledge of water meadows do you think that a beneficial effect might be produced by sewage irrigation?—Certainly.

1828. What weight of grass were you enabled to get from your water meadows?—I cannot say, because the land was always fed with sheep.

1829. It was considered advantageous?—Very advantageous.

1830. That was pure spring water?—Pure river water, the water of the river Mimram.

1831. In what district is that irrigation carried out?—About seven miles from here.

1832. Below or above?—It is in Hertfordshire.

1833. Is it down the river Lee below Luton or above?—It is on the river Nene, which falls into the river Lee at Hertford.

1834. What is the subsoil, is it chalk or lime?—Gravel; and not chalk.

1835. That is the land which you irrigated?—Yes.

1836. What did it cost per acre to lay out that land for irrigation?—I cannot say; it was done before I went there.

1837. Had it been a costly affair?—No; it was done by a series of side cuts and side drains falling one into the other; it was very simple.

1838. Do you think that you could readily with a plough lay out irrigating grips by contour lines so as to irrigate land in a similar way?—I have no doubt that arable land could be done so at very little cost.

1839. (*Mr. Harrison.*) Was there any difficulty in getting the water to pass over that character of soil?—No; it was blocked up and run out of the main river on to the beds, and it then flowed into the river again lower down.

1840. There was no difficulty from its soaking into ths soil too rapidly?—No.

1841. (*Chairman.*) What is the general character of the soil of the valley of the Lee?—Chiefly chalk; there is a little bit of gravel first of all, a kind of silt, and then you get into the chalk; but lower down beyond here I should say that you get into very boggy peaty land, that is in the lower valley close to the river, but as soon as you get away from it you are in chalk.

1842. I think that there is a new railway being made up here?—Yes.

1843. And that shows you that the soil is chalk for several miles?—Yes.

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1844. The excavations are chalk, and of course the embankments are chalk?—Yes; I should say that in the cutting at Chalton Cross, just at the source of the Lee, they are tapping springs, and they are in water the whole time; the Midland Company are about 55 feet deep in cutting and they have been flooded with water the whole time, and are now; I was there on Saturday.

1845. (*Mr. Harrison.*) Is that cutting at a considerable elevation, considerably above Luton?—Yes; it is gradually rising the whole way.

1846. How many miles distant is that cutting?—About 3½ or 4 miles.

1847. Would that volume of water which has been passing from the sides of the cutting afford a good water supply for the town of Luton?—Not at all, but it would certainly aid it very much.

1848. You have said that you carried out the sewerage works of Luton?—Yes, the earlier part of them.

1849. Did you find any difficulty in any part of the town in executing those works efficiently in consequence of the springs of water which came into your works?—No; we never got into the lower level.

1850. In the works which you did carry out did you tap springs to any extent?—Never to any extent.

1851. How many miles of main sewers were executed under your inspection?—I think probably not above a mile or a mile and a half.

1852. (*Professor Way.*) What is the usual value of land in this district for general agricultural purposes?—From 30*s.* to 2*l.* per acre.

1853. It is not a good wheat district, is it?—I think very good.

1854. You think it very fair?—Very fair.

1855. Then what has caused the straw plait, which requires an inferior wheat although a superior straw, to locate itself here?—A high state of farming has driven the straw trade into an inferior farming district.

1856. In the north we have heard that the manufacturers have gone to certain districts for pure water for dyeing and cleansing purposes; what do you imagine originally caused the straw plaiting business to settle itself in this district?—The quality of the wheat straw unquestionably.

1857. And that, we have been told, is not a fine quality of straw agriculturally?—Not agriculturally.

1858. Then is the land about here under the average of good fair land?—No; I should think that it is a very fair average, taking the country through.

1859. Straw fit for plaiting is only, I suppose, to be found on certain soils?—Yes, the best quality of straw, namely the softer quality of straw is on the green sand formation.

1860. If you found that on a particular farm a large quantity of straw was bought for straw plaiting purposes, would you suppose that that land would sell for more or for less than other land in the neighbourhood?—It would not affect the value of it in selling at all.

1861. We have been told that the poorest wheat gives the best straw?—That is quite correct. If you go to Totternhoe, the next parish to Dunstable, where they grow the best straw, it is open land, and they grow more straw than wheat, but it is a risk; if a shower of rain comes it is spoilt unless they do it at the right moment, but it answers the purpose where your farming is not up to the mark, and if they can get the straw they cut it very early; they sacrifice the wheat in order to get the straw.

1862. (*Mr. Harrison.*) In the case of the irrigation which you mentioned just now did the water issue from the green sand?—No, it came from pure chalk, the white wells, near Whitwell, Herts.

1863. (*Professor Way.*) Do you know whether any coprolites are got in this neighbourhood for manure?—Not nearer than Hexton, about seven or eight miles from here, over the hills; they are working them there very largely; they restore the land.

1864. Are they at any depth under the soil?—About seven feet. This specimen of a shell which I now produce came from Shillington.

1865. (*Chairman.*) Have you many of this form of shell?—Yes, a good many of them, not so perfect as that; I picked that out as being perfect.

1866. (*Mr. Harrison.*) Do you know whether the water issuing from the formation in that district is used for irrigation to any great extent?—Not at all, I think.

1867. Are you aware that it is very valuable for irrigation?—I was not aware of it.

1868. The beautiful water meadows of Dorsetshire and that neighbourhood derive a great deal of their superior quality from the water issuing from the green sand formation?—I was not aware of it; I do not think that it is used at all here; I am not aware of any case in the neighbourhood where we irrigate.

1869. (*Chairman.*) Is there anything further you wish to add?—No.

The witness withdrew.

Mr. C. Maffey.

Mr. CHARLES MAFFEY (Luton) examined.

1870. (*Chairman.*) You are the local registrar?—Yes.

1871. And you are sanitary inspector under the local board?—For the board of guardians in the hamlet, not in the township of Luton.

1872. Can you furnish the Commission with the local death rate for any period?—In the year 1864, in a very dry summer, we had a great excess of deaths.

1873. Could you extract from your books the mortality for the last five or six years?—I could.

1874. Could you give it to us for seven years before the board came into operation?—Yes.

1875. From 1845 to 1852?—Yes.

1876. And then from 1858 to the present time?—Yes.

1877. About what would be the cost of doing that?—It would be very trifling.

1878. I think that it would be best if we could get it from 1847 down to the present time. What has been the death rate per 1,000 for the last 12 months?—I should think that taking the 12 months it is 25, but in the dry summer which we had a year or two ago the mortality was greater on account of their being a short supply of water.

1879. What was it then?—I should think 35 per 1,000.

1880. Could you give us the death rate of different parts of the town?—I do not see very well how I could do that.

1881. In your experience is not the death rate in the poorer parts of the town, at a very much higher amount than the death rate in the better parts of the town?—Yes.

1882. If you have 10 in the 1,000 or 12 in the 1,000 in the better parts of the town, you may have 40, 50, or 60 per 1,000 in the poorer parts of the town, taking population and death rate?—There is no doubt of it; it is considerably greater.

1883. Therefore, when you sum it up all together, in a population of 20,000 it gives you a very poor idea of what one part may be suffering as compared with another?—Yes.

1884. What was your worst year?—The year of the dry summer, which I think was 1864.

1885. If you will give us the part of the town where it occurred it will be of real use?—We can do that.

1886. (*Mr. Harrison.*) Are you the registrar of any country district as well as of the town?—Yes, I am registrar for this union.

1887. Could you give the death rate in some of the outlying agricultural parts of the district?—I think that I could give it to you from parishes in my district; my district comprises five other parishes besides Luton.

1888. Do you find a very great difference in the death rate of some of those outlying parishes as compared with the town of Luton?—No.

1889. (*Chairman.*) But a death rate of 35 in the 1,000 must have been frightful?—Yes, but that only occurred, I think, in one dry summer. In 1864 and at the beginning of 1865 the water was very insufficient.

1890. Will you add to the return which you are about to give us the death rate of some of the outlying parishes?—I will.

1891. (*Mr. Harrison.*) How are the outlying districts supplied with water?—At Stopsley, which is two miles from here, I do not think there is more than one well in the hamlet, and they got their supply of water from the clay pits and the ponds till at last the water was completely gone, and they were obliged to have their water from the river Lee.

1892. The water which they had was water collected from the surface into ponds?—Yes.

1893. Was there much vegetable growth in those ponds during the dry seasons?—Yes.

1894. Could other pollutions get into those ponds?—Yes, all the refuse from the roads and everything.

1895. Was the condition of those ponds, while the inhabitants were drinking the water, very bad?—Yes.

1896. Was the effect upon the health of the people who were drinking that water marked?—Yes; we had more deaths in that hamlet at the time when the water was bad and short.

1897. Do some of the villages obtain their water from wells?—Yes.

1898. Have they an abundant supply of it?—Yes. I never heard of the water failing in the villages about, but only in the hamlet of Stopsley, which lies on a hill and where they have no wells.

1899. Are those wells in the chalk?—Yes, all but Barton, and that is on the clay.

1900. Do you find much difference in the health of the inhabitants in those parts as compared with the others?—They have been more healthy and are so at the present time; the water has been superabundant.

1901. Will you let the returns which you give be of two parishes, one of which is situated in a chalk district with an abundant supply of water and the other a parish which is dependent for its supply of water upon the rain water collected in ponds, as you mentioned in the first instance?—Yes.

1902. You are inspector of nuisances?—Yes, for the hamlet.

1903. Not for the town?—Not for the town.

1904. You are appointed under the board of guardians?—Yes.

1905. How long have you been appointed?—I have been inspector of nuisances for many years.

1906. Have you found in the country districts occasions to call upon people to remove nuisances?—A great many.

1907. What has been the character of those nuisances?—The overflowing of waterclosets and bad drainage and so on. There was no sewerage to take it away, and the sewage soaked into the ground.

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1908. Have you found any difficulty in obtaining the removal of those nuisances?—I have in some cases; I have summoned several parties before the magistrates.

1909. What system have you found in the country districts the best to adopt so as entirely to remove all occasion for complaint?—The only thing which I can find in the country districts is to have a privy, and to have it properly cemented to keep out the water, and properly covered in.

1910. And to have the refuse frequently removed?—Yes.

1911. Is it generally applied to the land?—Yes.

1912. Have you found any nuisances arising from the refuse from the farmyards?—No.

1913. You have not had any occasion to complain of that?—No.

1914. Have you found pigstyes kept by the cottagers?—Yes, and I have had them removed 20 or 30 yards from the houses.

1915. Have you found much opposition on the part of the occupiers?—No. I leave the proper notice, and it is done within the time, and if not I have been obliged in a case or two to summon them, but that is not a common occurrence. Brown Brick is the worst place which I have in my district.

1916. Is that towards the south-east part of the town?—Yes.

1917. Just outside the jurisdiction of the local board?—Yes.

1918. Did you hear Dr. Tomson's evidence?—I did.

1919. Do you corroborate it?—I do. A great deal of refuse lately has been thrown direct into the river Lee; it does not go into the deodorizing works. There have been many cases in the last few years of little bleachers and dyers, who have no drainage to take away the refuse, throw it down on the surface, and it is washed into the river.

1920. How did that locality happen to be without the district of the local board?—I do not know.

(*Mr. Pledge.*) That land has recently been sold for building land and a great population has grown up there, but it is outside the township.

1921. (*To Mr. Maffey.*) Is that a part of the town which has been recently drawn upon?—Yes; and I have seen two or three wells, the water of which was not fit to drink, and I have ordered them to be cleaned out; in fact there were places where a dumb well and a well of water were within a short distance of each other; I have had the dumb well filled up.

1922. Dr. Tomson said that there was evidently sickness arising from that state of things in that locality?—Yes.

1923. Is that likely to spread into the town of Luton?—Yes, it being so near.

1924. (*Professor Way.*) Those dumb wells are cesspools?—Yes.

1925. In what soil are they?—Chalk.

1926. Is any attempt made to prevent their leaking?—No; they make them here on the chalk so that the matter may sink away.

1927. Then what chance have the wells?—It drains through the chalk. What is called Brown Brick is not all chalk, it goes through the chalk and the gravel.

1928. They are never emptied?—No.

1929. It must go somewhere?—Yes, and it runs into the drains, and many of them go into the river; in fact drains have been laid from them into the road.

1930. Although the sewage of a house may not go into the river by the regular authorized drains it may get there sooner or later through the chalk?—It cannot help itself.

The witness withdrew.

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Mr. W. H. Higgins.

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Mr. W. H. Higgins (Luton) examined.

1931. (*Chairman.*) What are you?—A plait merchant.

1932. Where are your works situate?—In George Street.

1933. What number of hands do you employ?—I am a dealer in the raw material.

1934. What quantity of materials in value passes through your hands in the 12 months as a dealer?—It is a difficult matter for me to tell you exactly; there are so many things which we deal in besides the raw material that I could not tell you, the raw material would be one particular branch.

1935. Did you hear Mr. Willis give his evidence, who stated that the whole amount of straw plait weight come to nearly two millions?—I have not the least doubt that it would exceed a million.

1936. And that this district is the greatest straw plait place in the world?—Yes, and this town has the greatest amount of straw plait.

1937. This town of Luton is the centre of that district?—It is.

1938. And it has the largest dealings in it?—By far.

1939. Are there any special points in this inquiry to which you wish to speak?—I wanted to put one question to you, you have been told that a private company has been formed to erect waterworks in this neighbourhood.

1940. Or has been spoken of?—Yes, that is two years since; they have done nothing yet. I wanted to know whether that would be a legal obstacle in our way as a board in erecting waterworks ourselves, as the company have done nothing?

1941. It would not, but if you allowed a company to occupy the ground, and to acquire legal rights of any kind, it would then be very difficult for you as a local board to get past them without purchasing them out.—They have not purchased any land at present, I believe.

1941*a*. (*Professor Way.*) Have they an Act?—Yes, they have obtained an Act.

1942. (*Mr. Harrison.*) What is the period within which they must execute their works?—Seven years, of which two years have gone.

1943. (*Chairman.*) I do not think that the Secretary of State would allow them to stop you if you put the case fairly to him. You as a local board would have to make application through the Local Government Act Office to the Secretary of State for Home Affairs, to be allowed to raise the money for your waterworks, and you would have to devise waterworks. Was this company going to sink a well?—Yes.

1944. Then I have no hesitation in saying that, under those conditions, the Secretary of State would not stop you, and I speak as the principal inspector of the Local Government Act Office. Very probably the question would have to be submitted to myself.—I am obliged to you. There is another question. You have heard of the state of the hamlet, which has formed part of the town although not in the township, and which is not under the board of health; would there be any difficulty in getting that hamlet under the management of the board of health?

1945. None whatever.—It is a great nuisance to us as a board.

1946. Your clerk ought to have been able to acquaint you with what the proper process would be. You would have to petition the Secretary of State to be allowed to extend your boundary, and if the Secretary of State, upon a report laid before him, approved of it, that extension would be made by a provisional order, at no cost to yourselves excepting it was opposed in Parliament?—I am obliged to you.

The witness withdrew.

Mr. T. Taylor.

Mr. Thomas Taylor (Luton) examined.

1947. (*Mr. Harrison.*) You are bailiff to Mr. Crawley?—I am his agent.

1948. Where are Mr. Crawley's estates situated?—They are situated on the north side of the town of Luton, on both sides of the river Lee, extending for a mile and a half or two miles.

1949. Is that part of the river Lee at all subject to be flooded?—Very often.

1950. Has that flooding increased of late years?—I cannot say that it has, but there is an impediment which we consider might be removed. Formerly there was a mill on the north side of the town but now it is pulled down, and in the construction of the Midland railway they have put in a weir to keep up the water to its old driving height, which we consider is not of use to anyone. Formerly it was obliged to be at that height for the purposes of the mill, but now it is not required.

1951. Did the Midland Railway Company purchase the mill property?—Yes.

1952. Then with the mill they purchased the right of maintaining the dam?—I cannot say that.

1953. Would they not have to purchase the power of the mill when they purchased the mill, and the power could not be maintained without the dam, and therefore they would purchase the right to maintain the dam which the miller had before?—We consider that it overflows now perhaps rather more than it did before; for this reason, formerly when they found a flood coming on they could pull up their floodgate, but now they have none, and we consider that it floods our land six inches more than it did formerly.

1954. Have the Midland Railway Company done away with the mill?—Yes.

1955. (*Chairman.*) It is a common law right. We can listen to what you say, but I do not think that we can afford you any remedy?—By having this weir put in the water runs six inches deeper, and it floods the land all over its banks.

1956. (*Mr. Harrison.*) But you have said that the land is not flooded more than it used to be?—It is said that the amount is the same, but we consider that the land must be more flooded.

1957. (*Chairman.*) As I understand you, this is the fact which you wish to put before this Commission, that the Midland Railway Company have possessed themselves of a mill?—Yes.

1958. And have removed the wheel?—Yes.

1959. And have removed the mill?—Yes.

1960. They maintain the dam at the original height?—Yes, at the driving height.

1961. But they have put in no bye-sluices to enable them to draw down that water in time of flood?—Not at all.

1962. The miller had bye-sluices which he could draw, and did draw, in time of flood?—Exactly so.

1963. Therefore you may in flood time be more flooded than when the miller had possession, because there is no bye-sluice to be put in operation?—Just so.

1964. That is what you complain of?—Yes.

1965. (*Mr. Harrison.*) Have they lengthened the weir at all?—I should say not. The stream which leads up to the weir is narrower than the former bed of the river; it is about half the length of the former river. Formerly there used to be a large mill-head.

1966. (*Chairman.*) I suppose that you are not a solicitor?—No.

1967. But there is a solicitor belonging to the estate?—Yes.

1968. (*Mr. Harrison.*) Have the company erected a bridge above the weir across the Lee?—No, not across the Lee.

The witness withdrew.

LUTON.

Mr. T. Lye.

12 Dec. 1866.

Mr. Thomas Lye (Luton) examined.

1969. (*Chairman.*) What business do you carry on?—Dyer and bleacher of straw plait.

1970. Where are your works situate?—In New Bedford Road.

1971. What number of hands do you employ?—About 30; it varies.

1972. You dye straw plait?—Yes.

1973. Have you any idea what quantity you dye each year?—I have not kept any account of it.

1974. Do you know what weight of material you use in dyeing?—Yes; logwood is one of the chief things which we use in dyeing in this trade, because black is the prevailing colour.

1975. Is it chip or ground logwood?—Chip.

1976. What weight of logwood do you use?—I daresay that I use nearly 25 tons in the year.

1977. What becomes of the chip?—We burn it among our refuse.

1978. You do not send it down the sewers?—No, it is burnt.

1979. Do you use engine power?—No.

1980. What other material do you use?—There is a yellow wood called fustic, which we use in a smaller quantity.

1981. Do you use it in the chip?—Yes.

1982. Do you also burn that?—Yes.

1983. (*Mr. Harrison.*) What is the weight of that?—About two tons.

1984. (*Chairman.*) What other material do you use?—I use a few hundredweight of camwood; camwood is a perfectly red wood.

1985. Is it not red and yellow mixed?—There is an amount of yellow in it, but the main portion of it is red; it is called a red wood.

1986. It would be something like logwood?—It would be a deeper red. We also use madder; I should say four hundredweight.

1987. What else do you use?—I use copperas—that is sulphate of iron; I should think four tons in the year.

1988. Do you use sulphur?—I use it in the bleaching, but that has nothing to do with the dyeing, nor does it go down the sewer, as it is used in a gaseous state; I also use about two hundredweight of sulphate of copper per annum; and sulphate of indigo, perhaps five hundredweight per annum.

1989. (*Professor Way.*) What is it worth?—It is a sort which would be worth 1*s.* 6*d.* per lb.; there are different prices. We use four hundredweight of Cudbeer's article; also oil of vitriol.

1990. (*Chairman.*) How much oil of vitriol do you use?—Four or five hundredweight per annum.

1991. (*Professor Way.*) Do you dye anything but blue and black?—I dye various colours.

1992. What other colours do you dye?—Brown and different shades of drab.

1993. Do you use any of the fancy colours in aniline?—Yes, we use a small quantity of that; there are a number of little articles.

1994. Like this (*showing a specimen*)?—Yes; you would get this from the aniline dyes, but very little of the fancy colours is used in this trade.

1995. Do you use crimson or scarlet?—Yes, but the prevailing colour is black, a small quantity of brown, and a very small quantity of the others; we also use bleaching articles.

1996. (*Chairman.*) What are they?—Oxalic acid and salts of tartar. I do not do any large quantity of bleaching.

1997. About what weight of oxalic acid do you use?—About five hundredweight.

1998. Is it not a deadly poison?—We use carbonate of potash, and where a great quantity is used it neutralises it.

1999. (*Professor Way.*) But it makes the liquid into a poisonous salt?—We weaken it very much in the process by dipping the plait in it; we also use a small quantity of sorrel.

2000. (*Chairman.*) Have any accidents occurred upon the works from these poisons?—None whatever.

2001. What numbers of scores of plait do you treat in the year?—From 15,000 scores a week; perhaps 20,000.

2002. From 15,000 to 20,000?—Yes.

2003. A score being 20 yards?—Yes.

2004. (*Professor Way.*) Are there a great many sizes of plait?—Yes, there is a great variety; some very broad and some narrow.

2005. (*Chairman.*) They are all taken one with the other?—Yes.

2006. (*Mr. Harrison.*) What quantity of water do you use in dyeing that amount of plait?—2,000 gallons per day; I use a large quantity of water for it in the various processes, in rinsing and otherwise.

2007. (*Chairman.*) What quantity of that becomes liquid refuse passing into the drains?—There would be one-fourth lost at all events; you may say that 1,500 gallons pass into the drains.

2008. Which are contaminated with the dye refuse and the acids and the different ingredients?—Yes.

2009. Have you any difficulty in obtaining as much pure water as you require for your business?—None whatever.

2010. How do you get it?—Out of a well.

2011. By pumping it?—By pumping it.

2012. Do you pump it by hand labour, or by steam power?—By hand labour.

2013. Have you any idea of what it costs you a week to pump it?—I should say that 10*s.* a week would do the labour of it.

2014. If you could get as good a supply from the local board or from a company at anything like that cost, would you be a customer of theirs?—I do not think that I could get the large quantity I want in any other way so cheaply.

2015. (*Mr. Harrison.*) It would be 10*d.* for 1,000 gallons?—My men instead of standing idle pump the water, so that it costs me nothing except keeping the pumps in repair.

2016. (*Chairman.*) Have you any idea what proportion of dyeing you do, compared with the whole trade?—I do not know.

2017. Do you think that there is ten times as much as you do?—I think not; I do a great deal of it.

2018. (*Professor Way.*) Are you including the individuals who dye in their own houses?—Yes.

2019. Do you mean to say that there is not more than the labour of 120 to 150 people engaged in the dyeing and bleaching?—There may be more; I will not be sure, but I should not think that there is. Individuals do it at odd times.

2020. (*Chairman.*) Is there anything else which you wish to add?—No.

The witness withdrew.

LUTON.

Mr. F. Davis.

12 Dec. 1866.

Mr. FREDERICK DAVIS (Luton) examined.

2021. (*Mr. Harrison.*) You are a member of the local board of Luton?—Yes.

2022. Can you give us information as to the population of Luton?—I will give you the census in 1851.

2023. Can you give it to us in 1841?—I could if I had my books. I cannot give it from memory. I can remember the time when the population was 4,000.

2024. How long can you remember the town of Luton?—50 years.

2025. In what year was the population not more than 4,000?—In 1821 the population of the township was only 2,986, In 1841 it had increased to 5,827.

2026. You have written a history of Luton?—Yes.

2027. Can you put it in?—I can bring it down to you.

2028. What was the population of Luton in 1851?—I only speak of the township; 10,648.

2029. What was the population of the township of Luton in 1861?—15,329.

2030. Has the population increased rapidly since 1861?—I have taken the number of houses which have passed the board of health from the last census, up to last Christmas, and the average has been about 200 houses per annum, and the average inmates to each house at the time of the last census were between 5 and 5½, so that taking the same basis of calculation of 200 houses the population has increased about 1,000 a year.

2031. What population would that give at the present time?—About 5,000 more.

2032. That would be upwards of 20,000 at the present time?—Yes; we consider that the population would now be about 20,000, but then we must take into consideration a place which has already been referred to, namely West Hyde, which has been complained of by the medical men; it has been called Brown Brick; it has grown up in the last three years, and there is a population there of 1,000, and although it is not properly in the township of Luton it still forms a part of Luton.

2033. (*Chairman.*) And it torments Luton by breeding disease?—Perhaps it does; but still it fairly, I think, belongs to the population of Luton.

2034. (*Mr. Harrison.*) What is this considerable increase in the number of people in Luton resulting from?—From importation a great deal.

2035. Is it to carry on manufactures in Luton?—Entirely.

2036. What manufactures?—The manufacture of straw hats and bonnets.

2037. (*Chairman.*) Then the births are not increasing at that rate?—No, we import young women from a distance, some marry and settle down, and some do not.

2038. (*Mr. Harrison.*) Is that rapid increase of population any index of the probable increase of pollution arising from the town of Luton?—I do not think that there is so much pollution in the town now as there was when there was the small population of 4,000.

2039. How do you account for that?—Entirely from the sanitary measures of the board of health.

2040. That is in the town itself, but I mean as affecting the river Lee?—I think that the river Lee must be clearer now than it once was, because all the sewage formerly ran into the river Lee, but we are now restrained by an injunction from the Court of Chancery causing or permitting that pollution.

2041. Is the increase of population an index of the increase in the quantity of sewage matter which reaches your sewage works?—I hardly understand that question; what has it connexion with?

2042. With the dyeworks and the other manufactories in the town.—If the main sewer is complete all the refuse runs down into the works, and it does not affect the wells at all, supposing that it does not escape from the sewers.

2043. All the people who are brought to Luton to carry on manufactures, and who are employed in dyeing and bleaching goops tend to increase the pollution of the matter passing from your sewer?—I think that the importation is more for the manufacture of the article.

2044. Rather than for the dyeing purposes?—Yes.

2045. (*Professor Way.*) A small power in the shape of dyeing and bleaching, I suppose, will suffice for a large quantity of water?—Yes, many families do all their own dyeing.

2046. (*Chairman.*) Have you anything further to add?—I think not.

The witness withdrew.

Adjourned to Friday next at 10 o'clock, at Bishop Stortford.

Bishop Stortford, Friday, 14th December 1866.

PRESENT:

ROBERT RAWLINSON, Esq., C.B., IN THE CHAIR.

JOHN THORNHILL HARRISON, Esq. | Professor JOHN THOMAS WAY.

BISHOP STORTFORD.

Mr. J. D. Taylor.

14 Dec. 1866.

Mr. JOHN DOBEDE TAYLOR (Bishop Stortford), examined.

2047. (*Mr. Harrison.*) You are clerk to the board of guardians?—Yes.

2048. How many parishes are included in the union?—Twenty, containing a population of 20,000.

2049. Is the town of Bishop Stortford included in that union?—Yes.

2050. What is the population of Bishop Stortford?—A little over 5,000.

2051. Is it an increasing population?—No, not of late years. During the last 10 years it may have increased to the extent of 500 or 1,000; it was 4,000 and odd for some years, but it is not increasing now.

2052. What is the area of the union?—Over 19,000 acres.

2053. Does it lie chiefly in the valley of the Stort?—No.

2054. How far does the union extend?—The valley of the Stort runs to Sawbridgeworth, which is included within our union; it is four or five miles away.

2055. Are there any other places besides Sawbridgeworth included in the union?—There are 20 parishes altogether; the largest are Bishop Stortford and Sawbridgeworth and Stanstead in Essex.

2056. Is Stanstead within the valley of the Stort?—No; the Stort is an artificial canal beginning here, but there are some small streams which contribute to it and that run from Stanstead.

2057. What is the population of Sawbridgeworth?—Nearly 3,000; it is a very large parish and it is very much scattered.

2058. Besides the town of Bishop Stortford the population is chiefly agricultural, is it not?—Yes, the population of the union.

2059. Is there any other authority in the town of Bishop Stortford besides the board of guardians?—Yes, we have a highway board, and the inhabitants have recently resolved to adopt the Local Government Act, but that has not yet been put in force.

2060. Then any nuisance that may exist can only be remedied through the board of guardians at present?—Yes, through the board of guardians for the whole union, but as soon as the Local Government Act comes into operation the board will have authority to deal with nuisances in Bishop Stortford parish.

2061. The board of guardians cannot initiate anything in the way of improvements, they can only act in case there is a report made to them from some of the inhabitants that a nuisance exists?—Or through the inspector. They can only make structural works where a nuisance is not abated, not otherwise, and that is to a very small extent.

2062. Feeling the want of some authority to carry out improvements in the town, the inhabitants of Bishop Stortford have applied and are about to obtain power to adopt the Local Government Act?—Yes, I understand so.

2063. Do you know at all in what condition the public health is?—I think it has been pretty healthy as a whole—quite healthy.

2064. Is the town generally considered a healthy town?—I believe so.

2065. Do you know what the return of the registrar is as to the deaths per thousand?—I do not know that.

2066. Have there been any sewerage works carried out in the town?—No; except by the ordinary sewers draining into the river.

2067. Under whose direction were they constructed?—Lately they have been under the highway board; before their formation these matters were under the direction of the surveyor of the highways under an old Act of Parliament.

2068. Do the sewers discharge into the river?—Yes. The plan has been for many years for the parish to provide sewers for the houses as they were built, and into which the occupants of the houses might turn their filth, those sewers meeting each other in the town and discharging themselves eventually into the river.

2069. Are they carried out upon anything like a system?—I should say not. From time to time the surveyor of highways, and subsequently the highway board, have had a sewer made, and they have improved the sewers from time to time, and they have made others as they found that a greater quantity of filth required to be sent away. Thirty-five years ago there were not above two or three waterclosets in the town, but now they are to be numbered by hundreds.

2070. What manufacture is carried on in the town?—It is malt principally.

2071. Can you give any information as to the number of quarters of barley that are manufactured into malt in this neighbourhood?—No; but there are gentlemen here who will tell you that.

2072. Do you know of any nuisance that arises from the making of malt?—No. I do not think there is any particular nuisance except this, that the water from the cisterns in which the barley is steeped is turned into the river, and that helps to contribute to the pollution of it at certain times of the year, but as malt is made in the winter time the flood water carries everything away, and I should say that no great nuisance can be caused.

2073. Have you at any time observed that the liquor which is passed away after the process of steeping is objectionable?—I cannot say that I know much about that.

2074. What other manufactures are carried on besides that of malt?—None, that I know of.

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2075. The town is an important town having a market, and providing for an extensive neighbourhood?—Yes.

2076. Business is carried on, I suppose, chiefly on market days?—Yes; a very large trade in the manufacture of malt is carried on.

2077. There is a canal leading to the town?—Yes, it is navigable to the town.

2078. A railway also passes through the town?—Yes.

2079. Is the traffic on the canal large?—I think it is.

2080. Is the valley at all subject to floods?—Very much so.

2081. What is the effect of those floods upon the health of the inhabitants?—I do not know. I have never had any complaints, nor has it been suggested that the public health has been affected by them. We are not flooded so much now as we were years ago. The millers do not hold up the water as much as they did.

2082. Does any person control them?—I think not.

2083. Do the waters sometimes lie for a considerable time upon the lands?—Yes, but they get away quicker than they did. If the rain continues they will be there for some days, but when the rain ceases they get away more quickly.

2084. Are they considered beneficial or injurious to the land?—They are not beneficial, I think, but it depends upon the time of year the flood comes upon the pastures. If the grass was to be mowed the flood would leave it all gritty and no animal would eat it; it would be useless to mow it; there is no doubt however that upon some pieces of land flooding would do good.

2085. Do you think it would be an advantage if there was some system of management throughout the valley of the Stort by which the water would be regulated, and better means provided for passing it off?—I should say so decidedly.

2086. Do you think that would be an universal advantage?—Yes.

2087. At the present time, as well as being a disadvantage to the meadows from the water hanging upon them, it backs against the water wheels and I presume actually injures the millers themselves?—I should say so.

2088. Any body who had power to improve the condition of the valley would not only improve it for agriculture but also for the benefit of the millers?—I should think so.

2089. How is the town supplied with water?—Principally by pumps.

2090. From what stratification does the water come?—It varies; we get the strongest springs on the hills; in some places they are 70 feet deep; all our hills are wet, and the valleys here are comparatively dry.

2091. What is the subsoil in the valley?—We get down to brick earth and loam—stiff loam; after that we get into chalk, and then find water.

2092. You are rather upon the clay?—Yes.

2093. And the chalk below is full of water?—Yes; we get gravel on some of the hills.

2094. As clerk to the board of guardians, have you had many complaints made as to nuisances existing within the union?—No; we have recently appointed inspectors for the union, and they have been at their work for three months past, since the Sanitary Act came into force, and they have removed an immense number of nuisances. Without requiring the board of guardians to interfere at all, the public have admitted the necessity of doing whatever they can, and they have met the thing uncommonly well. We found a very large number of cottage houses without any privy accommodation, and it is astonishing what a number in the last three months of new ones have been made, and others will be made. The board of guardians have not been obliged to put the provisions of the Act

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in force against any one yet, the people have acceded most willingly; no doubt there are some cases which are now standing for consideration, but I believe that the efforts of the board of guardians and the local authorities will be effectually aided and willingly so by the inhabitants in carrying out the provisions of the Act.

2095. Before you appointed the inspectors of nuisances, did you find cases of sickness occur in certain parts of the town as distinguished from the health of the people in houses adjoining?—It has been recently so in one of the parishes of the union, where fever has prevailed to a considerable extent; in that case information was given to the board of guardians that it was caused by nuisances and bad drainage, and to some extent I believe the board considered that it was so. A great deal has been done in that neighbourhood, and the epidemic has ceased.

2096. Did that case occur in Bishop Stortford?—I think not. You may have some medical gentlemen here who will say that we have had fever arising to a great extent from defective drainage; it may be so, but generally speaking I believe that Bishop Stortford is a healthy town. We had some cases of low fever here some months ago, but it prevailed not only here but generally throughout the district, and it passed off after a time.

2097. (*Professor Way.*) The state of the public health is hardly observable by a non-medical person?—No, and I am not competent to speak upon the matter.

2098. (*Mr. Harrison.*) You are by profession a solicitor?—Yes.

2099. Have you heard of any advantage being gained from the lower price of coal by a railway being brought here?—There are gentlemen here who will give you better information than I can upon that.

2100. (*Professor Way.*) As I understand, you have applied to be placed under the Local Government Act?—Yes.

2101. In what stage is that application?—The clerk to the highway board, through whom the application was made, is here, and he will explain.

2102. It was not made through the board of guardians?—No.

2103. Do you know whether any legal proceedings have been taken as to the discharge of the sewage into the river Stort?—I never heard of any, and I believe there have been none. We have been threatened by several parties. Our neighbours at Sawbridgeworth have told us that we have been poisoning them. We have said that we are sorry for it, but we think that they contribute to the nuisance to some extent themselves, and we have therefore not heeded what they had to say.

2104. No actual proceedings have been taken against you?—Certainly not.

2105. (*Mr. Harrison.*) Has it ever been in contemplation to place the river under a distinct drainage board?—No. The nuisance of which the inhabitants have complained from the smell of the river was during the summers of 1864 and 1865, but it was very much abated in consequence of our having wet seasons, and a plan was adopted that succeeded remarkably well, and that was this: During the summer, when the water is very short, the filth will sometimes almost crop up to the mouth of the drains, and when there has been a flood in the winter this accumulation has been stirred up by a barge and a heavy rake behind, so that we have passed it on to our neighbour to some extent. We thought we had kept it long enough, and by the use of the flood water relieved ourselves from a considerable quantity of stink by that means.

2106. Do you think that there is a considerable amount of pollution in the river?—There must be, because we drain everything into it that we can.

2107. (*Professor Way.*) You say that the privy accommodation is being very considerably increased, do you mean that this accommodation is in the shape of waterclosets?—No, I am talking about cesspit accommodation.

2108. And that might indirectly affect the water if it does not directly do it?—It might; it would depend a good deal upon the position of the privies.

2109. If the town were placed under the Local Government Act could you then be required to take steps for the purpose of draining the whole of the town?—I really do not know.

2110. You have not contemplated that?—Yes, I have always contemplated that if we were put under the Local Government Act considerable works would have to be carried out to get rid of the sewage in a different way. I have foreseen that there would be very considerable outlay required, and I do not know that the town would be indisposed to make the outlay if they could see a means of effectually doing the work. The difficulty that I have always seen in the matter has been this,—that we may probably spend a considerable sum of money in carrying out some well-organized plan, and perhaps, very shortly afterwards, some general measure may be passed in the House of Commons affecting the whole country, and all we had done might be rendered useless. I believe that the inhabitants of the town and all the ratepayers have looked at it in that way.

2111. You have spoken of getting rid of the sewage; there are two stages in doing that, and the first is to get rid of it by passing it into the river?—We do that now.

2112. Not all of it, because the town is not fully sewered?—No.

2113. I suppose the more perfectly the town is sewered, if no arrangement is made to dispose of the sewage other than by passing it into the river, the greater will be the nuisance?—Yes.

2114. At first, probably, the town is contemplating, by putting itself under the Local Government Act, steps that will tend very largely to increase the impurity of the river?—I have no doubt that that has been passing in the minds of many gentlemen who have taken the subject up.

2115. (*Mr. Harrison.*) As a solicitor practising in the town, you probably know something of the ownership of the land in the neighbourhood?—Yes.

2116. Do you think there would be any difficulty in obtaining land below the town to which to apply the sewage of the town?—I have heard that there will not be any. An opinion, I know, was entertained that there would be no difficulty; probably there would be some difficulty which might be overcome. The difficulty we have always seen has been as to the meadows. They lie here very low, and they are all subject to floods frequently.

2117. Is there a considerable flow in the river?—No.

2118. What is the value of the land in the neighbourhood?—It is very valuable.

2119. Beyond a mile from the town?—It would fetch 100*l.* an acre. I speak of purely agricultural land. There is accommodation land close against the town, but that is getting very high too. Common agricultural land within a mile of the town is worth 100*l.* an acre.

2120. There are about 6,000 inhabitants?—Yes.

2121. Then you would not require more than about 40 acres of land to which to apply the sewage?—Perhaps that may be so.

2122. (*Professor Way.*) Bishop Stortford is about 32 miles from London, I think?—Yes.

2123. Is milk ever sent to London from this neighbourhood?—I think not.

2124. Is there any further information that you wish to give us?—I think not.

The witness withdrew.

Mr. Henry Glasscock (Bishop Stortford), examined.

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Mr. H. Glasscock.

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2125. (*Mr. Harrison.*) Are you surveyor to the highway board?—Yes.

2126. How long has the highway board been formed?—I have been surveyor about seven years.

2127. It is not a highway board formed under a recent Act?—No, it is not under that Act.

2128. What is the extent of the district over which you act?—There are about 11 miles of road.

2129. Does the district include any parish besides that of Bishop Stortford?—No.

2130. Does it include the roads through the town?—The turnpike road is part of the road that is connected with the town. I have about 11 miles of road as surveyor of the highway board to look after.

2131. Has the Highway Act been carried out in Hertfordshire to any extent?—No, but in Essex it has been—at Dunmow.

2132. What are your duties as surveyor of highways?—I am inspector of nuisances and I give attention to the state of the roads.

2133. Do the sewers of the town come under your management?—Yes.

2134. How far has sewerage been carried out in Bishop Stortford?—Pretty well through the whole district where there is any house property; not exactly to the whole of it, because some of the houses are at some considerable distance from the town, and there we have not sewered, but nearly the whole of it is sewered.

2135. Is the town sewered upon any system?—It has been going on for a number of years, but not upon any scientific principle.

2136. How many outlets are there?—Seven.

2137. Where are they situated?—We commence with two in Lee Street, then we come to the end of the town and the river, there is a main sewer that empties itself there, then we have four others in South Street.

2138. Where do they discharge themselves?—Into the river.

2139. What is the size of the main sewer?—The largest is 18 inches.

2140. Of what shape is it?—It is a barrel drain.

2141. Are the houses connected generally with those sewers?—No, I should think that about 300 of them are connected with the sewers from waterclosets and there are about 400 cesspools in the parish.

2142. How are the waterclosets supplied with water?—By private individuals for their own use.

2143. Do they pump the water up?—Yes, it is all done by pumps.

2144. Have you occasion to open up those sewers in different parts of the town from time to time?—Yes.

2145. In what state do you find them?—Some part of the town lies very flat.

2146. What do you find the state of the sewers is there?—Generally there is an accumulation of grit more than soil, which gets washed in from the washings of the roads.

2147. You find them so filled?—Yes, at times.

2148. What steps do you take to clean them out?—We thoroughly clean them out when we find them in that state.

2149. Have you to open a considerable length of drain in order to clean it out?—Yes.

2150. What length of drain have you had to open out and clean upon any occasion?—From 100 to 200 feet at different places.

2151. Are they constructed generally below the surface?—Yes.

2152. At what depth are they below the surface?—They are not very deep, on account of the fall to the river. A large portion of the town lies exceedingly flat, and of course we cannot get our sewerage down very deep on account of the river.

2153. Is there any ventilation to those sewers?—No; they are principally trapped.

2154. Have any complaints been made to you at any time of the gases being driven back into the houses and causing a nuisance?—Yes; I have had complaints made.

2155. Do they continue to be made?—I should say that the cause of that is on account of our sewers being so trapped, and that private parties when they leave a house often leave their drains not trapped, and there an escape of gas takes place.

2156. You trap it in the sewers under your control, and by that means you force it up the side drains into the houses, and where they are not trapped the gases find their way into the houses?—Decidedly.

2157. Have you on any occasion known sickness to arise in a house in consequence of the gases flowing back into them?—I cannot say that I ever did; but parties have sent for me frequently, and I have found that that was the cause, and in such cases the thing has been remedied.

2158. If there was a proper system of sewerage in this town, there ought to be no occasion to open the drains in the way you have just mentioned, 100 or 200 feet at a time, and there should be no gases passing back into any house causing a nuisance?—Such is the case, no doubt.

2159. How many cesspools are there in the town?—I think there are 400.

2160. And 300 water closets?—Yes.

2161. What is the character of the cesspools?—They are made of brick dug out of the earth, and closed in.

2162. What is the soil generally in which they are made?—It principally consists of brick earth here and strong clay.

2163. Impervious clay?—Yes.

2164. Is there any percolation?—No. We should not consider so at all.

2165. What steps are taken, or do you take any, to remove the refuse collected in those places?—We have done a great deal in that way during the last few months. By order of the highway board we were directed to go from house to house and to clear out everything.

2166. At whose expense was that to be done?—Partly at the expense of the highway board, and from them at the expense of the board of guardians.

2167. Not at all at the expense of the individuals?—Not at all.

2168. What expense may you have incurred in the last eight or ten months in removing these nuisances?—I cannot state exactly, but I should think 25*l.* or 30*l.*

2169. Were the directions which your board gave you to cleanse these places out systematically?—Yes, and we have done so.

2170. Shall you continue to do so?—I have not received any further orders.

2171. Was it merely a temporary effort in consequence of the cholera being in the neighbourhood?—Yes, that was the cause of it being done.

2172. Do you not think that some measure more efficient than that is required in order to prevent nuisances continually arising?—There is no question about it, and if it is not done in that way accumulations will grow up again.

2173. (*Professor Way.*) Do you remember how many years ago it is since it was first done, or has it been done before in your recollection?—It has only been done once during my term of office in seven years.

2174. What are the sizes of the cesspools generally?—They are between three and four feet square.

2175. Does one serve for one house, or more than one house?—There is generally one for two houses and sometimes for three.

2176. I suppose the water from a house drains into the drain of the town?—Yes, principally so.

2177. Nothing goes in there in the shape of water?—No.

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2178. Do you believe that ashes are thrown in?—Yes, at the side of it, but not into the cesspool generally speaking.

2179. Are these cesspools made with clay bottoms and clay sides, and then lined with brick?—Yes, they are principally so made.

2180. Will more than two families join in the use of these cesspools?—No, not generally speaking.

2181. Two families consisting of from 10 to 12 individuals?—Quite that.

2182. As I understand you, it would take seven years to fill one of them?—They are obliged to be emptied about every second year. I was not speaking of the cesspools when I said it would take seven years. It was the ashpits that I meant. We were ordered to go and cleanse every yard. Not all the cesspools, but many, were cleansed out. I do not think that the parish had been so clean before for many years as it was at that time.

2183. Have the cesspools any overflows?—No, only into the sewers; there are some connected with the sewers.

2184. With overflows at the top of them?—Yes.

2185. You draw a distinction between cesspits and ashpits?—Yes.

2186. Will you describe the cesspools as distinguished from the ashpits?—Generally speaking the ashpits are made purposely low down in some portion of a garden—at the bottom of it. The cesspools are about from three to four feet square, and of various sizes.

2187. Of what depth are they?—They are three or four feet deep.

2188. How many ashpits do you think there are?—There is one to every house; that is, not an ashpit, but there is an accumulation at every house.

2189. How do the inhabitants obtain their water?—I think as to water we are well supplied.

2190. What is the source of your supply?—We get the water from wells.

2191. Are those wells sunk through the clay that you mentioned just now?—Yes, and they get into the chalk.

2192. Throughout the township is there an abundant supply of water?—Yes, there is.

2193. Are there any gravel beds in the town overlying the clay?—Yes, just under the clay.

2194. Is water drawn from that bed in any case?—No, it is principally from the chalk.

2195. It is almost always carried through the gravel to the clays and the chalk, is it?—Yes.

2196. Is it very hard water?—I have heard it so spoken of, at least some part of it.

2197. Do the gravel beds run under the "George Hotel"?—Yes.

2198. Do you think that they get water from the gravel?—It is supposed to be one of the finest springs we have in the country. I have been speaking of the water with reference to the general health of the town.

2199. Would there be any difficulty in applying the sewage to the land below the town for irrigation?—That has been thought of, but I think there would be a difficulty in it.

2200. What would the difficulty be?—On account of everything lying so low.

2201. You could pump it?—Yes.

2202. If you were obliged to pump it, would there be any difficulty in obtaining land?—I believe some offers have been made of that description.

2203. What is the condition of the river as it passes through the town in consequence of the sewage being delivered into it?—We do hear complaints about it.

2204. From whom?—I have heard complaints from Sawbridgeworth, from people living there by the river.

2205. Have any complaints been made by residents in the town of Stortford?—Not particularly, that I am aware of; Mr. Davis has complained to me about it.

2206. Does he reside near the outfall of one of these sewers?—Not exactly; he is between two of them.

2207. How far are they apart?—I think they are from 200 to 300 yards apart.

2208. He is situated between the two, and not near either of them?—Yes.

2209. Which of them is he nearest to, the upper one or the lower one?—The upper one.

2210. When complaints of this kind are made to you, do you report them to the board?—They have been made to the board.

2211. Are they entered in a book when they are so made?—Minutes are always kept by the board.

2212. (*Mr. Harrison.*) They would appear in their books?—Yes.

2213. During the summer season is there much water coming down the Stort?—No.

2214. What becomes of the refuse from the sewers when there is so little water in the river?—It must of course accumulate.

2215. It would accumulate in the bed of the river, would it not?—Decidedly.

2216. And become a nuisance, and as you say, it would be complained of by some people?—Yes.

2217. As surveyor do you take any steps to remove the nuisance?—In the case of a flood we stir it up, if we have an overflow of water.

2218. And send it on by the flood to your neighbours below?—Yes, we get rid of it.

2219. Are you aware that the water, after it goes from here goes to London, and is one of the sources of the water supply?—Yes.

2220. Do think that that should be permitted to continue?—I have no doubt that some steps will be taken to remedy that sort of thing.

2221. (*Professor Way.*) When you stir it up, I suppose it is about at its worst?—That is the only means we have of disposing of it; when we get a flood we get rid of a large amount of it.

2222. Do you fancy that discharging the sewage occasionally in a flood, or discharging it regularly day by day so as to be able to distribute it equally, would cause the greater nuisance?—We cannot get rid of it except at the time of a flood.

2223. But the form in which you get rid of it probably constitutes the greatest nuisance you could create?—Yes.

2224. (*Mr. Harrison.*) Have you, as surveyor, to collect rates to meet the expenses of the highways?—I had to collect rates until within the last six or eight months.

2225. What is the rateable value of the parish?—I think that the last estimate was 23,700*l.*

2226. What is the annual rate in the pound collected for the maintenance of highways and for your superintendence?—It has been 8*d.*, this year it will be 1*s.*

2227. (*Professor Way.*) Do you know how many of these cesspools have overflows?—About 300. I mean the refuse of the waterclosets that flow into our sewers.

2228. I think you stated that the cesspools have an overflow at the top?—Yes; some of them have. I am speaking of those; I included those in the water closets.

2229. The waterclosets have cesspools, but with overflows?—Yes.

2230. Then the refuse in them does not go direct from the waterclosets into the drains?—Not all of them. I consider that there are 300 which are connected directly with the sewers.

2231. Have they any cesspools?—No; certainly not. I mean that there are 300 waterclosets that drain into our sewers, that go into the river.

2232. How many waterclosets are there, as we understand them generally, the contents of which go direct into the sewers?—I cannot say off hand.

2233. Do you think that the majority of them have cesspools as well as drain into the sewers?—Yes.

2234. It is only the liquid that drains into the sewers?—Yes.

2235. In London the houses have direct connexion, by means of a pipe running into the main drain, without any cesspool at all?—Yes.

2236. On the other hand, we know that there are such things as cesspools in the country districts with overflows into drains. What is the general character of the waterclosets here?—Some 10 years ago, when there was an order given with reference to the sewerage of the town, many of the waterclosets were connected with the drainage direct, that I am now speaking of, still they had no water supply further than that which they drew for themselves. They had no pumps.

2237. Have those got cesspools?—No; the cesspools were done away with at the time that these places were connected with the sewerage.

2238. How many do you suppose there are connected directly with the sewers but without cesspools?—I should say 300. We were ordered some years ago to take the sewage direct from the waterclosets into our sewers, and they were then connected with the sewerage.

2239. The figures I have taken down are the 400 cesspools and 300 waterclosets. Do you mean to say that those are all waterclosets, but that 400 are waterclosets with cesspools, and the 300 are waterclosets communicating directly with the sewers without cesspools?—Yes; as near as I can give it.

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2240. (*Mr. Harrison.*) How many privies are there in the town?—I think there are 400.

2241. I believe the highway board consists of the whole of the ratepayers in the parish?—Yes; they are selected from the parish.

2242. For how long are they appointed?—They are appointed every year.

2243. Of how many do they consist?—Thirteen.

2244. Is there any other officer besides yourself?—Yes; there is a clerk.

2245. Are there men employed under you?—Yes.

2246. How many are there employed?—The number varies from five to seven, according to the nature of the work.

2247. Are they employed in repairing the roads and opening and constructing drain?—Yes; when they are required. My own men do not construct drains.

2248. Not the main drains?—Not the men under my control. They do not do anything of that sort; the work is put out to tender, and it is done by the parish.

The witness withdrew.

Mr. RICHARD HUNT (Bishop Stortford), examined.

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2249. (*Mr. Harrison.*) Are you resident in Bishop Stortford?—No, but I come here occasionally.

2250. Are you a native of the town?—No, but I have known it from childhood.

2251. Do you own any property in the town?—Yes.

2252. What is it?—South Mill.

2253. How long have you owned it?—About nine or ten years.

2254. Have you resided there at any time?—No, but I go there two or three times a week sometimes.

2255. Is that mill near to any of the sewers that the surveyor has spoken of?—It is just below them all, I think, about a mile from here.

2256. Is there any nuisance arising from the sewage of the town being passed into the Stort?—Very great just now, and there has been in the last two or three years.

2257. How does it affect you at the mill?—The stench in the mill and dwelling-house and the neighbouring yard and garden is very bad in the autumn and summer of the year, so bad that in 1865 the miller who lived in the mill-house complained that he was obliged to send his wife and children away.

2258. Is there no one living there now?—Yes, but he sent them away in the dry time.

2259. Was their health affected by it?—Yes, very much.

2260. Had they to call any medical man in consequence?—Yes.

2261. Did he attribute their sickness to the condition of the river?—Yes; and he complained himself when he went into the house, so much so, that I consulted my solicitor about it, and I talked to Mr. Taylor and threatened proceedings against the town, but I hardly know whom to begin with.

2262. Is there much difference in the volume of water that comes down the Stort in the summer season and in the winter season?—Yes, very great.

2263. In the summer season is it reduced to a very small quantity?—Yes, very small.

2264. How many pairs of stones have you at your mill?—Two.

2265. Can you drive both of those pairs of stones in the summer time?—Not one, nor half a one. It would be I should think for about 10 hours out of the 24 with one pair of stones in the summer time.

2266. The sewage of Stortford being thrown into this small volume of water passing down to your mill increases the nuisance very greatly?—Yes, in the autumn part of the year; there is but little to complain of now on account of the large volume of water in the river.

2267. That has probably cleared away all the nuisance?—Yes.

2268. What regulations are there as to adjusting the quantity of water taken for your mill and for the canal?—The canal company have a right to take as much water as they require for passing and repassing barges, and they pay to the millers sixpence each time they fill their lock.

2269. Do you know what the size of a lock is?—Not exactly; but I think it is about 100 feet by 14 and about five feet deep.

2270. What fall have you at your mill?—About five feet or rather more—five or six feet.

2271. During the winter, when you say there is a large quantity of water passing down, do you find that your mill wheel is obstructed by tail water?—In a heavy flood, but not all the winter, for there are overflows or tumbling bays above each mill, above which the miller may not keep his water, it runs away and it does not affect us more than two or three inches when the section of the river is not so large, then it does for two hours.

2272. Is that often the case in the winter?—Yes; sometimes we have gone through a winter without a flood, and sometimes we have six or ten down in the same time.

2273. For what length of time do they obstruct your work?—It is variable; perhaps two or three hours; I mean not more than that unless we have two heavy falls of rain continuously, and that is very seldom.

2274. Have you any land adjoining the mill?—Yes, I have two acres.

2275. Are they liable to be flooded?—No, not unless it is a very high flood. I believe they have been flooded once or twice.

2276. Is the land that is flooded benefited, or otherwise, by it?—The land which adjoins the mill will be benefited by the flood—the small piece that belongs to me.

2277. Would the remainder of the land nearer the river and lying at a lower level be benefited in a similar manner?—Not unless there was a good drainage to it to get it off quickly.

2278. Is there good and sufficient drainage to the land in the valley of the Stort?—I am not able to answer that question. I have a very good knowledge

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of my own land; but I think there is generally good drainage in the valley of the Stort.

2279. In coming up by the railway last night I observed a great deal of land which appeared to me to be in a very indifferent condition?—Yes; lower down there is a large piece of land called the Mead, of 160 acres, and that is very frequently under water; it will be now drained and inclosed.

2280. Is that to be done under a special Act of Parliament?—Not for the parish, only under the General Inclosure Act.

2281. Not under the powers of a new Act?—No; besides the inclosure they will carry the outfall below another lock in order to get more fall.

2282. Does that merely extend to a short length of the river?—Yes, about a mile and a half or two miles.

2283. Do you not think it would be much better to have the river put under some general management, and carry out arterial drainage efficiently throughout the whole length of it?—I have not sufficiently thought of that to be able to give an answer to the question.

2284. Is what you have mentioned being done with the consent of the millers below?—There is no mill, as it happens, at this lock.

2285. Is there a weir without a mill?—Yes, a waste weir, and that is near the junction of the Stort with the Lee.

2286. As an owner of mill property, if there was a good system of drainage carried out throughout the valley, and if the flood waters were carried off more uniformly than they are now, would you not be benefited rather than otherwise by such a measure?—Yes, in some cases. I have a mill nearer to London, and and we suffer very much from flood water there.

2287. Is that upon the river Lee?—Yes, it is the last mill but one on the Lee, at Edmonton.

2288. Do you suffer at all from back water?—Yes, we suffer from back water and from the water getting out on to the meadows and lying there for days together.

2289. Do you live near to that place?—No, I live near to the junction of the Lee and the Stort.

2290. Are you near to the valley that is liable to be flooded?—Yes.

2291. Do you know whether the flooding of that district affects the health of the people living there?—I have heard that it does not; they say that a case of ague is rarely known in the valley of the Lee.

2292. Have you ever known of any cases of ague?—Very rarely; only one or two.

2293. Have you known fever to occur after the valley has been flooded for a considerable time?—No, I have not, the valley is so thinly populated.

2294. Is there any arrangement as to the payment by the Canal Company generally throughout the valley of the Stort?—The whole way down. I think it applies generally to every mill but one, and there are 11 or 12.

2295. What is the exception in that case?—I do not know.

2296. For each lock of water a payment is made of 6*d.*?—Yes.

2297. Is that so in the case of each lock?—Yes, it is paid to the miller adjoining. The barge owner generally pays 1*s.* when he goes through, and he comes back for the same payment.

2298. Does that repay the miller for the use of the water?—No, certainly not.

2299. If you had the water to use which they take, I suppose you would be able to turn over something more than 6*d.* by its use?—Yes, three times the money.

2300. (*Professor Way.*) Do the bargemen open the locks?—In some cases the owners of the canal keep a lock man to work two or three locks.

2301. The miller does not do it?—No. As to the injurious effect to health by the drainage being passed into the river, I may say that it was not so a few years ago. When I was a boy there were plenty of gudgeon and small fish in the river, but now one cannot live in it. A friend of mine lives 10 miles lower down, and he will tell you that he can remember when there were fish in it there.

2302. What is the condition of the water that comes down to your lower mill at Edmonton?—There it is apparently clear, but this water goes there and the water from Hertford too.

2303. Then they will have at Edmonton a larger volume?—Yes. I have a mill also at Stanstead, and there the water is offensive at times from the drainage of Hertford.

2304. Notwithstanding the steps which are taken at Hertford to purify it?—Yes; I have passed along the towing paths and I have had to put my handkerchief to my nose on account of the stench; that has been in the autumn of the year.

2305. Is the sewage of Ware turned into the river?—Yes; nothing is done with the sewage there, it comes in neat, but the sewage of Hertford is deodorized. The New River Company has a fixed volume of water from the river Lee above the point where the sewage of Hertford comes in, and they take in the autumn, when the water is short, nearly their full quantity, and we have scarcely any water in the Lee then.

2306. How are you paid, as a miller, for the water that is taken out there?—The millers receive no payment; it was done first by agreement some 150 years ago with the river Lee trustees, but since then there has been another agreement made, in 1851, by which they were to take a further quantity of water, and the millers were deceived.

2307. How many pairs of stones do you drive at the mill below Ware?—I had 10 when I first took it some 25 years ago, but the water has got considerably less, and we have but six now at work.

2308. Can you work them constantly in summer and winter?—No; nor can we work two in some summers. As I have said before, in a dry summer the quantity of water that is taken by the New River Company is always the same, and it takes all the water almost away; we have not water then for more than one or two pairs of stones.

2309. Is the water that is taken by the navigation larger than it was formerly?—I do not think it is; I think it is rather less at Stanstead weir.

2310. The diminution which you experience arises from the New River Company taking a larger volume?—Yes; there is certainly less water in the valley than there was 20 or 30 years ago.

2311. How do you account for that?—In this way, a great deal of woodland has been destroyed and there is less rainfall.

2312. Have you observed the rainfall over a series of years?—I have been informed that where the gauges have been kept they have found it so; they have been kept by the New River Company.

2313. Do you know how long they have been kept?—I believe for some years. I should mention that they have been sinking a number of deep wells at the lower end of the valley.

2314. Does that affect the discharge of the water in the upper parts of the valley?—Yes.

2315. The water which they abstract must come from somewhere?—Yes, it comes down through subterranean channels, but we cannot get the water we used to have. Who has got our water? We know that we have lost it; and the old millers will tell you that there is not now nearly the quantity of water there was 30 years ago.

2316. After making allowance for the increased quantity of water the New River Company take, you find that there is less?—Yes; and that applies to this stream particularly. We have no control or power at all, and there were two mills that I knew, which in the course of 20 years have been done away with because there was not a sufficient quantity of water to make it worth anyone's while to occupy them. On another branch of the Lee, the Rib, the river is entirely dry, there is no water for a mill.

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2317. Do you know of any other cases where mills have been abandoned from a similar cause?—Not that I can speak to.

2318. How many years have you occupied the mill below Ware?—25 years.

2319. In that period have you experienced a marked diminution in the volume of the water?—Yes; I have a mill also, and my family have two, on the Ash, which is another feeder of the Lee, and there again the water has disappeared in my time. More than one half the upper portion of the Ash is dry now.

2120. That I suppose would not be affected by any obstruction of water by the New River Company?—Not at all.

2321. You attribute the falling off of the water to two causes, the clearing of woodland in the neighbourhood and the consequent diminution in the rainfall and the abstraction of water by extensive pumping establishments?—Yes, by brewers and manufacturers, and there are many other causes that might be mentioned; for instance, farmers have taken to deep drain their heavy spongy land which retained the water very much, mixed varieties of soil containing gravel which would hold the water and supply us in the summer; through these lands they have driven five feet drains and these cause a flood in the winter, but the water is short in the summer; that is another cause. But I think the principal cause is the deep wells which have been sunk near London called artesian wells,

2322. (*Professor Way.*) Are there any deep wells in this district?—Yes, the New River Company have two or three wells.

2323. Do you think their level is interfered with by the pumping which takes place in London; we have heard that in London at the great breweries they do not pump on Sunday?—The wells I have referred to are comparatively new wells within the last 15 years, and I know they are affected. They sunk a well 15 or 16 years ago at Amwell and that is almost dry; they are spending money now to get lower down.

2324. Have you heard that the wells at Watford and some other places in the neighbourhood of London, in the chalk, are deepest on a Monday morning, and that they have several feet more water then?—No, I have not heard of that.

2325. Because the brewers have not been pumping on Sunday?—That may be so. In the autumn of the year the brewers do work very much, and the New River Company, in the largest wells about here, pump all Sunday.

2326. (*Mr. Harrison.*) Do you know whether at your mill below Bishop Stortford any of the nuisance you have mentioned arises from refuse poured in by maltsters?—Some little of it may, but I do not think it will affect us. We did not complain before the sewage of the town was turned in.

2327. Was malting carried on to as great an extent then as it is now?—Not quite to so great an extent, but the water that comes down from the cisterns is not always bad and is not at all offensive if the barley is clean; sometimes it is worse.

2328. Generally speaking, I believe it is delivered in the autumn and winter when there is an abundance of water in the river?—Yes, in the winter and spring.

2329. Have the millers below you experienced a similar kind of falling off in the quantity of the water near Edmonton?—Yes, they find that it is very much less.

2330. How many pairs of stones do you drive there?—Fourteen.

2331. Are you enabled to work them all in the summer?—No.

2332. How many are you able to work?—The number varies; sometimes I work them all for two or three years together, sometimes I work six or seven pairs, and sometimes only five. I know a mill where I was engaged when I was a boy, and there were there but six pairs of stones with bad machinery, and I never knew a year that they did not have as much water run to waste as they used. We work about five or six pairs of stones now from shortness of water.

2333. Would that diminution in the volume of the water, do you think, be accounted for by the increased abstraction of water by the New River Company and the East London Water Works Company?—Not by the East London Water Company, because they take water below us.

2334. Would it then be accounted for by the increased quantity taken by the New River Company?—Yes, I think so, and by the other causes I have mentioned.

2335. Have you much nuisance to complain of at that mill near Edmonton?—No.

2336. Do they suffer from the flooding of the water below you?—No; my partner lives on the bank of the river, and he has a large family, and they are remarkably healthy.

2337. (*Professor Way.*) You have attributed to two principal causes the falling off of the waters of the Stort of late years, viz., the diminished rainfalls and the wells; I suppose that one of those may be a substantial and obvious cause—the wells?—Yes.

2338. Might they not account for the greater part of the diminution, if not the whole, without taking into account the smaller rainfall?—I have been speaking of rain gauges kept in London, not here.

2339. It may be a fact, and probably is, that the cutting down of trees generally has diminished the amount of the rainfall?—The underground and the wood was a great reservoir of water in the summer time. It held the water up much longer.

2340. Your statement that there is less rainfall might be controverted, but it does not follow that you are in error in saying there is less water in the valley?—I know that as a fact.

2341. (*Mr. Harrison.*) Has that diminution been marked within a short period?—No; it has been going on as long as I can remember.

2342. The water has been gradually diminishing since you can remember?—Yes. I can mention half a dozen places where feeders of the rivers Lee and Stort had mills upon them, but in which there is now no water at all.

2343. Will you just mention them?—Bendfield, Elsenham, Haddam, and Waltham Abbey are instances.

2344. The cases you have mentioned are cases of mills which you know were in existence some years ago, and which, in consequence of the diminution in the water, if not its total abstraction at certain points, have ceased to exist?—Yes; they have been given up.

2345. Is there anything more you wish to mention?—No.

The witness withdrew.

Mr. JOHN D. FAIRMAN (Bishop Stortford), examined.

Mr. J. D. Fairman.

2346. (*Mr. Harrison.*) Are you a resident here?—Yes.

2347. Do you carry on business here?—Yes; I am a maltster.

2348. Have you been engaged in that business for many years past?—I have been in business for 14 years. I have lived here for about 18 years, and my father before me.

2349. Can you give us any information as to the number of quarters of barley that are converted into malt at Bishop Stortford in a year?—I can tell you what I do at Bishop Stortford, and that is about 40,000 quarters.

2350. Is that a large proportion of what is malted here?—It is a large proportion.

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2351. What proportion does it bear to the whole?—I cannot tell you.

2352. How many maltsters are there in Bishop Stortford?—Seven or eight.

2353. What becomes of the water which you use for steeping the barley?—From my maltings it nearly all goes into the river.

2354. Is it objectionable in its character?—I do not think I have ever had any complaint made about it. I have not found it any nuisance, and I have often been in the habit of going round the maltings when the water has been let off. I may say that I have not had two complaints made since I have been in business.

2355. Have you noticed in other cases that the water so discharged has been a nuisance?—No.

2356. Some of the malthouses lie up the hill, do they not?—Yes; I have several that are up the hill.

2357. Where does the water pass to from them?—I suppose it goes into the main sewer, and thence into the river.

2358. Is the barley that you malt here chiefly grown in this neighbourhood?—No.

2359. Where does it come from?—From Norfolk, and Cambridge, and Essex.

2360. Has the malting trade of Bishop Stortford increased of late years?—I should say that it has increased very much.

2361. How would you account for that increase of trade?—I may observe that the railway has benefited me, because if the supply of barley here is bad I can get it from an equal distance with other people, and that puts me on equal terms with the rest of the world. My business is certainly two thirds, and more than that, larger than it was before the railway was brought here.

2362. You have derived a benefit from the railway passing through this district?—Certainly I have.

2363. Is the canal used for the carriage of barley and malt to any great extent now?—I cannot tell you. I only do business with the railway company.

2364. You receive your barley by railway and you send it off, converted into malt, by railway?—Yes, that is so.

2365. How do you get your coals?—I get coals both by the railway and the navigation. The one is a very wholesome check upon the other.

2366. Do you live in the town?—Yes; on the top of the hill.

2367. Have you observed the condition of the river from time to time?—Yes.

2368. What is your opinion as to its condition in consequence of the sewage of Stortford being passed into it?—I have known it to be in a very bad state.

2369. At what period of the year?—In the summer.

2370. In dry seasons?—Yes; and we have had several complaints made about it to the highway board. I am a member of it, and that is why I suggested to our surveyor that we had had several complaints from persons living close to the river; for instance, Mr. Taylor has represented that the stench has been so great that Mrs. Taylor could not sit in her drawing room in the evening, such was the state of the water; but we got rid of it entirely by means of a barge with a large rake behind stirring it up and passing it on.

2371. As a highway board, I believe you have applied to be placed under the Local Government Act?—Yes.

2372. Do you propose to carry out a system of sewerage in this town?—I have voted for it and for this reason, I thought that something would be done which would benefit the town.

2373. Are you aware that the sewage of many towns is now very successfully, and with advantage to the towns, applied to the land in the neighbourhood?—Yes; we thought of that. The highway board have all come to the determination that something will have to be done, and the question was, what was the best thing to be done.

2374. Do you propose to carry out a system of sewers?—I do not think we have any plan.

2375. Do you propose to have any water supply urther than you have at present?—I cannot tell you, but we shall get the best opinion we can.

2376. Where do you obtain your water for malting?—From wells.

2377. Is that water very hard?—I consider that the water is very hard. It is very hard in my own house.

2378. Is it suitable for malting purposes?—We consider that we make pretty good malt here, and I suppose the water must be good.

2379. As a maltster, should you consider that hard water or soft water was better for brewing?—I think I should prefer soft water if I was asked.

2380. What is the effect of the application of water, is it to encourage the growth of the barley?—Yes; and the quicker it grows the better.

2381. Do you think that soft water would produce that effect?—Yes, I fancy so.

2382. (*Professor Way.*) There is no particular secret, I suppose, in the making of malt?—Not any that I know of.

2383. The barley is first soaked in water?—The barley is first steeped in water.

2384. In a large quantity of water or only enough to cover it?—Just enough to cover it.

2385. How long does it remain so?—Sometimes 48 hours and sometimes 64 hours, but it depends upon the barley.

2386. It remains until it is soaked?—Yes; it depends upon the season.

2387. Do different kinds of barley produce different coloured waters?—Yes; I should say that barley from heavy land gives water a much higher colour than barley from light land.

2388. Heavy land is not so good as light land for growing barley, is it?—I prefer barley that is grown in light land.

2389. Not only because it malts better, but I suppose it is better for the brewer?—I suppose that they get a greater amount of extract from it.

2390. You pay more money for barley grown in light land, do you not?—No; that depends upon a man's opinion.

2391. Does not a farmer get more profit out of light land than out of heavy land?—That I cannot tell you.

2392. (*Mr. Harrison.*) Have you ever known a case in which, after converting barley into malt, the barley has increased to such an extent in bulk that the exciseman was inclined to disbelieve the fact and to fine you?—I do not believe that barley, if the trader is an honest man, will increase to such an extent as to give any exciseman good grounds for suspecting anything. I think, generally speaking, there is nothing in the ground in which the barley is grown.

2393. (*Professor Way.*) What is the colour of the water that you run off after the barley has been steeped in it for 48 hours?—Of a deeper colour than the wood work there.

2394. Is it thick?—No, I think it is not thick sometimes.

2395. Will it settle if put into a vessel?—Yes.

2396. Something falls to the bottom?—Yes.

2397. What is that?—I cannot tell you.

2398. Is part of it dirt?—Yes.

2399. And the liquid will still remain of that colour?—Yes.

2400. Do you know whether that water has ever been applied in any way to grass or any other culture?—I have not heard of it.

2401. Do you think it would be possible to use it and to pump it over grass land?—Yes, it might empty itself into a tank if it was anywhere where it could be so used.

2402. Supposing it not to be so used, the water must pollute the river?—I suppose you will compel us to take it away.

2403. Could you pump it over any ground?—No, you must carry it away. The maltings are all in the town, and you could not pump it on to the land.

2404. I suppose when you speak of soft water you would get more colour out of the barley with that?—No, I do not fancy so; we very often change our water in 24 hours.

2405. (*Mr. Harrison.*) What volume of water do you use to a certain number of quarters of barley?—We first fill the cistern with barley, and we keep pumping in the water until the barley is covered.

2406. You do not use a very large volume of water?—No, certainly not.

2407. Of what size are your tanks?—The cisterns are of different sizes, according to the malting.

2408. (*Professor Way.*) Do you pump by hand?—Yes.

2409. You cannot tell how much water you use?—Not in the least.

The witness withdrew.

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Mr. Thomas N. Miller (Bishop Stortford), examined.

Mr. T. N. Miller.

2410. (*Mr. Harrison.*) Are you also a maltster?—Yes.

2411. What number of quarters of barley do you malt in a year?—From about 10,000 to 12,000.

2412. What is the size of the tanks in which you steep the barley?—They vary.

2413. How deeply do you put the barley into the tanks; do you fill them full?—The cisterns are generally full.

2414. Can you give me the dimensions of one of those cisterns?—They are so very various, according to the quantity; some will steep only about 20 qrs.—I am not speaking of ours in particular—some will steep 20 qrs. and some 100 qrs.

2415. Take some of your own?—Some steep 70 qrs.

2416. What are the dimensions of a cistern that will steep 70 qrs., what length is it?—I really cannot tell you exactly. I believe 10 cubic feet will hold a quarter of barley.

2417. Do you malt wheat here as well as barley?—We do not, and I do not think it is malted in the town.

2418. What becomes of the liquid after the steeping?—It passes through the sewers into the river.

2419. Does it cause an objectionable smell at any time?—I think if it was passing through any length of sewerage, for instance, if it was passing through the town sewerage, that at times it would be objectionable.

2420. Fermentation would be set up, and it would smell badly?—Yes.

2421. There is nothing in that liquid that would be mischievous to vegetation if it was turned on to the land?—Rather otherwise, I should think.

2422. It would improve the sewage for irrigation purposes?—I think so decidedly.

2423. You are chairman of the highway board?—Yes, at present. I have been a member of the highway board for nine years out of ten since it has been formed. I have been chairman only during the current year.

2424. Did you hear the evidence given by your surveyor?—Yes.

2425. Are the facts that he stated correct?—I think there were certain facts that he did not attach sufficient importance to; I think he did not attach sufficient importance to the complaints that we, as a board, have received from individuals at different times.

2426. Have you received from individuals a greater number of complaints than he mentioned?—I think we have.

(*The Surveyor.*) I stated that some had been made to me; but that the principal complaints had been made to the board, which are entered on the minutes by the clerk of the board. I thought you were asking me about complaints that were made to me individually.

2427. Complaints might have been made without your cognizance?—Yes, of course I was aware of them, and I said that the minutes would show them.

2428. (*To the witness.*) Have these complaints been more frequent of late?—Yes, and they would have been very much more frequent had it not been in contemplation to effect some general system of drainage which would remedy the evil. I believe that the inhabitants have no wish to throw impediments in the way, and in consequence of this measure being in contemplation the complaints have been fewer. I believe that if it had not been we should have had a great many more serious complaints, and frequent applications to the board.

2429. Do you attribute the increase in these complaints to a larger quantity of sewage matter being passed into the river?—I think there can be no doubt about it; in the early part of the year there certainly was not so much, not nearly so much.

2430. Have the waterclosets been increased considerably of late years?—Yes, very much so.

2431. Within how many years?—They have been within the last five years very materially increased.

2432. Has the malting business carried on in Bishop Stortford increased of late years?—It has increased.

2433. Then the refuse from the malthouses and the sewage are both sent into the river, and both accumulate more or less matter in the river adjoining the town?—Yes. We have one very important street here called South Street, and the drainage lies upon a level with the river, and the consequence is that the accumulations in that sewer must be such as to be very detrimental to the health of the people. We had at the lower end of South Street last year several cases of fever, and several deaths from fever, and I have no doubt that medical gentlemen will be able to give you some evidence in reference to that. I believe, under our present system, that that street lies so low that it is impossible to get the accumulations out even into the river, so as to render that neighbourhood healthy, without adopting some improved system of drainage by carrying the sewage actually away. I may mention that this being a gigantic question it has very much for the present limited the action of the highway board.

2434. (*Professor Way.*) Do you know how soon you are likely to come under the Local Government Act?—I think in about a month.

2435. Have you sent in any plans or proposals in applying to be so placed under that Act?—No.

2436. Do you know that it would be useless to carry out any large sewerage works without a large supply of water?—Yes, that is my own idea, and I think it would be the greatest boon to our parish to obtain a large supply.

2437. (*Mr. Harrison.*) Have you not a mill in this town?—Yes.

2438. What is its fall?—About an average fall, I dare say, of five feet.

2439. What is the next mill to it?—The next mill belongs to Mr. Hunt, that is called South Mill.

2440. There the fall, I believe, is about five feet?—Yes.

2441. Is there not a mill at Twyford?—Yes.

2442. What is the fall there?—Something similar.

2443. That will make 15 feet of fall within a mile and a half of the town?—Yes.

2444. With such a fall there cannot be very much difficulty in getting the sewage of the town on to some land without any pumping?—The difficulty that has always presented itself to us has been the difficulty of getting quit of it after getting it on the land, or into the reservoirs.

2445. If you were to carry out a good system of sewerage, and carried your sewage away to the land, no reservoirs would be required: you might have a

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trap to catch all the heavy gravel and so forth, but the whole of the rest of the sewage might be passed on to the land day by day as it came from the sewer's mouth summer and winter?—But will the landowners receive it?

2446. You must make your own arrrangements about that. You ought to secure, either by lease for a very long term or by purchase, land to put the sewage on, and have it completely under your own control, so that the sewage should be put on to the land and purified before it passed into the stream?—That is a matter for our consideration.

The witness withdrew.

Mr. C. Barnard.

Mr. CHARLES BARNARD (Harlow) examined.

2447. (*Mr. Harrison.*) Do you reside here?—No, at Harlow, but I own property in Stortford. Two sewers go through my property, one on one side of it and one on the other, in this street.

2448. You occupy some mills, I believe, in the town of Bishop Stortford?—Yes, and in the town of Harlow, but the property I own here is just below; there are two sewers running into the river from the town and they are most offensive.

2449. Do they run above or below it?—One below and one above the mill.

2450. Do you experience any annoyance from those sewers?—They are exceedingly offensive; in the summer time very much so. My men have been made ill by it at times.

2451. Are there many houses adjoining the river there, as well as the mill?—Yes; a great number all the way in the direction of South Street. The houses are very thick there.

2452. Those are inhabited houses?—Yes.

2453. You believe that the annoyance you find at the mill must be experienced by those people?—Yes; it is experienced by my men who work in the mill a good deal. The mill is right on the river, and the smell is most abominable at times.

2454. Have you known sickness to prevail among your men in consequence of that smell?—Yes; ast summer especially.

2455. The water in the stream, we have been told, is lowered very considerably in the summer time, is that so?—Very much so.

2456. Any sewage thrown into it must create a great nuisance?—A great nuisance. It not only does so here but it comes down to our place at Harlow where I have some land on the side of the river.

2457. You experience an annoyance, do you, from the sewage of Bishop Stortford at that distance?—Yes. I have a memorial here that we sent to the highway board in 1865 complaining of it, and I have the correspondence.

2458. The highway board have applied to have the town placed under the Local Government Act?—Yes; I know that they have.

2459. They are considering the question of carrying out a more thorough system of sewerage?—Yes; I have always said that they must come to that. The question would be a question of time, but the answer that they gave us was that they had not sufficient powers.

2460. If they carry out a system of sewerage and bring down more sewage into the river they will only increase the nuisance?—Yes. Some gentlemen have told you truly that they have sent men to work here; they have barges in the river for the purpose of raking up the sewage and sending it down to us below. We say that we have received it, but we do not very much like it.

2461. At the same time that they carry out a system of sewerage for the improvement of the town, it is necessary that they should take steps to pass the sewage on to the land?—Yes; that has been my opinion for many years.

2462. What is the fall at this mill?—Mine is a steam mill.

2463. Where do you get water from?—Out of the river, and we put it in again.

2464. What becomes of your ashes?—The ashes are sold. We do nothing but take the water out of the river, but all the condensed water goes back again.

2465. Have you any water power?—None at all.

2466. Is it generally the case where there are flour mills here, that they are applying steam power to them?—Yes, generally; there are several instances. I built two myself.

2467. So as to be able at all times to do a certain quantity of work?—Yes; at all times. I had a mill some years ago, a water mill, on the stream, and I put up a steam engine there, and when I gave the mill up I brought it away again.

2468. How do you obtain coals?—Sometimes by river and sometimes by rail.

2469. Have you found the competition caused by the railway to alter the price of coal at all?—Yes; it has cheapened it very much.

2470. How much per ton?—Something like from 5*s.* to 7*s.* compared with what we used to pay. We used to pay 23*s.*, now we get it by railway at 16*s.* or 17*s.*

2471. What quantity of coal do you use in a year?—About 10 tons a week.

2472. Five hundred tons a year, with a reduction of 7*s.* per ton?—Yes; which is a very considerable advantage.

2473. Has that reduction in the price of coal been enjoyed by the whole of the town?—Yes, by all.

2474. If they are obliged to use a little coal in pumping their sewage, the reduction in the price will be rather a benefit to them?—Yes, a very great benefit; the pumping is done so easily, and the machinery now is so good for pumping it. I know that it is very easily done.

2475. Have you experienced any annoyance from the malt works as well as from the sewage?—No. I do not think that the waste water from the maltings is of that deleterious nature as to cause any nuisance in the river. There is a little spirit in the water, but no great deal of sediment; now and then in the summer time there is sand. There is a little spirit in the water, but there is such a large amount of water that it does not pay to take the spirit out of the water. The barley is covered with the water; it lies under it for about 48 hours, and then the water is drawn off, and in that water there is a certain spirit or a certain gum, and that goes into the river, but it is not at all putrid or deleterious.

2476. (*Professor Way.*) It would become putrid if it was kept?—Yes, most likely; there is a sort of sugar that comes out from it.

2477. Does it get sour sometimes?—Yes; it smells rather sour in summer time, but there is not much malting carried on in summer time. There used to be, and the water was rather offensive, but now it is mostly carried on in the winter time.

2478. As a maltster you discharge your refuse into the sewers?—Yes. I let my malting business to Messrs. Taylor, but the water from my malting place goes directly into the river.

2479. You could discharge it into the sewers, could you not?—Yes.

2480. Supposing the sewage is diverted from the river, and the malting water goes into the sewers and is taken on to the land, will it do any harm?—Not at all.

2481. So that in fact that question will be dependent upon the question as to the application of the sewage?—Yes; I think there is land to be got just below the river. There is a great fall from the brewery; each side rises up very abruptly. On each side there are deep gravelly slopes that would take almost any amount of sewage.

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2482. Have you had any experience yourself of the application of liquid manure?—Yes; for the last seven years.

2483. Of what nature?—Where I live at Harlow, at my homestead, I have a great number of cattle of my own in sheds. We get all the liquid manure and run it into a tank shaped like that (*describing*), and after that I put in a wire grating, and take it into another tank, and then pump it out on to the land. I pump this two or three times a week on to the pasture, and in five minutes you cannot smell anything, although it appears to be putrid before it soaks into the land, which is porous. I have done this for the last seven years, and I think it has not cost me 5*s.* in seven years. It has been very effective.

2484. Then that experience would lead you to think that although sewage and farmyard liquid are not the same things, you could do the same thing with sewage as with the other?—Yes; you are aware of one case where certain operations in law took place.

2485. What was the case?—A certain kennel of hounds used to drain into my horse pond. It was just by my house. The drains ran from this kennel right into my horsepond, and it killed my cattle. Thereupon an action ensued, and we beat the gentleman, and now that sewage is taken and put into a tank and pumped on to his land; that has been in operation for several years, and it is now very effective.

2486. What is drained from the kennels is now pumped on to the land?—Yes, and it is offensive to no one.

2487. Do you know anything of that character in your experience which is more offensive than the drainage of those kennels?—There is nothing that I know of so offensive as that is. If you opened a small bottle of it in this room gentlemen could not stay here with any comfort at all.

2488. And that is now pumped on to the land without offence to anybody?—Yes; I took one or two gentlemen down there to see it, and it made them so sick that they were obliged to have some brandy before they could recover themselves.

2489. That was at the kennels?—Yes.

2490. Has anybody seen it when it has been put on the land?—After it was put on the land it made the grass grow so tremendously that they could hardly keep it down. In the early spring of this year it was so high that there was no such grass anywhere as where the kennel sewage was put. The dogs live a good deal on animal food, and the manure is very strong indeed, but the stench is very bad.

2491. Have you any land in the neighbourhood?—Yes.

2492. Have you any land which would take this sewage?—Yes; but I have none near Stortford.

2493. How far is it from Stortford?—Seven miles.

2494. Is it below Sawbridgeworth?—Yes; I should only be too glad to get it. We applied to the highway board from Harlow, and I got up this memorial to the gentlemen of the board of highways at Bishops Stortford.

2495. (*Mr. Harrison.*) When was that?—This was in June 1865. The newspaper has a report of it, which I will read. This is what I drew up, and it is signed by Mr. Pryer Field, vicar of Sawbridgeworth, William Barnard, Sawbridgeworth, R. Barnard, Harlow, Charles Barnard, Harlow, John Brickwell, Sawbridgeworth, Thomas Unwin, Sawbridgeworth, Frederick J. Unwin, Sawbridgeworth, Francis D. Beck, Sawbridgeworth, William Poole, Sawbridgeworth, surveyor, William Franklin, Sawbridgeworth, churchwarden, John Barnard, Sawbridgeworth, Henry James Bonner, Hallingbury, and William Death, Burnt Mill, and this is what they say: "To the "board of highways, Bishops Stortford, Herts. Gen- "tlemen, We the undersigned, being residents near "to the river Stort, beg to call your attention to the "increasing pollution of this river situated within "your district. There is at the present time so much "filth, ordure, and sewage entering the river from "the cesspools and main drains which have of late "years been constructed for the purpose of draining "the town of Stortford, that from this cause the "river has not only become very offensive to many "of the inhabitants of Stortford, but also to those "who reside some miles distant from the town (where "this foul nuisance arises); and we further say that "this nuisance is particularly offensive to some "of the inhabitants of Sawbridgeworth (through "which the aforesaid river flows). The foul effluvia "arising from this river in this parish is now very "offensive, and fears are entertained that it will soon "be very much worse unless some very efficient "method is adopted to prevent the Stortford sewage "entering and daily polluting the river Stort. Some "of the inhabitants of Sawbridgeworth and its "vicinity are about to convene a meeting for the "purpose of considering the propriety of sending a "memorial to the General Board of Health for "England, asking them to send a Government in- "spector to survey such parts of the river Stort as "are or may be considered injurious to the health "of the inhabitants residing near to the river. In "the mean time we shall be glad to learn that very "efficient means are speedily to be adopted to remedy "so foul a nuisance." That was the state of the river in 1865.

2496. Since that time the highway board have taken steps for the town to be placed under the Local Government Act?—Yes; I have a letter here which was received in answer to that application. It was written to my cousin. This letter was written by Mr. William Gee, who is clerk to the board, and it is as follows: "Bishops Stortford, 19 June 1865. Dear sir, I have "laid the communication received from you in refer- "ence to the pollution of the river Stort before the "highway board in accordance with your request. "The powers conferred by the Highway Act are in- "adequate to enable the board effectually to grapple "with the question. It is therefore, proposed to "convene a public meeting of the ratepayers for "Thursday the 29th June, at 10 o'clock, when the "matter will be taken into consideration."

2497. The highway board did take the step which they mention in that letter?

(*Mr. Miller.*) The highway board called the meeting.

2498. (*Mr. Harrison.*) And in consequence of that did you take steps to place the town under the Local Government Act?

(*Mr. Miller.*) We did take steps to gain additional powers so that we may do that which may be required, and which may be considered necessary, and in conformity with the Act of Parliament. We are the greater sufferers, of course, and we are anxious to get rid of the nuisance.

2499. (*Mr. Harrison.*) Are you expecting now to have a local board formed under the authority of the Local Government Act?

(*Mr. Miller.*) We expect it almost directly.

2500. (*Mr. Harrison.*) And have you heard that it is the wish of the town to take steps to improve the condition of things?

(*Mr. Miller.*) At a large meeting of the ratepayers and the inhabitants, I believe that it was unanimous.

2501. (*Mr. Harrison.*) (*To the Witness.*) Are you the owner of property in Bishops Stortford?—Yes.

2502. Besides the mill which you occupy?—Yes; I have malting premises near it, and a sort of market garden let to tenants.

2503. Have you any house property?—Two cottages for the labourers, situated near the malting premises.

2504. And you will not object to what is provided by the local board?—No; I think that it is the best thing which can be done, namely, to tax the town for the making of a very great main sewer, which I think might be easily carried out. I do not think that there is any engineering difficulty in the way; it is only a question of money, and that as far as I am concerned,

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having a good deal of property in Stortford, I shall be very happy to pay.

(*Mr. Miller.*) The Commissioners called very particular attention to the water sent from the malting cisterns, and it appears to me that they looked upon that as one of the greatest nuisances.

2505. (*Mr. Harrison.*) We only asked for information.

(*Mr. Miller.*) I did not state it at the time when I was being examined, but there is a very large brewery here, which of course discharges an immense quantity of sewage into the river, and there are also upon the banks of the river the gasworks.

2506. (*Mr. Harrison.*) (*To the Witness.*) Besides the sewers and the refuse from the malthouses, is there any other source of nuisance in the town of Stortford which you know of?—There are the maltings so far as they are a nuisance, but they are of course a very small nuisance. There is a brewery at the other end of the town, and from that I have seen a vast amount of sewage go into the river, such as brewers usually produce.

2507. (*Professor Way.*) You do not mean sewage, but a discharge of liquid of some sort?—It is very dark stuff.

2508. (*Mr. Harrison.*) In what part of the town is that brewery situated?—In the upper part of the town.

2509. Does that refuse, whatever it might be, pass right through the town?—Yes.

2510. And have you known objectionable matter to be passed from that brewery?—It looks very thick, and very muddy.

2511. Do you know what it arises from; is it from the cleansing of the casks?—I daresay that the gentleman who owns the property will give you that information.

2512. Are there also gasworks in the town?—Yes, right beside my property, and I have no means of going into the town without passing them; but the gentleman is here who has the management of the gasworks.

2513. (*Professor Way.*) Do you ever see any tar or anything of that kind floating upon the waters?—I cannot say that I have not seen tar, but the barges are a good deal tarred, and I cannot say whether it is from the gasworks or from the barges.

2514. Is it in any large quantity?—I never saw it in any large quantity.

2515. I suppose you know that tar is now too valuable to be wasted?—A great deal too valuable.

2516. (*Mr. Harrison.*) Besides being an owner of property in the town of Bishops Stortford and a miller on the banks of the river, do you farm any land in the neighbourhood?—Yes, about 500 acres.

2517. Is any of it situated in the valley of the Stort?—Yes.

2518. Is it liable to be flooded?—Yes.

2519. Is it benefited or otherwise by the floods?—Some of our land is very much benefited, and some of it is very much the contrary. When we get a surface of land like this table, and the water simply flows over it, and it soon gets dry again, the land appears to be very much benefited, there is a good deal of detritus left and a good deal of silt, and so on, and it makes the grass grow immensely. I have one field on the banks of the river, and that is very much injured by it.

2520. From what cause does that injury arise?—The water cannot get away, being dammed by the mill, and the land is constantly flooded. A few years ago, I could not grow any grass there of any value, and I dug the land and applied it to osiers.

2521. Had you any difficulty in passing the drainage below you?—Yes, the expense was so great that I would not encounter it.

2522. Are the proposed improvements in the river Stort proposed to be made in the neighbourhood of your farm?—No.

2523. That is lower down the river?—Yes.

2524. Is there much of the land in the valley of the Stort which is injured by the floods in a similar manner to what you have mentioned?—Yes, very much.

2525. Would a general system of arterial drainage be beneficial to the land in a very decided manner?—Yes, very much.

2526. Have any steps at any time been taken to carry out such a system?—Not a general system; there have been some local endeavours to put the land under drainage, and now and then, as Mr. Hunt was telling you, to put the water under another fall, and if you put it under another fall next to the mill, you can get good drainage, otherwise there has been no general system.

2527. Do you think that it would be a benefit to the land lying in the northern parts of the valley of the Stort, if the whole of the Stort basin were put under the authority of a board whose duty it should be thoroughly to drain the land, and to erect weirs, and to make the necessary arrangements for passing off the flood waters?—Very much indeed. I had a scheme, some years ago, and drew the plans myself for draining about 60 or 70 acres of land, which is now a mere swamp, and we could not carry it out, because we could not get everybody to agree to it. The land was owned by various people (I am now speaking of a large piece of land lying in and near Harlow Marsh), and we could not carry it out, because the land belonged to so many persons, that they would not all agree to the same thing, and therefore the land belonging to me is now in a swamp.

2528. Do you know that some few years ago, a Drainage Act was passed enabling such a work to be carried out, if a certain proportion of the owners of the property agreed to it?—Yes; but taking into consideration the amount of trouble and expense which it would be to us, we do not consider it worth while to enter upon it. At the same time the land would be very much benefited. I should think as much as a pound an acre.

2529. You think that the rent would bear raising to some considerable amount for the purpose of carrying out the improvements which you recommend?—Yes, I shall be very happy to pay 5*s.* per acre a year for my land to have it drained.

2530. Your experience of the working of the Land Drainage Act is, that notwithstanding the facilities which it affords and although it is desirable you have not been able to carry out the drainage in this district?—I am only speaking of this particular case. We saw so much difficulty in dealing with certain persons, that we dropped the matter at once, we did not go to any expense.

2531. Have you any facts which you can mention to us with respect to the diminution of the water in the river?—Some years ago, my farm happened to belong to some gentlemen who were conversant with the Land Drainage Act. My farm had a good many little springs on it, and they drained all these springs. Those little land springs used to remain till the summer, and used to go into the river, but now they all go away as soon as the rain falls, and that would diminish the amount of water in the river in the summer time.

2532. Is there no water passing in the summer time into the river from that source?—No, except we have a very heavy rain. In the winter time, of course, we have a great deal of water, and as much as we ever had.

2533. Do you agree with the former witness, Mr. Hunt, who stated that the quantity of water passing down is very much less now in the summer time than it was in former years?—Yes.

2534. Do you attribute that to the same causes as he did?—In some measure; but he did not mention the land draining which has been very extensively practised in our district.

2535. (*Professor Way.*) He mentioned that as one of the causes?—That I did not catch. That is one of the causes, and the other causes which he mentioned I have no doubt are very correct.

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2536. (*Chairman.*) At what depth do you drain?—Many farmers drain about four feet deep.

2537. Is from four to six feet about the average depth?—Some people average 18 inches, and some two feet, and others three feet, and others four and five feet deep.

2538. At all events four feet would be a deep draining?—Yes, and I think that it is a great deal too deep draining on heavy land, but it is light land where my drains were made.

2539. With regard to the question of diminishing the quantity of water by draining, do you imagine that springs are seated in any section of land which is touched by four feet in depth?—Those are what we call land springs, we get them in at four feet.

2540. Supposing that something could sweep away the four feet of surface altogether, do you not think that you would have the same amount of springs as you have now?—That I cannot say.

2541. Do you not think that that spring water has connexion with a much greater depth than four feet?—These are very small springs. I will describe the nature of the land. We will suppose that there is a cup of clay, as is the case in some of my fields of two acres in extent, and in that cup there is a bed of gravel, the water cannot get away when it rains,—there it is. If you take a four feet drain through it, it goes nearly to the bottom of the gravel, and the water goes right away. As an example, I could point out a land ditch which generally begins to run in the month of November, and continues to run till about the middle of May.

2542. You can take away that water which rises to within four feet in depth?—Yes. I have spoken as to the effect upon my land and not the effect upon the river. It is only consequential.

2543. It takes away on your land water to the extent of four feet, and it passes it on to the river more quickly than it did before?—Yes.

2544. (*Professor Way.*) The instance which you give is one of the worst which you could select, because it is not the case of a spring but the case of water logged land. But supposing that you had a hillside of gravel upon clay, the water would come out for months together, solely drawn from the superficial gravel, is that what you mean?—Yes. Sometimes the land crops out in gravel, and sometimes it crops out in clay, and what we call the four feet drains take a great quantity of water away.

2545. (*Chairman.*) Is there anything further which you wish to state?—No.

The witness withdrew.

Mr. T. Garratt.

Mr. Thomas Garratt (Hunsdon) examined.

2546. (*Chairman.*) Are you the proprietor of Hunsdon Mill?—I am the tenant of Hunsdon Mill.

2547. Where is Hunsdon Mill situated?—On the river Stort, about eight miles below Bishop Stortford.

2548. Down the river?—Yes. Roydon Mill is the mill below, nearer the Lee, which empties itself into Lee, it being upon the Stort, about four miles below Harlow.

2549. How long have you occupied that mill?—I occupied Roydon mill before I took Hunsdon mill; I have lived immediately on the Stort about 15 years.

2550. What number of stones can you ordinarily drive there?—There are six in the Hunsdon Mill, but the water of late years has come so irregularly that we frequently have water sometimes more than the mill will take, and at other times we have not more than enough for about two or three pairs of stones. It averages about three pairs of stones in summer, but now there are considerably more.

2551. Do you mean three pairs of stones, with cleaning and dressing machines?—No.

2552. Do you use steam power?—Not on the Stort, but on the Chelmer I do, where I have a mill in partnership with my brother.

2553. What is your fall?—Between 13 and 14 feet at Hunsdon. It is the highest fall on the whole river.

2554. What horse power do you use?—From about 24 to 26 horse power.

2555. What is your horse power when you have the least volume of water?—About 12 on the average. It is about half. I consider that I can do barely half as much in winter as I do in summer, because I am flooded in winter for days together. It is an overshot wheel.

2556. What diameter is your wheel?—14 feet 8, and it is about 12 feet high.

2557. Have you only one wheel?—Yes. I formerly worked two, but I had an overshot wheel put in lieu of a breast wheel some years ago.

2558. In what condition is the river ordinarily?—In a very bad state.

2559. Do you mean bad as regards the quantity of the water, or the condition in which the river itself is?—Both as regards the condition of the water, and the dirty state of the mud at the bottom, so much so, that about eight years ago it was a pure stream, and being in the habit of keeping trout where I come from in Hertfordshire, I introduced trout into the river, and I fed them till they were about 4 lbs. or 5 lbs. weight: but about four years ago the water came down in a green filthy state, and the whole of my trout died. The mud has come down by the barges. My water after it leaves the wheel is a private water for about three fourths of a mile to a mile, where there is no navigation, and the mud settles there to a great extent. I find that other people send the mud to me, and I had a large hoe constructed, and I put four horses to it, and I sent the mud down again into the navigation. It is cheaper than throwing it out.

2560. Can the persons below find any fault with you for doing it?—We occupy the mill below.

2561. What do you do at that mill below?—We drive the mud away in the best way we can. We have had iron harrows, with two or three horses. In some places a barge comes down on Sunday when my mill is stopped. The River Lee Company do not allow the navigation to be opened on Sunday, and the barges run up on the Saturday night to get to the mouth of the Stort before the river closes, and the others come down to get to the mouth of the Lee by the time that it is opened on Sunday night, and the mill standing still, there being no fresh water, it is just like a ditch, and the fish frequently come to the top of the water on Sunday from sickness.

2562. Has the condition of the river been getting better or worse since you have known it?—Decidedly worse.

2563. It is getting worse every year?—Yes. There is not a house near the river but what drains its sewage into the river the whole of the way up. Farmyards and other houses do so.

2564. In what condition do you occasionally find the surface of the water?—It is covered with green scum like a pond.

2565. Are there the carcases of dead animals floating on the surface?—Yes, frequently; and unfortunately, about three weeks or a month ago, I found the body of a dead child floating on the surface.

2566. When you find the carcases of dead animals, what do you do with them?—I push them through the gully hole.

2567. You do not bury them?—No; they would stink too much for that.

2568. What became of the carcase of the poor child?—I sent immediately for a policeman, and had an inquest held upon it.

2569. Was it found out where it came from?—No. There was an open verdict, "Found drowned." The child was about 24 hours old.

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2570. As the sewage of the towns and villages and of the individual houses comes in, do you ever see human ordure floating upon the water?—I cannot detect it.

2571. It gets broken up?—Yes, from the wheels disturbing it. It is at times more like churning up mud than anything else. I have frequently seen a barge come down and there has been a foot of mud. It shoves it down to the navigation, and there is a channel which drives it down to the head of the mill, and I am obliged to remove it in the best way that I can.

2572. Does it ever affect you or your men with sickness?—I have a pretty good constitution, and I do not think that it affects me.

2573. Where do you get your drinking water from?—From a well, and if the well is out of repair I send nearly a mile off for water for the use of the house.

2574. You do not think of drinking the river water?—Not in the least, and two years ago it was in such a state that my horses would not drink it, but that was only for a few days from the refuse of gas-works, or something of that sort.

2575. Do you think that it is a proper water to send on for the people of London to drink?—Decidedly not.

2576. If any improvement can be made so as to restore it to a pure condition I suppose that you think that it ought to be made?—Yes. The whole of the streams would be very pure water barring the pollution which comes in.

2577. If the springs were kept pure you think that the water coming to London would be pure water?—Yes.

2578. If they did that they would take certain water past your mills?—Yes.

2579. I suppose you would think that that should be compensated for?—I do not see why one individual should monopolise the whole to the detriment of thousands.

2580. I suppose that most of your mills are water mills?—Yes; those on the Stort.

2581. What is the rent of your mill?—The rent of my mill is 310*l.* a year with the land, and the tollage on the lock. I value the mill and the machinery with it, without the grounds, at 240*l.* or 250*l.* We have very good grounds. Nearly the whole of the machinery is mine, in addition to that.

2582. Any scheme which contemplated buying up the mills for the purpose of carrying out these improvements must face a very considerable outlay?—Yes.

2583. For instance the purchase money of a mill like yours would amount to a very good round sum?—It was purchased some few years ago.

2584. 5,000*l.* or 6,000*l.*?—It would not be worth that without the house and the grounds.

2585. If any scheme contemplated sweeping away the mills for the sake of a good water supply for London, it would come to a good round sum?—Yes; and I have always advocated that it would pay. The mills now are often flooded.

2586. An area of land is now back watered, and the annual value of water-logged land is much greater than the annual value of the power?—With the exception of a few instances in Hertfordshire, I consider that the mills cause more detriment to the land than they are worth. My family work two mills on the Lee and two on the Stort. My family occupy one on the river Ash and one on the Mimram.

2587. Is steam used at all in this part of the country for supplementing mill power?—On account of water falling-off some four or five years ago we hired another mill with 13 pairs of stones on the Chelmer to make up for it; six being worked by steam, and seven by water.

2588. Have you ever used steam for grinding?—I do so now on the Chelmer.

2589. Is there anything in water power which gives it an advantage in driving your machinery as compared with steam?—There is more wear and tear with steam power than there is with water power, because there is the friction, but in my opinion it makes very little difference if we had a full supply of water, cold water was the cheapest; but situated as we are, if we cannot do more than half our power, water power is very little cheaper than steam power. My family now occupy with water and steam upwards of 40 pairs of stones, and I think that 20 pairs of stones with steam would do more than 40 with water. When Monday morning comes and we make sales for 500 or 700 sacks of flour we know that we can do it in a certain time, but with water perhaps there may be a flood to-day and we are standing still, and to-morrow we have no water. At the mill at Hunsdon I have stood still for want of water at 9 o'clock in the morning, and before 9 o'clock next morning I have stood still from a flood, and that is within a fortnight of the present time.

2590. Then we have these facts; you find the river itself, you think, from some cause or another, to be more uncertain in its volume than it used to be?—Decidedly.

2591. You have the water getting much more impure than it used to be?—Certainly.

2592. You have greater deposits of mud than you had formerly?—Certainly.

2593. And you have large areas of land water-logged most injuriously by reason of the mill dams which are existing?—I do not think that at the lower part where I occupy, after a flood, if you lowered the river one yard, you could stop it from, at times, overflowing the banks.

2594. But you could easily bank the river in; you could raise a parallel bank which would keep the land from being water-logged?—I think that you must first of all see to the river the whole way. The Stort is the floodiest stream running into London. My water wheel is frequently from six to seven feet in tail water when I am standing still for a flood.

2595. Of what length is the weir?—About 22 or 23 yards in the widest part.

2596. If your mill were to stand in dry weather, what depth would the water come over it?—I frequently have to stand seven or eight hours when the water will not rise an inch. The other mills shut down at nights, and the water is frequently running over the banks for the whole of the day, and then the mill stands still after the others have stopped.

2597. What with the water wanted for the canal, and the water ponded by the other mills, and let down by the other mills without any consultation with you, you cannot tell what you will be able to do?—Just so.

2598. And yet the Stort is liable to very rapid floods?—I think that there is scarcely a river in England which is so subject to floods.

2599. Can you give me any idea of the height to which the river would rise in the middle of one of your ponds when it is in flood?—Our lands are frequently three feet under water besides what the gates will take.

2600. (*Professor Way.*) How much is the river below the banks?—Not more than about eight inches, but the valley is so low below that it fills the valley, it takes a sweep right down the valley, so that four-fifths of the water comes right down the meadows and over the roads.

2601. You know that very mischievous floods very frequently come down which you cannot control?—Just so. I do not think that you could construct banks high enough to carry them over, unless you went with the natural valley of the river. My mill is carried along a side hill, and when the banks overflow the valley is filled up. The original river Stort is now nothing but a dry ditch. I have no doubt that the old valley might be constructed to carry the whole of the water. If you swept away all the mills and opened the valley, you might carry all the water away without any difficulty.

2602. I suppose you need not sweep all the mills away if you replaced the water by steam?—You could not do that in the case of my mill at Hunsdon, it would be useless, for it is three miles distant from a railway station. You had better pull down the mill and build it elsewhere.

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2603. (*Mr. Harrison.*) You have two mills, one at Roydon and another at Hunsdon?—My brother-in-law lives at Roydon.

2604. Do you receive anything from the navigation?—Yes.

2605. How much do you receive for each lock of water passing the navigation?—Under the original Act it was 6*d.* a barge, and we had to let the barges through. After that, there was some arrangement with the proprietors of the river Stort and the mill-owners, that they should give 10*d.*, collecting a shilling, and should retain 2*d.* out of every shilling towards the labour of letting the barge through.

2606. At what mill is that?—At all the mills.

2607. A former witness stated that it was 6*d.*?—I have the 6*d.*, but I return one penny to the lock-keeper employed for the Stort proprietors; the 10*d.* and the shilling apply to the journey up and the journey down; there are two locks. I maintain that if there was a fair compensation for the loss of water I ought to have four times as much as the other mills do; it takes double the quantity of water to fill my lock that it does to fill the locks of my neighbours, and the water is of double the value to me.

2608. Is the 13 feet fall at your mill the same now as it was before the navigation was formed?—I believe that it is exactly the same.

2609. At what time of the year was it that the refuse which you have mentioned came down and killed your fish?—In the summer, in July and August. We always consider that there is the shortest water in the Stort as soon as the grass is cut, because there are so many ditches and water courses on the Stort which are affected after the grass has grown; there are a great many flags and, the sun having considerable power, they draw out the water into the atmosphere. When vegetation begins to cease we have more water.

2610. You have mentioned that the refuse collects; have you much of it in your tail race?—No, it is not so deep there; for the bed of the river is gravel and shallow.

2611. You mentioned that you obtained some water from a well, where is that well?—That is in my own house, and if the pump was out of order, rather than use the Stort water, I would send a mile for water to a spring.

2612. Do you think it desirable that the river should be put under some government, so that these evils which you speak of might be remedied throughout?—It wants some alteration.

2613. Do you think that it should be done at a system?—It would be for the benefit of the community at large. I think that it would be a detriment to occupiers of mills like myself, but for the community I maintain that it wants a different system altogether.

2614. Do you think with the last witness that the benefit to the land from the arterial drainage would be such as would bear the expenses necessary to carry out the improvements?—Higher up the stream it might be so, but with me as soon as the water is gone the land is so porous that I could plough it to-morrow, and it is so till you get to Stanstead marsh which Mr. Hunt has alluded to, and then it is bad. I consider that the floods are a benefit to me personally, but in places they are a great detriment.

2615. In parts of the river where rushes are growing, do you think with the last witness, that the benefit derived from arterial drainage would be equal to 1*l.* an acre?—I know the land which Mr. Barnard alluded to well, and it would be a great improvement.

2616. Is there much land in the valley of the Stort which would be considerably improved?—In Hallingbury it is very bad, it is a good deal flooded; but where I alluded to was on the Mimram, and there I believe that the mills are a great detriment. I refer to the neighbourhood of Welwyn.

2617. (*Professor Way.*) On the line of the Great Northern railway?—Yes, the Mimram is the purest stream which runs into London. I never knew that water the whole of the time fall below its banks. Whitwell is a place where nearly all the privies hang over the water, and in Welwyn the whole of the sewage runs in.

2618. (*Mr. Harrison.*) One of the former witnesses mentioned a number of mills which had had water power some few years ago, and which, in consequence of the diminution of the water, had been abandoned as water mills, are you aware that that is the case?—The water power is abandoned in this way: there is a mill which has been in my family for upwards of 50 years that is dry for three or four months at a time, but steam power is added to it; there are several mills in my family to which steam power is added. I maintain that the whole of the mills from Whitwell to Hertingfordbury, on the Maran or Mimram, do more harm than they are worth; there are about eight mills there, and I should think that the average of them do not make more than from 50 to 60 sacks of flour a week in the summer time. There are two mills on the river Lee which scarcely have any water; there are about 400 feet on the river Lee, from the source to the mouth.

2619. (*Chairman.*) That is from Houghton-Regis?—Yes.

2620. It is about two miles above Luton?—Yes; the mills have been dry for months together there in summer time. When I was a lad at home I took the height of all the mills from the source of the Lee, right down the Lee, and I calculated that there were about 400 feet.

2621. What is the number of mills?—There are about 12 or 13 mills on the river Lee above Hertford.

2622. In dry weather what amount of flour would those mills grind on the average?—Below Wheathamstead 100 sacks a week, and above Wheathamstead about 50 sacks.

2623. (*Professor Way.*) Do you know the river Stort and Lee sufficiently to give us an account in writing of the mills on them?—Yes, I know every mill from Luton to London, and every mill on the Mimram from the source to London.

2624. (*Mr. Harrison*) And the Bean and the Ash?—Yes, and I can give the fall to each mill. There is not a mill on the whole stream but what I have seen.

2625. (*Chairman.*) We shall be obliged to you if you will furnish us with that information?—I will do so.

2626. Is there anything which you wish to add to your evidence?—I think not.

The witness withdrew.

Mr. William Gee (Bishop Stortford) examined.

Mr. W. Gee.

2627. (*Chairman.*) What are you?—I am a solicitor, and I am clerk to the highway board of the town of Bishop Stortford.

2628. Under what authority is the highway board acting?—Under the General Highway Act of the 3d and 4th of William the Fourth.

2629. Then you have not adopted the new Highway Act for consolidating the previous enactments?—No, the parish of Bishop Stortford has just adopted the Local Government Act.

2630. What is the area of the parish?—I cannot state.

2631. Is the area of the parish and of the township the same?—Yes.

2632. Does the parish include a considerable acreage of agricultural land?—I really do not know, but I should imagine 2,000 or 3,000 acres.

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2633. Do you know what length of highways you have to maintain?—Eleven miles. We shall shortly have some more highways on account of the expiration of the turnpike trusts.

2634. When did you adopt the Local Government Act?—On the 25th of October, I think, and it will come into force on the 25th of December. I think that the time for appealing has now expired.

2635. Have you had any inspector down here?—No.

2636. Do you know what number of members you are going to elect as your local board?—Fifteen.

2637. You have settled that?—Yes, we have settled that at a meeting.

2638. The qualification will be settled by the Act?—Yes.

2639. It will be, I suppose, 500*l.* property, and 15*l.* rateable value?—Yes.

2640. You are under 10,000 in population?—Yes.

2641. Your population is about 5,000?—Something over 5,000.

2642. What have been the difficulties which have prevented your carrying out any sanitary measures as a highway board; have they been legal difficulties?—We object to any considerable outlay of money. I believe that at present we have no borrowing powers as a highway board.

2643. Are you pretty well acquainted with the Local Government Act?—I have had no practical experience of that Act.

2644. As a lawyer have you looked over its provisions?—Yes.

2645. Have you had any legal decisions as to what it can do and what it cannot do for you?—No, we have not gone into it generally. We have had two public meetings.

2646. Has the question been at all raised of the chance of excessive outlay?—Yes. I think that there is a fear on the part of the ratepayers that it may lead to a large outlay.

2647. Do you think that the ratepayers would be at all assured if they knew that an outlay which would be burdensome and would not give any benefit for the expenditure need not be contemplated?—I have endeavoured to impress that upon them.

2648. That if you manage your affairs as you ought to manage them, any rating or outlay will really add more than the money expended to the value of the property of the town?—Yes.

2649. If you have better streets you have better means of getting over them. If you have sewers and drains which are properly devised, you ought of course to have more comfort and better health, and less poor's rates?—Yes.

2650. And if you have a water supply you can give facilities which you cannot possibly possess where you have no water supply?—There is no doubt of that, but the great bugbear is a great increase of rates.

2651. Have you had any discussions amongst you as to what the sewerage might cost if properly executed?—We have had no definite estimate at all.

2652. Have you had any sum mentioned?—There was a scheme of drainage proposed in, I think, the course of last year, of which the estimated outlay was about 5,000*l.*

2653. That is about 1*l.* per head of your population?—Yes. It was rather an indefinite estimate; no particulars of measurements had been gone into.

2654. You have no debt, I suppose, now upon the township?—No.

2655. You expend the rates which you levy annually?—Yes.

2656. What amount of rate have you levied as a highway board?—Varying from 6*d.* to 10*d.*, and I believe that this year it has been 1*s.*, but I think that we shall have a little surplus from it.

2657. Are there any exemptions now from the rate?—No; we rate the whole parish.

2658. Does the land pay equally with the town property?—Yes; for all purposes of the Highway Acts. It is exempt from the lighting rate, with which, as a highway board, we have nothing to do.

2659. You have adopted the Lighting Act so far as enabling you to light the district?—Yes; there is a separate board of inspectors.

2660. Will all that be incorporated under your new local board?—Yes.

2661. At present where does the sewage of any drains or sewers which you have empty itself?—Into the river.

2662. Into the river which goes on to London?—Yes.

2663. Have you had any complaints from parties below, from millers, or owners of property, of the fouling of the river?—Yes. I think that the only formal complaint is the one which was brought forward by Mr. Barnard this morning. He read the requisition which he sent to the highway board. That was in the course of last year. That complaint was principally by the inhabitants of Sawbridgeworth.

2664. Complaining of the nuisance which is sent down to them?—Yes. At the same time they themselves drain into the river.

2665. And they send down the sewage to some one below?—Yes.

2666. So that if that system was general you would have people making complaints, and threatening actions all the way down?—No doubt there are great nuisances arising at times.

2667. Are there any privies situate in Bishop Stortford so as to overhang the edge of the river?—Yes, I believe that there are.

2668. Where the soil passes right away into the stream?—I believe that there are such; not a great number.

2669. But there are some few?—Yes.

(*Mr. Taylor.*) There are many.

(*Mr. Miller.*) There are many.

2670. (*To Mr. Gee.*) What measures have you adopted with reference to the nuisance of privies, or pigsties, or nuisances of any kind?—An inspector acting under the board has given notice to the parties in the ordinary way, and has taken such steps as might be necessary to remove those nuisances. A connecting drain may have been necessary; and in certain cases he has done that.

2671. How long have you had an inspector of nuisances?—All the time that I have been clerk to the board, and some years before.

(*Mr. Miller.*) From the formation of the board about 10 years ago.

2672. (*To Mr. Gee.*) What does he get per annum?—He is inspector and surveyor of the highways.

2673. What do you pay him for his services altogether?—60*l.* a year.

2674. What has been the general health of this district since you have known it?—I should say that it is a very healthy town as a rule.

2675. Have you had any outbreaks of fever?—For several years past there have been cases of fever, but I do not think that we have been more subject to it than the neighbouring villages and places of that sort.

2676. Have you ever had cholera?—I never heard of a case here.

2677. Has there been cholera at all in the neighbourhood at any period, above you, or below you?—Not within some miles that I know of.

(*Mr. Hawke.*) In the year 1834 I lost a relative by cholera.

2678. Were there any other cases at that period?—There was only one other instance of cholera, and that case survived.

2679. (*Professor Way.*) Was that case in the same year?—Yes.

2680. And there has been no case of cholera since that you know of?—Not that I know of.

(*Mr. Skipp.*) About ten or twelve years ago there was a bargeman who died of cholera in the town, and it was supposed that he brought it from London.

2681. (*Chairman.*) (*To Mr. Gee.*) Have you as a board anything to do with the house drains—do the parties make application to you for leave to drain into your sewers?—As a rule they are supposed to make application to the surveyor, but I believe that the sewers are sometimes made use of without any application.

2682. Have the highway board made any new sewers since you have been clerk to the board?—Small additions have been made to the sewers.

2683. I suppose that you would not be authorized to construct what we should call sewers?—No.

2684. They would be drains to carry off the surface water from the roads?—That is no doubt the origin of the drains here. They have since been applied to sewage purposes. On the hills I believe that they answer very well for that purpose.

(*Mr. Miller.*) They are no more than surface drains for the roads.

2685. Of what shape are they?—They are circular.

(*Mr. Glasscock.*) They are all barrel drains.

2686. (*To Mr. Gee.*) As regards the Local Government Act, we may take it that you have complied with all the requirements. Have you received the assent of the Home Office?—We shall receive it when the time for notices of appeal has expired.

2687. And you have not received any notices of appeal?—No.

2688. (*Mr. Harrison.*) The surveyor was asked this morning with regard to the complaints; I think that you have brought the book in consequence?—Yes.

2689. Will you refer to a few of the complaints, so as to give us an idea of their character?—On the 1st of August 1863, "Mr. Marshall Taylor and "Mr. John Miller attended to complain of the "offensive state of the mill below the town mill. "After inspecting the nuisance in question it was "proposed by Mr. March, seconded by T. N. Miller, "and resolved, that the assistant-surveyor endeavour "to make arrangements with Mr. Davis, the superintendent of the Stort navigation, for the use of his "boat and implements to clear the filth from the bed "of the river between the town mill and the navigation, and also in the rear of the steam mill, and at "the outlets of the sewers." Then on the 28th of May 1864,—"Mr. John D. Taylor and Mr. Marshal "Taylor attended to draw the attention of the board "to the state of an open ditch in the rear of the "houses on the north side of Hockerill. A large "quantity of sewage and filth accumulated there, and "ultimately flowed into the brook running by the side "of the causeway, which was thus rendered very "offensive." A committee was appointed to inspect and report, "as to the most effective mode of remedy-"ing these nuisances." That ditch ran into the river.

2690. What steps were taken to remedy that state of things?—The ditches were cleaned out; that was the only thing which was practicable under the circumstances.

2691. (*Chairman.*) And then you had a new start, the same thing repeating itself?—Yes. On the 17th of September, 1864, "it was proposed by Mr. J. L. "Glasscock and seconded by Mr. Hawke, that steps "be taken to cleanse the bed of the river from Rye "Street, opposite Mr. Odams' house, as far as South "Mill Lock." On a show of hands there were three votes for and three against the proposal.

2692. What is the general character of the complaints; have they generally reference to the foul state of the river and the bad sanitary state of some part of the town?—They are principally as to local nuisances.

2693. In all cases they refer to some sort of local nuisance?—Yes. The old river at the mill tail is a very shallow stream, and several sewers are discharged there, and when there is a very short supply of water no doubt a nuisance occasionally arises there.

2694. As you have no power as a highway board to initiate proper works for the future prevention of that kind of thing, you are simply doing that which will require to be done over and over again. I assume that if your board complied with any of the requisitions, or set themselves to work to remedy the nuisance, it would be as bad as ever in a few months?—No doubt, and it would require removal again.

2695. It is a sort of up-hill work which will never end?—No doubt, so long as the sewers discharge there, there will be an accumulation.

2696. (*Professor Way.*) I suppose that small nuisances leading to complaints are not discussed and entered in your book?—Just so.

2697. Your book merely refers to matters of importance?—Yes, which are brought before the board. No doubt a great many of the small nuisances are obviated by the inspector.

2698. Then the general tenor of the book which is before you will be of the nature of important nuisances, and I suppose principally regarding the state of the river?—Nuisances which the inspector did not feel himself competent to grapple with without instruction from the board.

2699. (*Mr. Harrison.*) Without going specially into each case, will you mark the number of cases which you have taken out to bring before this Commission since the last date which you have mentioned?—I have not gone carefully through them. There was another proposal for dredging the bed of the river in October 1864. Steps at that time, I believe, were taken to remove accumulations. It is only in certain parts of this river that those accumulations form.

2700. From that time to the present have the complaints been numerous?—No; several of these cases are a further consideration of the same complaint. I do not think that since that time there have been more than three complaints made to the board as to the state of the river.

2701. (*Chairman.*) May we take it that your highway board has done all that they could within their legal powers?—I think that they have strained their powers.

2702. What number of members generally attend?—Six.

2703. How are they appointed commissioners; is there a qualification?—It is an annual appointment and they must be householders.

2704. Are they elected?—Yes; on the 25th of March.

2705. Are they elected by voting papers in the same way as the board of guardians are elected?—No, they are nominated in vestry.

The witness withdrew.

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Mr. W. Gee.

14 Dec. 1866.

MR. JAMES ODAMS (Bishop Stortford) examined.

Mr. J. Odams.

2706. (*Chairman.*) How many years have you known Bishop Stortford?—About 27.

2707. Do you reside in it or near it?—I reside in the parish.

2708. Are you a member of the highway board?—I am not.

2709. Has there been any reason why you should not have been so; have you not chosen to act, or have the electors not chosen to appoint you?—They have not chosen to appoint me. I think that perhaps had I put myself forward I might have been appointed, but my business occupations take me so much away from the town, that I could not very well devote the time to it.

2710. Have you noticed the state of the river during the period that you have lived in Bishop Stortford?—I have.

2711. Is its present condition better or worse than it was when you first knew it, as regards foulness?—I think that in the summer and autumn months the state of the river is decidedly worse, and must be of necessity

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worse than it was some few years ago, when I first knew it.

2712. I assume that there has been an increase of population in the valley?—There has not been a very great increase of population in the valley that I am aware of.

2713. What has occurred to cause the river to be in a worse condition that it was formerly?—The increase of sewage matter thrown into it from the drainage of houses into the stream.

2714. In former periods, I suppose, houses were not drained, and the filth lay around them, or in cesspools, but now they are drained and the drains end in the river?—Yes.

2715. And that has caused the extra pollution of the river?—No doubt of it.

2716. What is the character of the land below on either or both banks of the river?—It varies; there is some very good rich alluvial soil, and there is gravel very near.

2717. Is there any land upon which the sewage of the town could be beneficially applied?—I have no doubt that sewage may be beneficially applied to almost any description of land.

2718. Are there any parts of the town with which you are acquainted where there are nuisances existing such as at Providence Terrace?—I know Providence Terrace.

2719. Is there any cause of nuisance from that terrace?—Occasionally in the summer months. As I have walked from the town to my house, I have noticed an unpleasant odour from the drain which runs across the road to the river at that spot; and the drainage is from the Providence Row Cottages.

2720. What is that drain made of?—I believe that it is a wooden trough drain.

2721. How many houses constitute Providence Terrace?—Eleven.

2722. Does the sewage generally in the vicinity of the river, above and below, get into it in one way or another from houses and villages and places along the river?—I think so, from the whole valley of the Stort, but it does not do so immediately, it percolates through; but I have no doubt that it gets into the river.

2723. Have you taken any part in the movement for the adoption of the Local Government Act?—Not any active part.

2724. Have you considered the question as to whether it would be beneficial or otherwise?—Yes; I decidedly thought that it would be beneficial, rather than that we should be under the superintendence of a board of guardians who reside some distance from the town.

2725. Are you a ratepayer in Bishop Stortford?—I am.

2726. Then if any money is expended and if any rates are levied you will have to pay your share?—Unquestionably.

2727. And I suppose that you have not the slightest desire that there should be any unnecessary rating?—Certainly not.

2728. Have you seen at any time land under sewage irrigation?—Yes.

2729. Where?—I have seen the Craigentinnie meadows at Edinburgh; I have seen the Carlisle works, and I have seen a portion of the Croydon works.

2730. I suppose that at the Craigentinnie meadows you saw Italian rye-grass being grown?—I do not know that I saw Italian rye-grass. I saw a very coarse description of grass, but it was not the true description of Italian rye-grass.

2731. And at Carlisle you saw certain meadows irrigated, and cattle and sheep grazing?—Yes.

2732. What did you think of the grass there?—The grass was very coarse. I believe that it answered the purpose as far as the grazier who hired the land was concerned; but I think that the odour arising from the works was rather objectionable at Carlisle.

2733. Do you think that it was the odour from the sewage or from the proprietor's patent carbolic acid?—It was from a combination of the two, I should think.

2734. The person there professes to use carbolic acid to disinfect the sewage?—Yes.

2735. Have you ever been upon the ground after the sewage has been applied; have you smelt anything disagreeable after the application?—I have not been there immediately after the application, and therefore I have not smelt it. I am told that the inhabitants of Portobello at the present time are very much complaining of the nuisance from the irrigated meadows in the neighbourhood of Leith.

2736. That is near Edinburgh?—Yes.

2737. (*Mr. Harrison.*) When you were there did you go over the irrigated meadows?—I went over the irrigated meadows near to Leith. Not those running to Portobello. There are two portions of irrigatated land. I went over the irrigated land near to Leith. I saw the proprietor, Mr. Scurwin, who has been farming there for many years, and on that morning he had let one acre of his land for 27*l.* 10*s.*, and I was very forcibly struck with the enormous rental.

2738. (*Professor Way.*) Was that the rental of the grass?—Yes.

2739. That is to say, that the person to whom he let it had to take it away?—Yes.

2740. (*Chairman.*) That would be a Scotch acre, which is about one fourth larger than ours?—Yes.

2741. (*Mr. Harrison.*) Did you perceive the condition of the ditches on those irrigated meadows?—Yes, I noticed the ditches. Plots of land intersected the ditches, so that the sewage was put on upon every alternate day, or whenever they thought proper to put it on.

2742. When you visited the property, did you observe any of these ditches with stagnant sewage in them?—No.

2743. Did you perceive any smell when you visited the land?—None at all.

2744. If you had visited the meadows below towards Portobello you would have noticed many ditches which are large, and in which the sewage is allowed to stagnate, and I am satisfied, from inspection, that the nuisance from those irrigated meadows chiefly arises from the stagnant sewage?—I did not visit those meadows.

2745. (*Chairman.*) When you visited Carlisle do you think that you had anything more offensive than you have in an ordinary farmyard?—Decidedly so.

2746. When were you there?—I think that it was three or four years ago.

2747. The proprietor professes to make no stink at all except in his patent carbolic acid?—I believe that he does not.

2748. (*Mr. Harrison.*) When I was there I was particularly struck with the decided absence of smell. Whether the operation was a beneficial one or otherwise in other respects I will not speak so decidedly upon, but so far as the degree of odour from the works went, I thought that the absence of it was carried to a very great extent?—I certainly perceived a disagreeable smell.

2749. (*Chairman.*) When were you at Croydon?—It was three years ago. They had not carried out the plan in perfection there.

2750. Was it at Croydon or South Norwood that you saw the irrigated land?—It was at Croydon.

2751. (*Professor Way.*) I suppose that the power of the soil to deodorize sewage has its limits, and that you may put on so much sewage that the soil has not power to deodorize it all?—I of course bow to your superior judgment; but I should think that some soils would absorb almost any amount of sewage, but of course there must be a quantity running away.

2752. Supposing that the quantity of sewage put on at Edinburgh was more than in proportion to the area of land devoted to it, would not what I suggest be the case?—Yes.

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2753. Possibly it is not necessary to repeat at other places what is done at Edinburgh, where comparatively few acres of land take the sewage of a very large population, and therefore that would not be any guide. We are accustomed to say that Edinburgh shows what can be done, but that it is far from a place to be imitated?—Quite so.

2754. And that the evils of the sewage application there need not be necessarily repeated in any other place, and that therefore it is possible to deal with sewage in other places without any such evils, and that it is done?—Yes.

2755. The case of Edinburgh is one for the enemies of sewage irrigation, and not for its friends?—I think that it has a great many friends there in consequence of its success.

2756. (*Chairman.*) Do you know that one element of the dissatisfaction of the people in the neighbourhood of those meadows is that the proprietor is an Englishman?—I was not aware of that.

2757. The most searching examinations and inquiries have been made in the neighbourhood of those meadows by constituted authorities; for instance, there are some large barracks there?—Yes.

2758. And examinations were made by the War Office authorities, and the result was that it was found that the troops in those barracks had better health than in any other barracks in Scotland, consequently the accusation that the sewage caused ill health fell to the ground. I know that to be the case, because I was a member of that War Office Committee?—It is very satisfactory to hear that statement.

2759. (*Professor Way.*) Supposing that it is made incumbent upon this town of Bishop Stortford to divert its sewage from the river Stort, and so from the river generally, which plan would your experience (having seen these places) dictate to you, the plan of precipitation of the sewage or the plan of direct application to the land?—The plan of direct application to the land decidedly. I think that you had a statement in the evidence given by Mr. Hunt this morning, who told you that the effluvium from the precipitation at Hertford is very noxious, and that therefore the water of the stream must be polluted again.

2760. Have you ever seen the precipitating works?—No.

2761. Would you be surprised to learn that it costs the people of Luton between 400*l.* and 500*l.* a year for precipitation?—And when the precipitate is thrown down it is not worth carting away.

2762. (*Mr. Harrison.*) They get something by it?—I should think that it is very trifling.

2763. (*Professor Way.*) At any rate they are at the expense of 500*l.* a year over and above what they get?—Yes.

2764. (*Chairman.*) Anything which you precipitate out of washed sewage is of course of secondary importance for agricultural purposes?—Yes; there is so little of fertilizing power left after the liquid has been removed, and in a commercial point of view it is a great loss to attempt to precipitate it.

2765. At Luton they get about seven tons a day of solid matter, taking six days in the week, which comes to an enormous weight of material, and that is principally road grit. They get nearly weight for weight out of the filter beds, but they put it upon the roads to make the roads, in the shape of stone?—I think that we should be a good deal troubled by that here. I think that there are many people here who have a prescriptive right to drain into the river. If I understand the drainage of Stortford aright, the new drains are only enlarged old ones.

2766. Is there any further information which you can give us?—I think not.

The witness withdrew.

Mr. J.P.Davis.

Mr. John Poole Davis (Bishop Stortford), examined.

2767. (*Chairman.*) You are surveyor of the Stort navigation?—I am.

2768. For what length is the river Stort navigable?—13½ miles.

2769. Where does it commence, and where does it end?—The springs which form the source of the river commence about five miles above Bishop Stortford, in the neighbourhood of Elsenham.

2770. And it is navigable to what point on the Lee?—It forms a small stream till it gets to Stortford. It is navigable from Stortford to a place called Field's Weir, near Rye House, on the Lee.

2771. The navigation begins at Stortford?—Yes.

2772. What number of locks have you in that length?—Fifteen.

2773. What is their fall?—They average about six feet. The whole fall is about 90 feet.

2774. What tonnage can you get up that navigation?—In ordinary times we carry from 45 to 50 tons. It depends upon the supply of water.

2775. Have you any idea what tonnage goes up and down in a year?—Up and down our tonnage reaches nearly 60,000 tons.

2776. Is your navigation a separate navigation from the Lee?—Yes, it is a separate property. The Lee is a trust, and the Stort is private property owned by individuals.

2777. Is it a company?—It is a firm.

2778. Consisting of how many?—There are five persons in the firm.

2779. Is it under Act of Parliament?—The firm who have it now foreclosed a mortgage which they had upon it, so that they got it for a small sum, which is no criterion of the value of the property.

2780. How long have they had it in their possession?—About 12 or 13 years.

2781. Do you know what the amount of the mortgage was?—40,000*l.*

2782. For what length of time has the Stort been navigable?—It was commenced in 1766 and was opened in 1769.

2783. Do you know who was the engineer who formed the navigation; was it Smeaton?—No. I have not his name at this moment.

2784. Do you know whether Smeaton ever reported upon it?—I do not know. I have only been connected with it for ten years. He may have done so in the earlier part of it.

2785. In what condition is the navigation now as regards its locks and permanent works; are they in a pretty good condition?—They are in a very fair condition.

2786. Have you spent much money upon it recently?—A great deal of money has been spent upon it in the last 10 or 12 years. This is a plan of the drainage of Bishop Stortford (*producing the same*). A great part of the drainage runs into the river before you come to the navigable part.

2787. You have been connected with the navigation for ten years?—Yes.

2788. Is the pollution any greater now than it was when you first knew it?—Yes, considerably greater.

2789. At what points?—We have had two new drains made into the navigation during that time. One of those drains carries all the drainage from the union, and another drain brings the drainage from New Town, and they have added very considerably to the quantity brought into the river.

2790. As surveyor to the owners of the navigation, have you any power to stop drains being put in?—We have no power which we can act upon. The power is very ill defined. We have on all occasions

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protested against drains being put in, and we have been in communication with the East London Water Works Company to try whether they would aid us in mitigating the evil, but they felt a difficulty in doing so, their Acts are not sufficient.

2791. What is the date of your oldest Act?—We have only one Act, and it is the 6th of George the Third, chapter 78; it was passed about the year 1765.

2792. Have you any dredge boats on the navigable part of the river?—Yes, two.

2793. What do you do with the material which you dredge?—We generally get rid of it to the farmers, some of them take it and spread it on their land, and find it very beneficial, and others dislike it.

2794. It breeds weeds, I suppose?—If you lay it in a heap it will breed weeds just as farmyard manure will, but not if you break it up.

2795. Have you any fish in the navigable portion of the river?—Yes, we have a very great many fish.

2796. Is the river affected by floods to any extent?—We have many floods, our highest floods rise from two to three feet, and they now go off very quickly; there is a system of drainage everywhere; they are more rapid than they used to be, and we get rid of them sooner.

2797. When a flood is at its height does it stop the navigation?—Yes, it stops it for a time.

2798. What distance on either side of the navigable portion of the river belongs to the proprietors of the navigation; do the towing path and the line of water alone belong to them, or have they any further right?—Generally our right only consists of the towing path, 14 feet from the edge of the river; we have much land belonging to the property.

2799. You have separate land belonging to the property?—Yes.

2800. Do you claim to have the right of soil of the bed of the river?—No; we can deepen and scour.

2801. Does it belong to the landowners?—It is supposed to belong to the landowners and the millowners, and so on.

2802. Do the mills belong to the proprietors of the navigation?—No, they existed before the navigation was made, so that the water was always dammed up.

2803. Can they interfere with your navigation; can they pull the water down when you want it?—Yes, and they interfere with us a great deal. We constantly have differences with them about their lowering the water so as to obstruct the navigation.

2804. Does that lead to lawsuits?—We have not been to law, we generally settle those matters amicably.

2805. If you can?—If we can.

2806. Your experience is that you are getting the river fouler than used to be the case?—Yes, in the neighbourhood of Bishop Stortford.

2807. In summer is it sufficiently foul in hot and dry weather to create an offensive smell?—Yes, very offensive.

2808. Do the boatmen ever complain of it?—Yes, all of them; it is very offensive.

2809. Is it offensive when you are dredging it?—Yes, in the neighbourhood of Bishop Stortford. In the very hot weather the sewage rises to the surface, and floats down the river.

2810. It ferments, and comes up in bubbles, and forms a scum on the surface?—Yes, we find that to be the case seven or eight miles down the river, before it is lost.

2811. Are you troubled at all with floating carcases of dogs and cats which are thrown in to be drowned?—Yes.

2812. Does the navigable portion of the river flood the valley on either side during floods?—Yes, the water overflows the valley on each side.

2813. Do your locks, tending to pond up the river water, flood any portion of the valley?—No, above the locks we have floodgates.

2814. At what height do you keep the water as compared with the adjoining land in the flattest parts of the valleys; have you not sometimes your water nearly up to the grass surface?—We regulate our water by the height to which the mills originally dammed up the water, the overshot fixed at that time formed the head of the water mark. Our rights to the water are limited, the mills having a prior right.

2815. Do the men who navigate the river use the water for cooking and cleansing?—They do in the lower parts of the river, but not in the neighbourhood of Bishop Stortford. Besides those at Bishop Stortford there are three drains into the river at Sawbridgeworth.

2816. Have you any list of the mills which there are upon the stream connected with your navigation?—Yes.

2817. Do you remember what their nominal power is, and what they do?—I do not, they are continually altering their power; we know the fall, and so on.

2818. Is the entire fall made available at one point or another all the way down, as far as your navigation goes?—No, we have 15 locks and only 11 mills.

2819. Then you could establish four more mills?—Yes, but we would much rather do away with those which exist than establish any more.

2820. (*Mr. Harrison.*) Have those four mills been purchased by the Canal Company?—No. In making the canal the length of water could be more cheaply dammed up by having additional locks.

2821. (*Chairman.*) Is the navigation fed by any considerable springs during its length which is navigable?—Yes, we have springs coming in all directions; there are very considerable springs about six miles down.

2822. Have you much more water coming down the river than is absolutely required for navigation purposes, and flowing to waste?—Yes, we have a good deal more than is required for navigation purposes. The mills are working constantly as long as they can go, very often night and day, and in addition to the water which they use we pass through from 800 to 1,000 barges each way in a year.

2823. And each barge takes its lock full of water?—Yes.

2824. And one lock full of water goes through the entire navigation?—Yes.

2825. Have you any side ponds to save the water?—No. We should be very glad to have them to save the water, but the works have been made in an economical manner.

2826. Have you any double locks?—No.

2827. If your trade increased you would consider them desirable?—Our trade has increased very considerably, but the increase has not been sufficient to cause us to make double locks yet.

2828. Have you felt the effect of railway competition?—For some years after the railway was opened the traffic upon the canal very much decreased, after that it took a turn, and in the last 11 years it has been increasing every year.

2829. What do you principally carry upon the navigation?—We carry corn, building materials, coals, and flour. We carry manure free of toll for the benefit of the farmers and landowners.

2830. Are you obliged to do that by your Act?—Yes. We also carry a great deal of artificial manure, such as oilcake and sundries.

2831. (*Professor Way.*) Do you carry timber?—Yes, a great deal of timber.

2832. (*Chairman.*) And malt?—Yes. We carry nearly 600,000 sacks of flour and corn in a year.

2833. What is your tonnage rate per mile?—We have no barges of our own. We only charge a toll upon the barges as they pass, and our average toll is about 9*d.* a ton.

2834. Is that for the entire navigation?—That is for the entire Stort navigation, and the river Lee trustees charge a further toll to London.

2835. Does that toll apply to boats, whether they traverse only a portion of the navigation or the whole of it?—No; the rates are proportioned according to the distance.

2836. Is your lock where you regulate the toll near the junction with the Lee?—Yes, it is the second lock from the Lee.

2837. What draught of water have you throughout the navigation?—About three feet six is the average depth.

2838. What are the dimensions of your locks?—They vary in length. They vary from about 104 feet to 90 feet, and they are 13 feet 6 wide.

2839. Then the barges, I suppose, are 13 feet barges?—The barges are about 78 feet long, and about 13 feet 1 inch wide.

2840. Are any of them worked by steam power?—No; they are worked by horse power.

2841. You say that your proprietors have no barges of their own?—They have not any.

2842. Have you ever tried steam upon the river?—No. We have hired steam dredging machines.

2843. But you have not had steam barges for towing purposes?—No.

2844. Have you seen any of the steam barges upon the Aire and Calder navigation?—No. I have seen them upon the Lee and upon the Thames.

2845. What is the ordinary width of your river?—It does not average much more than 35 feet. It is rather narrow for anything of that sort. There is no doubt that that is a very economical way of working barges, if you have room.

2846. At what velocity are the barges generally taken?—About two miles an hour.

2847. If you propelled one of your laden barges at the rate of four miles an hour, I suppose that it would give a great scour to the river?—Yes, it would injure the banks.

2848. And in some instances, I suppose, it would ground the boats—it would throw the water out of the river?—Yes. We have an advantage over the railway company in carrying malt, which is the great staple of this neighbourhood, because malt is a thing which, by friction, decreases in quantity. There is a saving of about 1½ per cent. in carrying malt by water.

2849. That is to say, the motion in loading and unloading and the jarring friction upon the railway would cause malt to weigh less by 1½ per cent. than in carrying it quietly by a barge?—Yes. Many of our malthouses are upon the banks of the river, and the malt is sent to the breweries on the banks of the Thames, so that a sack of malt has only to be lifted into a barge, and it remains quiet till it is taken out in London.

2850. Do you bring many coals up?—No; our trade in coals decreases as the railways get into the coal districts, but we have a certain trade still. Sometimes when freights are low we get more coals, and so on. Of course they come from the Pool. They are all the north country seaborne coal.

2851. Do you think that any plan might be devised for purifying this water more than it is purified at present without injuring the navigation?—My opinion is, that if the sewage of the towns upon its banks were not allowed to flow into the river there would be nothing to complain of. There is no hope for the river in any other way.

2852. It is the sewage which causes the mischief?—Yes, particularly the sewage of Bishop Stortford.

2853. How many bankmen have you upon that length of river?—We have about eight lockmen, but then we have a number of labourers.

2854. They keep the towing path in order?—Yes. The number varies.

2855. They move about?—Yes.

2856. What do you repair the surface of the towing path with; do you at all form the surface upon which the horses travel with gravel and broken stone?—Yes. We use unscreened gravel just as it comes from the pit.

2857. Do you get any gravel from the bed of the river?—Yes, occasionally, but it never binds; it is always loose.

2858. Because it is washed?—Yes.

2859. It has not sufficient loam in it to bind it?—No.

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2860. Have any proprietors upon the river a right to dredge or to take material out of the river for their own purposes?—We always take out what we like.

2861. But do any of the owners of property do so?—No. No one else has claimed that right for many years, but our Act of Parliament does not say that we have any right to the bed of the river except for scouring and deepening.

2862. It only gives you a right to the navigation?—Yes.

2863. (*Mr. Harrison.*) We may take the locks to be about 100 feet long and 13 feet wide in round numbers, and the fall of the locks to average about six feet?—Yes.

2864. That would be in round numbers pretty nearly 50,000 gallons each lock full?—Yes, we average them at about 50,000 gallons.

2865. For a lockful of water, what do you pay the miller?—By the Act of Parliament we pay him 6*d.* For this he is required to open the lock on payment of 3*d.* for a lockfull of water, and 3*d.* is paid him for opening the lock itself.

2866. You have said that he gets 5*d.*, and that you have a penny for passing the barges?—Originally by the Act they took 3*d.* for a lockfull of water, and 3*d.* for opening it. By long usage they have got into the habit of taking the whole 6*d.*, and finding it more easy to take it by means of our lockmen than to send their own men to take the toll, they have adopted the plan of allowing the lockmen a penny in the 6*d.* for collecting this amount, so that they only get 10*d.* out of the shilling, but still they get 4*d.* more than the Act intended that they should get, unless they opened the locks.

2867. But in effect they get 5*d.* for each lockfull of water?—Yes.

2868. And for a barge going the length of your canal you have to pay 5*d.* at each of the fifteen locks?—One mill does not charge at all, there is 5*s.* each way paid.

2869. And the millowner gets 60 pence?—Yes; he gets the whole amount, and the terms which he makes with the lockmen whom he appoints for collecting the money are a private arrangement.

2870. You pay 1*d.* for 10,000 gallons of water?—Yes, a penny and a fraction, but according to the Act the payment should be only 3*d.* for 50,000 gallons.

2871. Have you the power of taking all the water, supposing that the traffic increased to such an extent as that you required it?—Yes.

2872. Could you by paying that rate per lockfull divert the whole of the water from the mill premises of the valley?—There is no doubt we could. The miller is bound to open the lock when a barge arrives there, under a penalty of 20*l.*, and no limit is placed to the number of barges, so that I apprehend that we could take the whole of the water if it were necessary.

2873. Making a payment to the millowner?—Yes, 3*d.* per each lock.

2874. (*Professor Way.*) In case you come to loggerheads with the millers you could not keep running the barges up and down?—No. A court of equity would no doubt prevent that.

2875. (*Mr. Harrison.*) For getting a boat down and back again, you pay 2*d.* per 10,000 gallons?—One and one fifth of a penny each way.

2876. You mentioned that a number of these sewers (*pointing to the map*) had been put in of late years?—Two of them.

2877. You heard Mr. Odams mention just now, that he claimed for the inhabitants of Bishop Stortford some vested rights, do you think that they would have any vested right in these new sewers?—I should say that they would have a vested right in the old sewers, but not in the new ones, and therefore when the new sewers have been put in we have protested against them.

2878. Besides these new sewers which are put into the river, is there not a considerable scour washed down from the soil into the basin of the river?—A great deal

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is washed away from the banks; the banks are continually wasting, so that a great deal of soil gets in in that way.

2879. Have you any account of the number of tons, much you have dredged out in past years, has it been an increasing quantity of late years?—The firm who now own the navigation have only had possession of it for about 12 years, which is hardly long enough for comparison. It depends very much upon the season; if we have a rainy season, we take very little out; if we have a dry season, we are obliged to take a great deal out.

2879*a*. That would rather point to its being to a great extent the sewage matter which you have to get out, is that so?—We always find that there is an accumulation at the mouth of the sewers, and we find that at Bishops Stortford it fills up much more than at any other part of the river.

2880. (*Professor Way.*) You have mentioned that there is a decrease in the quantity of the malt by carrying it by railway?—Yes, in the measurement by the bushel.

2881. That does not mean by weight?—The lost particles of malt diminish the weight.

2882. Do not they remain in the bag?—Yes, but they are not used in making beer.

2883. Does the malt sell for less money?—Yes.

2884. Practically you know that that is the case?—I have been so informed by maltsters in a large way of business. Some maltsters make the difference the amount of the rent of the malthouse, and others say that it is about 1½ per cent. The ordinary load of one of our barges is 600 sacks of pale malt, or 800 sacks of brown malt. The loss in this quantity if carried by railway would be nine sacks of pale or 12 sacks of brown malt, when the malt passed the meters in London.

2885. From what does it arise?—It is from the carting of it into the station, and the shaking of it in the train, and its being carted again.

2886. (*Chairman.*) You have been asked with regard to the quantity of the dredgings which you have taken out of the river; has the same amount of power been used within the last two or three years, between the town of Stortford, and the South Mill as has been used in previous years; have you used the same exertions to cleanse the river between those places recently as you have hitherto done?—We keep an account of the quantity taken out of the river, but it is very difficult to answer a question of that kind in a general way. If you asked me the difference between the quantity taken out in 1855 and the quantity taken out in 1865, I could, perhaps, state it from my books.

2887. But you can state whether your expenditure between Stortford and South Mill in the last three years has been as great as, or greater, than it was previously?—I should say that in the last three years we have not taken out so large a quantity as usual.

2888. But you have been understood to say, that the sewage of Stortford has very much increased?—The town has had it under consideration on several occasions lately to clean the river in the neighbourhood of the town itself, and on one or two occasions I believe it has been ordered to be done, but has been postponed, and that has rather hampered us in our arrangements; besides which, as the town has insisted upon putting drains in against our protest, we have felt it desirable not to do work which we should do under other circumstances.

(*Mr. Miller.*) Mr. Davis will bear in mind that the highway board have requested applications to be made to the navigation company as proprietors to assist them, which applications they have resisted from time to time.

(*Witness.*) We protest against these new drains, and they keep insisting upon putting them in, and then they ask for 100*l.* from us to take the deposit out of the river again.

2889. (*Chairman.*) We have this broad fact, that the sewage gets into the river, it causes a nuisance, it occasions a deposit, and the river people have more or less to take it out?—Yes.

The witness withdrew.

Mr. W. R. Hawkes.

Mr. William Robert Hawkes (Bishop Stortford) examined.

2890. (*Chairman.*) You are a maltster and brewer?—Yes, and a wine and spirit merchant.

2891. Where is your brewery situated?—In Water Lane, Bishop Stortford. It is sometimes called Back Lane.

2892. What quantity do you brew?—From 8,000 to 10,000 quarters.

2893. Where do you obtain the water for brewing?—From an artesian well on the premises.

2894. Does that artesian well go into chalk?—Yes, ultimately into chalk.

2895. Of what depth is it?—210 or 220 feet.

2896. Is it truly artesian, does the water rise above the surface?—It is not truly artesian.

2897. It is a bore hole with a well on the top of it?—I should think so; it was made many years ago, before I was connected with it, and therefore that is a question which I cannot answer, but I understand that in a well which is strictly artesian the water flows to the surface, and over the surface from the orifice.

2898. What volume of water per day do you pump from your well?—I cannot answer that question. When we are refrigerating, for instance, probably three barrels a minute would pass through.

2899. How many gallons are there to a barrel?—Thirty-six.

2900. (*Professor Way.*) That is for the surface refrigeration?—By passing cold water.

2901. By pipes?—Yes.

2902. (*Chairman.*) Is the water good water for your purposes?—The water is hard, but there is a difference of opinion, which has been expressed here to day, amongst brewers and others, as to whether hard or soft water is better or worse.

2903. Does not it rather more depend upon what you want to brew; whether you want to brew dark coloured ale or light coloured ale?—I have no doubt that soft water would extract more colouring matter than hard water.

2904. Is not the Burton water hard?—I suppose so.

2905. What number of men do you employ upon the premises?—From 30 to 40 of all grades.

2906. Have you privies?—There are two privies; they adjoin.

2907. Where does the refuse from the privies go?—Into the river.

2908. Have you many horses?—Yes.

2909. Does the drainage of the stables go into the river?—No, I should think as a rule not; some of it undoubtedly does.

2910. Where does the waste water from cleansing the utensils and barrels go?—It goes entirely into the river, but you know what the nature of that cleansing is.

2911. Do you cleanse a great many of the barrels by steam jet?—No.

2912. Is not that process used as a cleanser and sweetener?—Yes; we use it in some cases, but as a rule we do not make use of that apparatus.

2913. Have you formed any views of your own as to what should be done with the river to purify it?—I can scarcely say that I have. No doubt, from the refinements of modern civilization, which have resulted in the watercloset system, the river is worse than it was from more of the excrement getting into it; but what is going to be done with the river

I cannot say, and I have not gone a great deal into that question.

2914. Do you carry principally upon the river or upon the rail?—We principally carry by means of our own horses and waggons.

2915. You do not export?—No, not to any extent.

2916. (*Mr. Harrison.*) In pumping the water from your well, is the quantity which it delivers from the bore holes such that your pump does not much alter the level of the service?—That is a question which I cannot answer; it is all covered in.

(*Mr. Nash.*) When it was first done we could not lower the spring by applying three different appliances; there were hand pumps.

2917. (*Mr. Harrison, to the Witness.*) At what height below the surface of the ground did the water stand in the ground when the spring was first tapped?—When the well was made it was dug down into the chalk, and a seven inch cylinder was let down, and when they cut off the smaller cylinder the water flowed into the larger cylinder which we call the well. When the pumps were applied to it, we could not reduce the head at all, it was an immense quantity of water.

2918. What height was it?—It was about 20 feet below the surface, but that is not very much from the level of the river.

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2919. (*Chairman.*) What was the size of the bore hole by which the water came up from the chalk?—About nine inches, but I am not sure about that.

2920. You are sure that it comes from the chalk?—Yes; I should think that it is about 150 feet in the chalk.

2921. (*Mr. Harrison.*) Do you know the level at which the water stands in that well at the present day, as compared with what it stood at after the completion of the works?—No, we have had no opportunity of judging of that.

2922. (*Chairman.*) For anything which you know, I suppose that it is at the same level as when you first started it?—Yes, as far as we can judge.

2923. (*Mr. Harrison.*) The information which we have had to-day would go to show that it probably might stand at a lower level than it did?—Possibly it may.

2924. (*Professor Way.*) At what depth were your pumps put?—I do not recollect now, but we have never had anything like a deficiency of water since we have had that well.

The witness withdrew.

Mr. G. Perry.

Mr. George Perry (Bishop Stortford) examined.

2925. (*Mr. Harrison.*) You are the manager of the gasworks in Bishop Stortford?—Yes.

2926. How long have you been so?—About 24 years.

2927. How long have the gasworks been established?—Since 1835. They have been twice enlarged during my supervision. They are situated at the south end of the town on the banks of the river Stort. I should think that the site is about one third of an acre.

2928. Is there any refuse from the gasworks which passes into the river?—None whatever; we have not a single drain at this time communicating with the river, neither have we had a foul water drain communicating with the river in the last nine years. I had it nine years ago, but in consequence of the frequent complaints of persons living on the banks using the river, and other persons, I cut it off, since that time I have evaporated the foul water under the ashpans.

2929. So that now you can positively state that no foul matter passes into the river from your works?—None whatever, except what is occasioned by the ordinary rainfall washing our premises. It is impossible to keep the yards and places exempt from ammonia, and when there is a rainfall a small quantity of the surface water will find its way down into the river. If we turned the ammoniacal liquor into the river and had a disposition to conceal it we could not do so, because it would be patent to everybody who passed by us. If the waste was turned into the river it would render the water from the works opaque all the way down to South Mill. If you take a tumbler of clear water and only take a straw and dip it into ammonia and put it into the water it will become opaque.

2930. All the products of your gasworks are now so valuable that there is an abundant demand for them, and you dispose of them?—We find it rather an expensive thing for us to store the ammoniacal liquor. We, of course, store our tar as much as we can. A great deal of it is used for rough buildings and agricultural buildings.

2931. (*Professor Way.*) And for boats?—Yes, some of it for boats, but the great bulk of it is taken away for making creosote and other articles in London.

2932. (*Mr. Harrison.*) When it is used on boats, is it not mixed with pitch?—I think that it is rather mixed with Stockholm tar.

2933. Would it be liable to defile the water?—Whenever the vessel passes up and down the river it breaks out in a few illuminated particles on the top of it, and that is the result.

2934. Then you think that any person observing that kind of thing upon the river might mistake it as coming from your works, whereas it possibly comes from a barge?—Yes.

2935. (*Chairman.*) What number of retorts have you now?—21 at work.

2936. What is your make of gas?—About 6,000,000 cubic feet in a year.

2937. What weight of coal do you use?—About 600 tons.

2938. At what price is gas selling here?—5*s.* per 1,000 cubic feet.

2939. For private consumption?—Yes.

2940. And are the lamps by agreement?—Yes, 3*l.* 6*s.* 8*d.* a year each, the company supplying the lamp and keeping it in order, and lighting it and putting it out.

2941. And do you supply the post?—Yes. That I believe is a cheaper rate than gas is supplied at under similar conditions in any town in England, or in any town in this part of the country.

2942. The gasworks belong to a company?—Yes.

2943. (*Professor Way.*) That is 5*s.* a head upon the population for that quantity of gas?—Possibly so.

2944. (*Chairman.*) I assume that gas is used very largely in the malthouses?—No, it is only used for the purpose of lighting.

2945. (*Mr. Harrison.*) From what quarter do you get the coal?—From Newcastle.

2946. How is it brought?—By the navigation.

2947. It is brought to London and up the canal?—Yes.

2948. What is the price of coal now as compared with what it was when you first were manager of the gas works?—I do not think that we are paying as much for it now as we did by 4*s.*

2949. Do you give the railway company credit for that reduction?—I do not know; I think that the

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price was reduced before the railway came into operation.

2950. What is the price now per ton?—About 16*s.* 6*d.* in the river. I refer to the price in London.

2951. What is the price of coal now in Bishop Stortford as compared with what it was when you first became manager of the gasworks?—I do not recollect what it was, but my impression is that it is not more than 4*s.* less.

2952. (*Professor Way.*) You have been manager of the gasworks for 24 years?—Yes.

2953. At what time did you begin to preserve the tar; you, I suppose, threw the tar into the river at one time?—It never found its way there unless it was once by accident; it has been most carefully preserved. I myself have sold a barrel of tar for 12*s.* 6*d.*

2954. What does a barrel weigh?—It contains about 28 gallons.

2955. We hear that a ton is worth about 1*l.* in the north?—I have sold three gallons of it for 1*d.*

2956. In other rivers the tar was thrown into the river, after an Act was passed to prevent it?—I should think not, because it was of such great value.

2957. But possibly you had a consumption for it; did you at any time throw it in?—We never did.

2958. (*Chairman.*) Had you a sale for it when you were first connected with the works?—Yes. I think that there is evidence from the gas company's books which will show that the tar has been sold for 12*s.* 6*d.* a barrel.

2959. What do you get per ton for your coke here?—We sell it by the chaldron, 12*s.* a chaldron.

2960. Have you a ready sale for all that you make?—Yes, a very fair sale.

2961. Do you use most of it for your own purposes?—We use fully one third of it.

2962. Then you have two thirds for sale?—Yes.

2963. What dividend is your company paying?—We have paid 7½ per cent. for the last three years.

2964. (*Professor Way.*) Do you get any of your coal by rail?—No, except in one instance.

2965. Do you think that you could get it cheaper if you contracted to get it by rail?—I am not aware of it.

2966. (*Chairman.*) The canal company puts your coals alongside your yard, you have a wharf alongside the side of the river?—Yes, our works are better adapted for the reception of coal by water than in any other way.

2967. Is there anything farther which you wish to add?—Nothing, except that I hope that every publicity will be given to my declaration, and I almost wish that I was allowed to make it upon oath, because I have been so strongly suspected and charged with foul practices upon the river. I take this opportunity of publicly declaring that we have not a single drain flowing into the river, and that for the last two months there has not been a single surface drain from our works flowing into the river, but for nine years our foul drain has been most effectually cut off.

(*Mr. Miller.*) We have an instance in our minute book of the highway board where we had to draw attention to a nuisance from a ditch from the overflow at the gasworks and which was of a most abominable character, and there is always found in the neighbourhood of the gasworks a great nuisance. I do not know how the gas company get rid of their nuisance, whether it is by absorption or by fire from the ash-pits, but we all know, living in that district, that we are very much annoyed.

(*Witness.*) When the foul lime from our works, which is strongly impregnated with sulphur, has accumulated in consequence of not being removed, a heavy rain produces a smell.

2968. (*Professor Way.*) Then you acknowledge that there is a smell, whether by your act or not?—Yes.

2969. Is it possible to make arrangements for that lime to be taken away, and if not bought for you to take it away?—We should not then go to the expense of it.

2970. (*Chairman.*) Cannot you purify it?—No, I do not like the oxide of iron.

2971. Have you never tried it?—No; the late Mr. Mr. Gripper, who was a large shareholder in the Hertford gasworks, where they had adapted their gasworks for oxide of iron, recommended me not to do it.

2972. But is his opinion to be put in opposition to the opinion of the managers of the great gasworks in London, all of whom use oxide of iron?—I have had communication with the City of London Gasworks, and there I think they use dry lime.

2973. They are all altering it into the oxide of iron?—I do not like it.

2974. Have you any children brought into your purifying house when they are suffering from croop or whooping cough?—I have only had one instance of it. A lady brought children down there about two years ago; she paid but one visit to us; she wished to be there when the purifier was opened. I did not go into the place myself, but I think it was too strong for them; they never repeated the visit.

2795. (*Mr. Harrison.*) Was that visit of any use?—I did not hear the result.

The witness withdrew.

Adjourned to To-morrow at 11 o'clock, in London.

Victoria Street, Saturday, 15th December 1866.

PRESENT:

ROBERT RAWLINSON, ESQ., C.B., IN THE CHAIR.

JOHN THORNHILL HARRISON, Esq. | Professor JOHN THOMAS WAY.

LONDON.

Mr. J. Muir.

15 Dec. 1866.

Mr. JAMES MUIR, further examined.

2976. (*Chairman.*) At your last examination certain documentary evidence was required which you promised to supply?—Yes; and the first that I promised was an abstract of analyses, by Dr. Letheby, o the water supplied by the New River Company during the year 1866. I have that abstract here, with a detailed return of the last-mentioned analysis.

2977. Have you any other returns to hand in?—Yes; I have also a statement of the quality of the Hertford sewage. A detailed analysis by Dr. Letheby has not yet been made.

The following papers were handed in:

ABSTRACT of ANALYSES, by Dr. LETHEBY, of the Water supplied by the New River Company during the Year 1866.

Month.	Amount of Organic Matter in Grains, per Gallon.	Saline Constituents in Grains, per Gallon.
January	0·30	21·10
	0·40	20·60
February	0·40	20·40
	0·40	20·80
March	0·30	19·80
	0·20	21·20
April	0·20	19·80
	0·20	18·80
May	0·20	17·60
	0·30	18·60
June	0·30	17·90
	0·20	15·90
July	0·16	17·90
	0·20	16·96
August	0·24	17·15
	0·22	16·87
September	0·52	16·80
	0·21	16·17
October	0·28	17·84
	0·31	18·56
November	0·52	20·57
	0·52	19·46
December	—	—
	—	—
Average	0·29	18·67

The samples analysed were generally described as bright and colourless.

DETAILS of last-mentioned Analysis:—

	Grs. per Gall.
Carbonate of lime and magnesia	13·26
Sulphate of lime	2·91
Alkaline chloride	1·02
Alkaline nitrate	1·97
Silica and alumina	0·30
Organic matter	0·52

The samples were perfectly bright, and free from organic tint.

QUALITY of HERTFORD SEWAGE.

The whole amount of suspended matter in the discharge of the Hertford sewers, when least diluted, has been found to be little more than 6 grains per gallon.

Precipitating by about 2 grains of lime per gallon, and filtering through fine gravel, reduced the suspended matter of the said discharge, before its delivery into the Lee, near Ware, to 2·3 grains per gallon, of which 1 grain was *mineral*, and 1·3 grain *organic*.

On the advice of Dr. Letheby (who was applied to on the subject in August last) the proportion of lime employed was increased. It is now *three times* its former amount.

Analysis by which it is intended to ascertain precisely the effect of this additional application of lime has not yet been made.

It is mentioned in the paper last handed in that the examination of the sewage took place at a time when we were using a comparatively small quantity of lime; in August last we applied to Dr. Letheby on the subject generally, and asked him what deodorizers he recommended most, and he stated that he thought we could not do better than increase the quantity of the lime, and the quantity has been increased threefold.

2978. (*Professor Way.*) You now use six grains of lime per gallon instead of two?—We are now using 7½ grains.

2979. (*Chairman.*) Have you seen the deodorizing works at Luton?—I have in a general way some time ago, but I have not minutely examined them.

2980. Have you any control at all over them?—None at all, except by way of complaint. There is that amount of control, which the company has exercised (as I explained on the last day of my examination) more than once.

2981. Your company has not in any way contributed to the efficiency of those works, nor interfered with them?—No, except by calling upon the Board of Health to do their duty.

2982. Are any periodical inspections made of them to see whether they are doing their duty?—I have sent for and procured specimens of the water as it flows from their works without their knowledge.

2983. Have you had any analysis made of those specimens?—No.

2984. Will it not be in future advisable to make periodical examinations and analyses of them, and have them recorded?—Yes.

2985. Can you form any idea as to the amount of the impurity and the kind of impurity that goes into the river at that point from Luton and all the manufactories there?—A great deal of impurity must pass into those deodorizing works, but I have had specimens taken of the water as it has flowed out of the works after being treated, and those specimens were not generally to be complained of from their appearance.

2986. Do you know of your own knowledge what weight of chemicals are used in Luton in the processes of bleaching and dyeing?—No.

2987. (*Mr. Harrison.*) I believe they adopt at Luton the same system that you do at Hertford for deodorizing the sewage?—Yes, but I understood the Chairman's question to refer rather to the impurities.

2988. (*Professor Way.*) Are you aware generally that the precipitating process only throws down the matters already in suspension, and that it does not remove the matters in solution?—I am aware that it does not.

2989. The 7½ grains of lime that you have spoken of would not be enough, I presume, to soften the water?—I think not.

2990. Consequently it is not enough to precipitate lime in solution in hard water?—No.

2991. Therefore it will not throw anything down but the suspended matters?—No.

2992. It is merely a better means of clearing the liquid?—That is all; you will see that after the

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process was conducted some time ago with a small quantity of lime, there remained but one grain and three tenths of organic matter in suspension.

2993. Which you before explained?—Yes.

2994. (*Chairman.*) Have you any control over the sewerage of Bishop Stortford?—None at all.

2995. Do you know of your own knowledge what they have been doing there recently?—I do not.

2996. Do you know that their sewerage goes into the River Stort?—I know that it does.

2997. At Bishop Stortford?—Yes.

2998. The Stort is a tributary of the Lee?—It is.

2999. Is it in any way a tributary to your supply?—Yes; but the bulk of our supply, as I have already explained, or that portion of it which we take from the Lee, is drawn above the entrance of the Hertford sewage. We have legal power to take the water from Tottenham, and we have there a steam engine, but that is hardly ever exercised; the engine has not been at work there for two years.

3000. If there is any impurity passing into the Stort at Stortford, you would get your share of it?—Yes, if we pumped at Tottenham. The chief reason for having a station there was this, in times of very hard frost it has been found that the river channel, especially if there has been a heavy fall of snow, was apt to be choked up, and of course then it would be a convenient thing to fall back upon a source so much nearer home, and pump the water into the Stoke Newington reservoir. Practically we do not use the Tottenham source of supply, and therefore we are not affected by the Stort impurities whatever they may be.

3001. Did you before state how many springs you had control over?—I cannot say whether my enumeration was complete without seeing the notes.

3002. There is a certain number of large springs which you have under your control?—We have the Chadwell spring, a natural one, and several artesian wells sunk deep down into the chalk, which I think I mentioned before.

3003. Do those wells deliver water over the surface?—None of them do. In that sense they are not artesian wells. They are only artesian in the sense of being bore holes through an impervious stratum to reach the chalk below. In some of them the water reaches within three feet of the surface.

3004. If you carried a heading up to such wells as those, you would get a flowing spring?—We should, at a sufficient depth.

3005. That, I assume, would not be a very large volume of water as compared with the entire volume that you use?—I mentioned before that the Chadwell spring had this year delivered as much as 700 cubic feet a minute; I have, since my examination here, taken the average for the year, and it may be put at 500 cubic feet a minute; that is, of the Chadwell spring. I am not quite sure of the minimum, but it is something under 300 feet a minute.

3006. And what is the maximum?—It may deliver as much as 700 cubic feet. The artesian wells, or rather these chalk wells, yield very abundantly.

3007. When they are pumped from?—Yes.

3008. Would it be possible, if sufficient cost was incurred, to bring in a volume of spring water without any surface contamination at all by separate mains and gathering conduits?—The cost would be very great, I am afraid.

3009. Putting that out of the question, and rejecting everything that might stand in the way, abolishing the navigation, and taking possession of the water and bringing it in through brick conduits, do you think you could get a supply of spring water equal in volume to what you supply now from the other conduit?—If you call the water of the streams above Hertford spring water, we could; but if you exclude the River Lee, which is at present a partially polluted stream, and exclude also the Beane, which is not quite so pure as the Mimram, I do not think that you would get the quantity that would be requisite.

3010. I assume that these streams are themselves supplied by springs, and that any contamination they receive is after they issue forth and come into the open channel?—Yes, it is so.

3011. If cost were no consideration, I assume that that spring water might be collected in covered conduits, and brought down to a junction with the main arterial conduit, and so bring the water on to London?—Yes.

3012. Therefore, putting aside cost, and supposing that the object of this Commission is both to exclude from these streams all pollution, and to secure an abundant supply of spring water, what is your opinion?—I believe that the upper valleys of the Lee would furnish beautiful water, and sufficient in quantity for our present purpose, excluding the sewage.

3013. What is the present capital of the New River Company?—I answered that question roughly on my last examination from memory, but I will put in the Act of Parliament in which is mentioned the capital that was settled by Parliament in 1852,—exceeding a million and a half. The company obtained Parliamentary powers in 1852, and also in subsequent Acts in 1854 and in 1857, to borrow money to the extent of 1,000,000*l*. Last session again they obtained power from Parliament to increase their capital by 500,000*l*.

3014. The capital now may be considered as exceeding 3,000,000*l*.?—Yes.

3015. If such works as have been indicated or suggested were carried out, I suppose one might expect that there would be a much larger capital?—It would require a large increase of capital to execute works such as you have mentioned.

3016. I dare say you have seen the projects which have been laid before Parliament for bringing in water to London from enormous distances, from North Wales as one place, and I believe there is another to bring it from the lakes of Cumberland and Westmoreland. Looking at such schemes as these, it being contemplated to use covered conduits, as an engineer, knowing your own ground and your own river and its tributaries, do you think you would have to face anything like an equivalent expenditure to make your water supply as unexceptionable as could possibly be desired?—The expenditure in our case would be nothing like that in either of the other cases you have named.

3017. What you would have to deal with would be works not of a complex character; you would not have nature to control you in any way; you have a gradual fall all the way; you know all the difficulties you would have to encounter, and it would be merely dealing with trade property and proprietary rights as exercised upon the river now?—As a matter of engineering the works would be of the easiest kind.

3018. Looking at what London was when Sir Hugh Myddelton first projected his New River scheme, at its population, its requirements, and its means of contributing to a work of that class; then looking at London now, with its population, its requirements, and its means of contributing, without going into detail, do you think that such a work as I have suggested, viz., that the New River Company should collect spring water and bring it in covered conduits, and distribute it without any chance of contamination, would be a greater work in the present day than it would have been in Sir Hugh Myddelton's day?—I believe it would not be so great a work in proportion.

3019. Taking all the elements into consideration?—Yes.

3020. The population, its ability to pay, and its requirement of water?—I think it would not be so large in proportion.

3021. Looking back to Sir Hugh Myddelton's day, I assume you will agree that then the country was very thinly peopled, that agriculture was in a very rude condition, as compared with what it is now, patent manure was not used to so large an extent, and all the forms of pollution that existed then would have been trifling as compared with what they have grown to?—Yes.

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3022. We have now a population growing far more rapidly than before, and taking all those circumstances into consideration, do you not think that it is necessary to deal with this question upon a liberal and great scale?—It is quite my own view that it is.

3023. In making these suggestions I always assume that your company would not have its property sacrificed, but that the company would be dealt with upon liberal terms?—It would be quite the feeling of the directors of the New River Company that some comprehensive scheme of that kind should be carried out, if they could only see their way to an adequate remuneration.

3024. That they shall be treated as honourable men dealing with honourable men, and that their property shall not be dealt with in a spirit of confiscation, but in a fair trading way?—Quite so; if fresh expenses are laid upon them in this way, some new arrangement would of course be necessary to make their returns in some measure proportionate to the additional outlay.

3025. Do you produce a general map showing your scheme of rivers and the area you supply?—Yes, this map which is on a small scale, does that.

3026. Will you put it in?—Yes (*handing in the same*). It shows the metropolitan area of the New River district, and I call it metropolitan, because the company can supply parishes along the course of the river, and this is the metropolitan area of that district (*pointing to the map*), which is coloured.

3027. You have coloured it pink?—Yes.

3028. You say that the company have power to supply the adjoining properties along the whole line of this conduit from Hertford down to the metropolitan area?—Yes.

3029. Have any applications been made to you by the adjoining parties for a supply of water?—Only those have applied who have residences near the river.

3030. The townships or parishes, I suppose, have not applied to you?—I think not; the town of Enfield has waterworks of its own, and that is almost the only town of importance upon the line of the river.

3031. Has Tottenham a supply of its own?—Yes, that is rather out of the line of the river. I may add with regard to Enfield that not only has it its own wells, but it has water from this portion of our river (*pointing to the map*). That loop is kept for their use, and from that loop they take water.

3032. Have you any other documentary evidence to hand in as to the rainfall?—I have gone through my rain gauge returns, and the one that I rely upon is one that I took in conjunction with Mr. Beardmore at Field's Weir, and he will put that in. The other returns are not in so perfect a condition as to enable me to furnish you with them at present, and I am afraid the returns would not be all that I could wish them to be. Another document which I have to hand in is an abstract of complaints made at the office.

The same was handed in as follows:

ABSTRACT of ENTRIES made in the "COMPLAINT BOOK" at the Office of the New River Company during the year 1866.

No.	——
182	Complaints of short supply from defect in ball cock, lead pipe, or other apparatus belonging to the tenant.
23	Complaints unfounded, or unaccounted for, supply having been found on inquiry to be good.
19	Complaints of leakage, or other defect, in company's pipes, plugs, or cocks.
17	Complaints of dampness; found on investigation to proceed not from water pipes, but from defective drains, &c.
16	Complaints of waste at adjoining houses.
5	Complaints of want of water through breakage of pipes by sewer and gas excavations.
12	Complaints of want of water from mains or engines being off for repairs.
13	Complaints of deficient supply through service being given at a time of day when draught of other consumers reduced pressure in mains, remedied by serving at a different time.
42	Complaints arising from insufficient size of pipe or cistern, or from time of service not being equal to increased consumption.
3	Complaints of want of water through severance of pipes by adjoining owner.
8	Complaints of want of water where additional cisternage had been put up without notice to the company's servants.
6	Complaints of water being temporarily discoloured by the iron of newly driven pipes.
3	Complaints made to the company from houses not supplied by them.
1	Complaint of supply having been cut off for waste or non-payment.
3	Complaints arising from foul state of consumer's cistern.
1	Complaint entered in error.
1	Complaint caused by defect of meter.
1	Complaint caused by water having become fouled by ferrule defect.
1	Complaint of turncock not keeping proper time.
3	Complaints of want of Sunday supply; said supply given.
5	Complaints of want of Sunday supply; proved not to be required.
1	Complaint in regard to which the company's servants were not allowed to enter house to ascertain the cause.
11	Complaints through want of separate communication pipes.
1	Complaint arising from neglect of turncock.
3	Complaints caused by gas leakage into water pipe.
4	Complaints under investigation.
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3033. May this document be made use of?—I think so; we have no objection.

3034. Have you any other return to hand in?—I think not. I think what I have handed in includes all that were mentioned on the last occasion.

3035. (*Mr. Harrison.*) I see, by the return you have handed in, that three of the complaints arose from the foul state of the cistern of a consumer?—Yes.

3036. What control have you over the cistern of a consumer?—We have no direct control.

3037. By whom would the complaint be made?—By the consumer himself, who not having examined his own cistern, and not knowing its condition, nor the cause of the impurity of the water, applies to us; we examine it, and find out that something has got into it that ought not to be there, from the cistern probably being left uncovered.

3038. Not through the medium of your water, but from some external source?—Exactly.

3039. Do you put the cistern to rights in a case of that kind?—No, we only point out to the person complaining what it is necessary for him to do.

3040. In schemes that have been proposed to bring water from the Severn and from Wales, do you know whether it was proposed to carry the water throughout the entire length in a covered channel?—Not to be covered I believe throughout. Mr. Bateman in his report mentioned covering merely where it was necessary.

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3041. Does he explain at all what he considers that to be?—No, but I think he gives representations or drawings in his report of the kind of conduit that he intends in different places to construct; some are to be covered and some uncovered.

3042. Does he point out the cases in which he considers it will be necessary to cover them on account of situation or other cause?—I think not.

3043. Do you think that if you were to collect the spring water above Hertford in different directions, and brought that spring water to the present river at Hertford, that the New River would be a sufficient channel in which to convey water to your reservoirs and without a cover?—The covering of our river would of course make the whole thing more perfect and if you had no regard to cost it would be advisable to do it, but I have made no estimate. I think that the cost of covering the New River from end to end would be a very considerable item in any estimate for new works.

3044. Are there any sources of pollution by which the New River is contaminated between Hertford and the reservoir?—None.

3045. Are any steps taken to prevent pollution getting in in any way?—Much of the channel of the New River is railed in. Where it passes through private property and garden grounds, railing cannot always be applied. There are banksmen in charge of the river from end to end, whose whole duty it is to go backwards and forwards to clear the stream of weeds and to prevent pollution of all kinds.

3046. Might we take the New River between Hertford and Ware, as we saw it, as exhibiting a fair sample of the condition of the New River throughout its entire length?—I think so. In some places the river is prettier and looks even neater than that.

3047. If you maintain the New River as an open channel to convey the water to the reservoirs, would not the expense of collecting the water from your springs and supplying the New River with pure spring water be comparatively small?—The chief difficulty with regard to the collection of water above Hertford I think would arise from the nature of the ground in which the reservoirs would have to be made; the porous nature of the ground and the collection of the water there might be a matter of difficulty. It may be known to the Commissioners that the late Mr. Rendel, in conjunction with Mr. Beardmore, proposed certain reservoirs to be made; one on the River Lee, one on the River Ash, and a third one was to be made on the River Rib. The scheme was abandoned, but Mr. Rendel seemed to think that it was feasible to make reservoirs there. I cannot myself overlook the difficulty of making reservoirs sufficiently water-tight in such a geological formation as we have above Hertford.

3048. Do you think that if dams were run across the valley as proposed, the water would escape by some other outlet?—I fear that. You have heard from Mr. Beardmore how porous the soil is, which is an advantage in some respects, but that advantage would be a disadvantage in my opinion when you came to construct reservoirs upon it. It would make the construction most costly, because so much puddle would be required.

3049. You mentioned the other day, or Mr. Beardmore did, that there were a great number of springs issuing below Ware, between Ware and Waltham Abbey?—There are a great many. Mr. Beardmore's own gaugings and Mr. Simpson's gaugings have shown that the river is receiving an accession in its own bed from some unseen channels, and that the volume of water is increased considerably after it leaves the Ware tumbling bay.

3050. Do you think it is possible for the East London Waterworks Company to obtain their supply from those springs without taking any of the polluted water of the River Lee?—My idea is this, that if you succeeded in cleansing the river of the sewage coming from the places which have been named, it would be of little consequence where the reservoirs were made. If the reservoirs were made lower down the valley, where the nature of the soil would make their construction comparatively easy, and where also you could collect a much larger volume of water, there would be no difficulty in supplying with good water the East London Water Company, as well as adding to the quantity of water the New River Company might take.

3051. You mean after they have reached the London clay?—Yes.

3052. Where there would be no leakage?—Yes.

3053. That would be below the junction of the River Stort, would it not?—Yes. The clay I think comes into the valley above the junction with the Stort, but to obtain the advantage of the Stort water for the East London Company, some of the reservoirs would need to be below that junction.

3054. (*Chairman.*) Do you know anything of that report (*handing the same to the witness*)?—Yes, I have read it.

3055. Were you engineer when it was made?—No, but I was in the New River Company's service. I was not chief engineer, I was Mr. Mylne's assistant at that time.

3056. Perhaps you will be kind enough to look over the description contained in that report of your works as far as it goes, and add to it any further information which you may have collected?—I shall be happy to do so, although I may state that at the beginning of this year a return was made to the Board of Health, which would, I think, in every way answer your purpose, showing how far we have extended the works since that report was made.

3057. Did you draw up that return?—Yes.

3058. Then you speak from personal knowledge of it?—Yes.

3059. Was that return sent in direct to the Local Government Act Office, and at what date?—It was sent in to the office of the Board of Health, I think, in May last.

3060. Was it sent in in compliance with a requisition, or in the ordinary course?—In compliance with a requisition from them.

3061. (*Mr. Harrison.*) In the return you have handed in there are many complaints of want of water where there are additional cisterns; have you a record of all the cisterns to which you supply water?—No. I explained before that the time of the service during which the water is left on to fill the cisterns is always made sufficient to fill the largest cistern on that line of pipe. If, without our knowledge, a cistern has been increased in size very much, the time of the service may be found insufficient, and we do not know of it until a case of this kind occurs, and then we take measures to increase the time of the service to fill it up.

3062. There appear to have been three complaints in the course of the year of the leakage of gas into the water?—Yes.

3063. What is the effect of that leakage when it occurs?—I may first explain that it arises generally from some heavy leakage in the gas pipe near to the water pipe, and when the water is shut off from the service the water drains into the lower cisterns of the houses, tending to cause a vacuum in the last-named pipe. This vacuum is supplied by gas, found in the ground round it, if the water-pipe is defective.

3064. When you shut off the water from a certain district during 24 hours do you find that the pipes in that district have filled in the meantime to any extent with air?—Very often.

3065. How does it get into the pipes?—I suppose it is chiefly drawn into the pipes through the tenants' lead pipes.

3066. Does it collect in your mains?—Not in the mains, because the mains are what we term always charged, and the branch pipes (that run from the mains from which the tenants' communication pipes get water) only are shut off: and those branch pipes are liable to an accumulation of air to some extent.

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3067. Are these branch pipes large ones?—They are generally three and four inches in diameter.

3068. Do you find that the air accumulates in them?—Yes, when they are shut off.

3069. If there was a gas pipe leaking in the neighbourhood, would not the gas be apt to get into those pipes instead of atmospheric air?—Yes, and it does get into them, when there is leakage also in that branch water pipe. The kind of complaint you refer to generally arises when there is a leakage in the gas-pipe and when there is a leakage in the water-pipe near it.

3070. That is a kind of complaint that would not arise if the system of supply were a constant one?—It would not. It must be borne in mind that the cases are very few in which such a thing occurs.

3071. (*Chairman.*) Have you ever considered this point when you are drawing off the water intermittently, whether it would be difficult to invent a reversing valve that should fill the main so as to prevent it sucking from any foreign source?—I have done so in some cases by little valves but they are very apt to get out of order. I tried them as an experiment only.

3072. It must be a valve of considerable size?—No doubt larger valves would answer better.

3073. Supposing you had a flat disc 12 inches in diameter that would drop a quarter of an inch, and that was connected with a six-inch pipe, the moment the water rose, that disc being so much larger than the pipe, the pressure underneath would close it?—Yes.

3074. Being so much larger than the pipe, when you drew the water away the pressure of the air on the top would open it; that is to say, by making the disc larger than the pipe you would make it self-acting?—Yes, I quite see what you mean.

3075. Would it be possible to make such balance valves and place them where you would be absolutely certain that you would fill your mains and not force impurities into the pipe?—It would be quite possible if we had one of those valves on every one of our 5,000 services; but it would, I am afraid, be rather a troublesome addition to our apparatus.

3076. How many sections have you divided your works into? I do not imagine that such a valve would be required upon every service, but upon every section of services?—It is only in the service pipes that this gas accumulates.

3077. Not in any of the branch mains?—No. If the thing was to be carried out completely, it would require one of those valves in each of the 5,000 services that we have, and it would be only to meet the few cases of complaint that we have had made.

3078. (*Mr. Harrison.*) There have been 182 complaints of short supply from defects in ballcock, lead pipe, or other apparatus belonging to the tenants, but those would be complaints for which I suppose you are not liable?—Not at all, a great number of the complaints will be found to be of that kind when they are investigated.

3079. Complaints arising from neglect on the part of the tenants themselves or the owners of the property?—Yes.

3080. (*Chairman.*) Your supply being intermittent, I presume you supply the service tanks and service tubs which are placed in the back yards and front areas, and in fact almost every conceivable place contiguous to the houses?—We do. There is a great deal of waste in the New River district, as in others, and our attention is constantly directed to that; it requires quite a staff of men to visit continually in order to keep that tendency down in places within control.

3081. Do you know that servants almost as a rule either prop up the ballcock or take it bodily off, so that there may be no stoppage to the incoming of the water when it is on?—Yes.

3082. And supply, in that case, means a supply of waste?—Yes, we know that half the quantity would probably suffice for use.

3082a. That is, for all reasonable use?—Yes.

3083. (*Mr. Harrison.*) You mentioned the other day what you considered to be a fair sized cistern for the ordinary tenements of the poorer classes?—Yes, I said that I had gauged a certain class of houses called model lodging houses, specially to be used for the habitations of the poor, and in those houses the consumption did not reach seven gallons per head per day, allowing them to take all they required.

3084. (*Chairman.*) Had they a constant service?—It was not a constant service, but the enlarged cisterns were filled daily; they were never empty, so that it was constant to them.

3085. If you had to supply a block of property with 1,000 persons in one court or range of courts, it would not, I suppose, require a very large cistern to supply 1,000 inhabitants?—No, it would not.

3086. Do you think that if London were divided into sections, and were so supplied with water, you could reduce the volume of water that is now wasted to a very large extent?—Very much indeed, and the supply would be constant to the whole. The only objection that I ever heard against the plan is that of having cisterns at all. Some persons exclaim against cisterns as being something wrong, but if they are made of cast iron or slate and are covered and properly placed, so as not to be fouled either by dust or infiltration, I think no mode of supply is better.

3087. (*Mr. Harrison.*) If cisterns were made such as the Chairman suggested, those large cisterns might be placed under the control of the water company, might they not, and with advantage?—We are allowed now so far to control the cisterns and the fittings as to require imperfect ones to be made good, but we find that the amount of power we have is not sufficient to make sure that the cisterns are sufficiently well covered and that proper apparatus is provided by the landlords.

3088. If cisterns were provided to supply 1,000 houses, could not the water company then overlook them and see that they were properly attended to?—To have one large cistern to overlook for the supply of a large number of houses would of course be easier than having one little cistern in every house.

3089. If such a plan was adopted, do you think that the water company could keep the cisterns in an unobjectionable state?—Yes, by cleansing them; at the present time we do not undertake to cleanse them, and it would be an additional duty laid upon the company if we had to cleanse any cisterns.

3090. (*Chairman.*) If the water is clean when passed into the mains, and it is not allowed to see daylight till it comes into a properly arranged cistern, is there any probability that it will get foul?—I think not, if the cistern is only properly placed.

3091. And protected from external impurities?—Yes; I believe that the thing it would suffer most from would be vitiated air coming into contact with the water, and the water absorbing it.

3092. If the cistern were covered and ventilated, do you not think that you could dictate what kind of air should go in, as every particle might be made to pass through a charcoal filter?—We could do that.

3093. (*Professor Way.*) So that when the air went in and out, when the cistern was filled, it would be pure air that went in?—It might be drawn through a charcoal sieve.

3094. (*Chairman.*) Do you know that pure water, that is to say, water which so far as we know has no impurity in it, if placed in a covered reservoir absolutely requires ventilation to keep it sweet?—Yes; I believe that the purer the water the more rapidly it gets contaminated.

3095. (*Mr. Harrison.*) You mentioned seven gallons per head as the quantity taken in the case of the model lodging houses, but 30 gallons per head is the actual quantity consumed over the whole district?—Yes.

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3096. You stated that you had very much diminished the leakage throughout your district; if so, what becomes of that large difference?—It is wasted through having defective ballcocks.

3097. (*Chairman.*) Or defective services which have no ballcocks, where they have been deliberately taken off?—Yes.

3098. Is there anything further which you wish to bring before the notice of the Commissioners?—I was asked at the last examination touching the limits or limit of the company's supply. I mentioned then 35,000,000 of gallons per day as the limit, but I wish it to be understood that that is the limit with the existing works, because it is already in evidence that the New River Company have a right to a moiety of all the water of the Lee. At present, we use only between 18,000,000 and 19,000,000 of gallons per day on the average; the average quantity for the past portion of the present year has been very little over 18,000,000 of gallons.

3099. What would be your limit if you went to the utmost extreme, knowing all the sources that you have to draw from?—All the flood water of the Lee, not yet touched, could be made available for the two companies after the purification of the valleys which you have now in hand. The exact addition that it would make to our resources I cannot say. It would require more careful gaugings than I have made to ascertain that.

3100. That flood water would be economised, and held in storage reservoirs?—Yes. The New River Company, moreover, have an old right which has not been exercised for many years, but it is in their power to deliver water into the streets of London, for sewer purposes and sewer flushing, for surface cleansing and similar uses (for which filtered water is now wasted) by pumping from the Thames between Blackfriars Bridge and Southwark Bridge. We have now a suction in the Thames, which has not been used for many years, and by carrying out separate lines of mains a very sufficient supply of water for the above purposes may be obtained in the New River district from the Thames.

3101. For surface washing and surface watering?—Yes, and it would practically add a good deal to the company's resources.

3102. Looking to the supply of water as it exists in London and the population of London as it at present exists, what are your views, as an engineer having charge of one of the greatest sources of supply, with respect to an entirely new supply for so great a population as that of London?—I cannot think that an entirely new supply is yet needed. If you look into the very far future, there is no saying what may be required, but if the Thames is to be thoroughly purified, and the valleys of the Lee are to be purified, and the water can be properly economised and distributed, it will provide a fair and abundant supply to the inhabitants of London for many years to come.

3103. If you replaced a moiety of all the water that is supplied to London, that quantity, utilized as it might be, would supply the wants of a population of 6,000,000?—Without bringing in an additional drop of water, that saving would provide London with water for 50 years to come.

3104. Is there anything further you wish to add?—I should wish to state what payments the New River Company have already made for the improvement of the River Lee. Some of the payments were for navigation purposes, other outlays have been for the purification of the Lee. I have here the amounts more accurately set down, and I believe that the sums which the company have paid for the improvement of the navigation may be put down at upwards of 53,000*l.*

3105. Within what period of time?—The payments before 1855 appear to have been but few and small, but in 1855 the sum expended was 42,000*l.* for navigation purposes. The New River Company have lately re-erected one of the locks on the navigation at Hertford, and altogether their outlay for navigation purposes has been 53,000*l.* up to the present date It has been 47,400*l.* since 1855, and there were other small amounts before 1855.

3106. (*Professor Way.*) It has not been for the improvement of the water supply, has it?—Indirectly it has. It has been like sums of money to be laid out on the River Thames in improving the navigation of the whole course of the River Thames, and water companies are supposed to benefit by those improvements.

3107. (*Mr. Harrison.*) It has been stated that the water which the New River Company abstracted from the river at Hertford lowered the water to such a degree that the boats could not pass over the sill into the lock?—Yes.

3108. And therefore the company went to the expense of constructing a new lock, so as to improve the navigation and enable you to continue to take the same quantity of water?—Exactly so.

3109. (*Professor Way.*) That did not improve the water, but it enabled you to take more?—It did not affect the quality of the water, but I may say that other outlays which the company have made have had to do with the quality of the water, and they have spent more than 30,000*l.* on sewage works connected with the River Lee.

3110. Do you mean at Luton?—No, at Hertford. The town was sewered and works were erected, the working cost of which exceeds 600*l.* per annum, so that if you take the interest upon the first cost of the sewerage works, rather more than 1,500*l.*, and add to that the annual outlay for carrying on the works, the total is 2,132*l.* annually paid for sewerage works, without at all saying whether the money has been judiciously spent or not. The New River Company pay to the River Lee trustees annually 1,500*l.*

3111. (*Chairman.*) Looking at what you have had to do to make your own supply available, and at what you have to pay annually for the purification of the sewage, do you think that the West End companies are hardly dealt by in having to pay 1,000*l.* a year to the Thames Commissioners for what they are to do for them?—I think that we already pay more in proportion.

3112. (*Professor Way.*) Are you under any engagement with the town of Hertford for the purification of the sewage for any number of years?—No; I suppose it is to be perpetual.

3113. Supposing that you desired to apply the sewage of Hertford to the land instead of precipitating it, would it be feasible to do so?—I believe it would be quite feasible.

3114. Who do you think would have to move in it?—The Act of Parliament does not contemplate such a way of disposing of the sewage. It states that it is to be deodorized, and if a certain process—say the process of distributing it over the land—is proved to be the best plan, I think it would come within the terms of the Act to apply it to the and.

3115. Have you any other evidence to lay before the Commission?—Nothing else occurs to me at present except to give you this account (*handing in the same*), and the titles of the Acts of Parliament to which I have referred.

1. Chapter 160. An Act to enable the Governor and Company of the New River to improve their supply of water, and for other purposes, dated 30th June 1852.

2. Chapter 39. An Act to enable the New River Company to construct certain sewers, drains, and other works in and near the town of Hertford, and for other purposes, dated 2nd June 1854.

3. Chapter 42. An Act to enable the New River Company to raise a further sum of money, to construct other sewers at Hertford, and to amend the Acts relating to the company, dated 13th July 1857.

The witness withdrew.

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The witness subsequently forwarded to the Commissioners the following paper:—

STATEMENT OF THE CHANGES AND EXTENSIONS WHICH THE NEW RIVER COMPANY'S WORKS, &c., HAVE HAD SINCE REPORT THEREON BY SUPERINTENDING INSPECTORS OF THE GENERAL BOARD OF HEALTH IN THE YEAR 1856.

Acts of Parliament.

Since 1856, the New River Company have had authority (by their Act of 1857) to create a debenture stock in lieu of bond debt, to construct additional sewers at Hertford for the maintenance of the purity of the River Lee, and to raise a further sum of 300,000*l.* for the execution of these works, and for the general purposes of their undertaking.

The company are now seeking authority from Parliament to obtain the additional amount of 500,000*l.* for the increase, improvement, and extension of their supplies.

Sources of Supply.

The New River Company have, for their sources of supply (as in 1856)—

The Chadwell Spring,
The River Lee,
Amwell Well,
Amwell Hill Well,
Cheshunt Well,
Hampstead Road Well, and
Tributaries to the New River.

Also the following sources of which the company have possessed themselves since 1856:—

The springs at Hampstead and Ken Wood, the waters of which are collected in 13 ponds on Hampstead Heath and at Highgate, having a joint area of about 30 acres.

These waters are distributed by *separate* mains for *street, sewer,* and other *non-domestic* uses.

An artesian well on Hampstead Heath, formerly (with the springs and ponds above named) the property of the Waterworks Company, the supply of whose district was undertaken by the New River Company in the year 1857.

A new artesian well, recently made by the side of the New River at Hoddesdon, in Hertfordshire.

The last-mentioned well has, as yet, done no work; and there has been no occasion for any use of the Amwell, Hampstead Road, and Hampstead Heath wells, for several years. They have been kept in reserve.

From all the above-mentioned sources (reckoning contribution from the Lee at only 2,500 cubic feet per minute) there may be obtained a daily supply of more than 35,000,000 gallons.

Although no supply has been taken from the Thames into the New River District, for any purpose, for many years, additional quantities of water may be drawn by the New River Company from that river, below *Blackfriars Bridge,* and delivered through *separate* mains to any extent that may be hereafter required, for *street cleansing, sewer flushing, extinction of fire,* and other such uses.

In order to add to the provisions which they have already made, for the future, the company have purchased nearly 90 acres of land for the construction of a store reservoir near Broxbourne, are increasing their means of supply from Amwell well; and are making arrangements for the sinking of a new well on the line of their river between Hoddesdon and Cheshunt.

The company's draught from the River Lee is not limited to the 2,500 cubic feet referred to above, and named in the report of Inspectors to the Board of Health in 1856. The said quantity (equal to 22,435,000 gallons per day) represents only the rate of draught to which the New River Company have a prior right. For by pumping to supply the demands of the Lee navigation, and by provision of steam power for mill owners, the New River Company, in conjunction with the East London Waterworks Company, may take the water which those two objects would otherwise absorb, and may, by storage, also make use of the flood waters of the Lee to any extent that may be necessary.

Since 1856, the New River Company have constructed sewers throughout the town of Hertford, and have erected works at which the sewage of that town is dealt with, and disposed of, as the New River Company's (Hertford Sewage Diversion) Act of 1854 directs.

The shortenings and improvements of the channel of the New River (effected before 1856 as far down at Cheshunt) have been subsequently continued, and completed between Cheshunt and London. And so much of the river channel, as is within the more urban parts of the metropolis, has been covered over for the better protection of that part of the company's supply which is delivered for filtration at the New River Head.

Reservoirs.

The small circular basin which was situated in the Hampstead Road, and reported in 1856 as then used only for the supply of contiguous baths and wash-houses, has been removed, the establishment which it served having been closed. This excepted, the company now have, in addition to the reservoirs named in the report of 1856, and in addition to the above-mentioned 13 ponds at Hampstead and Highgate, a new subsiding reservoir at Hornsey, with an area of 8 acres, and a capacity of about 20,000,000 gallons; also covered, filtered-water, service reservoirs on Highgate Hill and Hampstead Heath, having a joint area of 22,000 square feet, and a joint capacity of about 1,500,000 gallons.

The company's store and subsiding reservoirs now have a total area of about 100 acres, and a total capacity of about 200,000,000 gallons. Their covered, filtered-water, service reservoirs, have a total area of about 164,000 square feet, and a total capacity of about 20,000,000 gallons.

Filtration.

The means of filtration which the company had in 1856, have been increased by the provision, at Hornsey, of three new filtering beds, having a joint area of two acres. Contracts have been entered into for the construction, at the Company's Stoke Newington Station, of two other beds of the united area of two acres.

When these two beds are finished, the company's whole filtering area will be equal to 11½ acres.

The result of the company's filtration is seen in the analyses, which they regularly obtain, of the water of the New River, as the same is delivered to consumers in their district:—

The average amount of organic matter which *twenty-four* of these analyses (made by Dr. Letheby during the past year) assigned to one gallon of water in decimal parts of a grain, was	0·454
Some of the examples examined had but	0·2 or ⅕th
of a grain of organic matter in a gallon, that is one part in 350,000 parts.	
Eleven analyses obtained and published for the same period by the Registrar General, gave an average of	0·671
parts of a grain per gallon, as the amount which New River water contained of organic ingredient, hygrometric moisture, and whatever else was driven off by incineration.	
Analyses published under the same authority, have shown the organic impurity of—	
Loch Katrine water in parts of a grain per gallon to be	0·605
And of *Manchester* water, according to the same scale, to be	0·680

Pumping Arrangements.

Since 1856 the New River Company have erected an engine of 75 horse-power (with three boilers) at Hornsey, and an additional engine of 30 horse-power, with extra boiler, at Highgate, to aid in the "second lift," by which water is raised to the top of Highgate Hill and Hampstead.

They have also placed a 50 horse-power engine and boiler at their new well at Hoddesdon.

Their whole engine power is now that of 1,680 horses.

Tenements supplied.

The New River Company now supply water to 111,958 houses.

Rates of Charge.

These are regulated by the New River Company's Act of 1852 (sections 35 to 41 inclusive).

This Act makes a supply of water for domestic use, in the New River District, to be generally liable to a charge of 4 per cent. per annum on the annual value of the houses served with certain extra rates for baths, high service, and waterclosets, in houses having a higher annual value than 30*l.*

In many cases charges remain considerably below the limits at which they might, by the said Act, be fixed.

All supply of water for extinction of fire is *without charge.*

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Mode of Supply.

The New River Company's supply continues to be, in most cases, an "intermittent one," delivered into the tanks, or butts, which consumers provide. And wherever there is sufficient cisternage, properly placed, protected, and cared for, consumers have no inconvenience from the arrangement. They then, on the contrary, have, what is practically, a *more constant* kind of service than that which would be furnished by the mere connexion with a "main" which is often described as "constant supply." With this so-called "constant supply," without cisterns houses must be entirely without water on every occasion on which mains have to be closed for their unavoidable extension or repair.

Supplies, intermittently furnished by the New River Company, are "turned on" daily, for, at least, six days a week; and are "left on," on each occasion of delivery, for as long a time as may be necessary (with adequate house pipes) for the filling of any reasonable amount of cisternage which consumers may provide. In some cases of intermittent service, in which the supply of the poor is concerned, and in which parish authorities remain unable, after their best exertions, to compel the landlords of small houses to provide properly for their tenants' reception of water, a seventh, or Sunday supply, is given. About 4,000* houses in the New River District now have such extra service. Sunday supply is, of course, also afforded to all houses "on the main." The company have more water to pump on other days of the week because of non-delivery of it on Sundays. They also pay their foremen, turncocks, and engine-workers for Sundays, as if they all then worked; but their rule is not to deprive these men of their Sunday's rest without good cause. And in few cases can it be truly said that the turncock's services on Sunday are necessary. Often where the want of them is complained of as an evil, the loss of water by leakage, through the consumer's faulty cistern fittings, is the sole cause of the inconvenience felt.

Wherever consumers are ready to take water in any way that will give a sufficient guarantee against *waste*, the company are ready to make supply "constant" in the sense of allowing an uninterrupted communication with their mains. They do so now in more than 1,200 cases. The general adoption of the "constant system" would be for the company's advantage, if only it could be effected without waste. The company, therefore, have no interest in the discouragement of *that* system under any conditions which would effectually prevent waste. *Without the strictest precautions against waste*, the "constant system" would greatly increase the company's filtering, pumping, and other expenses, and would through these expenses alone, operate not a little—although indirectly—to the disadvantage of the public. A wasteful, constant supply, would bring this further injury to consumers, that in consequence of the excessive discharge which it would allow in the lower levels of a district, it would leave houses, in the higher ground of the same district, far short of their fair share of supply.

Thus special provisions against waste are the indispensable accompaniments of any attempt to afford constant supply. Such provisions, however, involve both a *cost* in the alteration of house pipes, &c., and *restrictions* to which consumers in London are not ready to submit. Hence it is that there is yet but a *partial* adoption of "constant" service in the New River District, although the New River Company have been perfectly prepared for years to furnish it, on the fulfilment, by tenants, of the conditions which the 15th section of the Metropolis Water Act of 1852 prescribes.

In no case has there been requisition to the company, under this section, to provide the constant supply to which it refers.

"*Constant supply*" is sometimes spoken of as if it were the only *high pressure* one. But the "*intermittent*" supplies which the New River Company give *are of high pressure.*

Although so many houses in the company's district continue to be "*intermittently*" served, all the company's leading pipes, or "mains" (having an aggregate length of more than 200 miles) are "*constantly*" charged, so that by the mere drawing of a plug on any of these mains, there may be instant supply for the extinction of fire; and by the opening of a single cock, there may be immediately charged, for like service, any one of those short, subsidiary, lines of pipe which are branched from these leading mains, and which lie in every street in the company's district. Here are better means of concentrating pressure for water supply at fires than there would be with all pipes charged (as under the "constant" system) and open at all times to the draught which the service of consumers, or their waste, might cause.

Under existing arrangements it is very seldom that water from the company's pipes is not flowing *before* the engines of the fire brigade are ready at a fire to use it. If fire engines have had, at any time, to wait for water, it has been through delay in the call of a turncock to the spot. To induce the early call of their turncocks, and to insure the quickest attention thereto, the company reward all persons who first give notice of fires; they allow their own men gratuities for promptness, they set up marks to indicate the places at which their turncocks and deputy turncocks reside, and they forward, every quarter, to all *police, fire, parish,* and other public stations, printed lists of the names and addresses of their street foremen, turncocks, and deputy turncocks, with advertisement of the reward which they pay (as aforesaid) for "first calls." To meet the rare occurrence of a turncock's late call, the company have repeatedly intimated their readiness to allow both firemen and police the use of the keys, by which these officers might, at any time, in the absence of turncocks, obtain themselves the water wanted at a fire. The firemen have, in fact, such keys, but decline the responsibility of using them. By the attachment of improved hydrants to mains, these might be some additional facility for the ready acquirement of water for extinguishing fire, but such new appliances would throw on parishes considerable additional outlay.

What Parish Authorities have done to require a Supply of Water to the Houses of the Poor, under the 27th section of the Metropolis Water Act of 1852.

Parish officers have exerted themselves, on many occasions, within the New River District, to require the owners of small houses to procure a proper water supply for their tenants; and in so doing, they have had all the aid which the company are able, in such circumstances, to render.

No formal requisition, in regard to a reduction of charge, has, in such cases, been made to the company by churchwardens, or other parish authority, under the 27th section of the Metropolis Water Act of 1852; but the company have always willingly laid down pipes, when these have been needed, to bring water within the reach of the poor; and they have been careful to apply only *reduced* rates of charge for the water supplied to any house property of the humbler sort.

Quality and Quantity of Water supplied.

In regard to the *quality* of the water served by the New River Company, it will here suffice to refer to analyses already published, and to the previous statements under the head of "filtration."

As to *quantity*, the company are always ready to serve as much water as the consumption of their district requires. The average daily demand of 111,447 houses during the past year was 23,460,548 gallons.

The company have no knowledge of any complaint by memorial to the Board of Trade, under the 9th section of the Metropolis Water Act, with regard either to the *quality*, or the *quantity* of their supply; and they have not had either inquiry or notice on such subject from any inspector appointed by the said Board, under the 10th and 12th sections of the above-named Act.

There are, no doubt, within the company's district, many cases of very imperfect supply, especially to houses in the occupation of very poor people; but for the defects of these cases the company are in no way responsible. The company have laid down the pipes which could furnish a good supply; they have, in certain cases, offered, for moderate interest on their outlay, to provide the apparatus by which landlords ought themselves to secure for their poor tenants a proper water service, and they are ready, with any provision which landlords may make for the reception of supply, without waste, to let the service of the houses in question be a "constant" one. Whatever defects remain are due to the indifference of landlords, and their inadequate arrangement for the water supply of their tenants.

Cost of the Company's Works.

The report of the Inspectors of the Board of Health in 1856, represented the New River Company's whole outlay on works, up to the end of the preceding year, as 1,987,801*l.*

The company, at the close of the past year, had laid out on new works and extensions, inclusive of purchase of lands, &c., the further sum of 508,756*l.* 17*s.* 7*d.*, making, with their previous outlay, a total expenditure of 2,496,557*l.* 17*s.* 7*d.*

(Signed) JAMES MUIR.

* This number has been raised, since the date of the above return, to nearly 50,000.

LONDON.

Mr. J. Knight.

15 Dec. 1866.

Mr. JAMES KNIGHT examined.

3116. (*Chairman.*) What are you?—I am surveyor to the vestry of Mile End Old Town.

3117. Was the report which is lying on the table made by you to that vestry?—It was.

3118. Do you wish to put it in?—If you please (*handing in the same*).

3119. Does that report contain an account of a personal inspection made by you of the New River?—Yes, and of the river Lee, and the river Stort.

3120. I see that you have given the details here with regard to these rivers, and you end with a summary. You say in this summary that "the water "of the East London Waterworks Company is pol- "luted to a very large degree by the drainage of the "towns and villages situate on the banks of the river "Lee, from whence they derive their supply." You speak, I suppose, from personal inspection?—I do.

3121. Then you say that "an abundant quantity "of water, of even flow, and of the character at "present supplied, is not to be obtained in the sum- "mer without storing it for several months in open "ponds." Where are those open ponds situate?—They are reservoirs which have been recently constructed at Tottenham.

3122. What volume of water do they contain?—I do not know the actual quantity; but the average is something like 80 acres. 110 acres of land altogether would include the whole.

3123. Then you say lastly, that "pure water in "sufficient quantity for the present and probable "future wants of the district cannot be obtained in "my judgment from the present source of supply at "all"?—I do.

3124. Do you know what is the volume of water that they profess to give daily to the metropolitan population that they supply?—About 24,000,000 of gallons.

3125. What would that be per head of the population that they deal with?—Nearly 30 gallons per head.

3126. From your experience, do you believe that 30 gallons per head are recognized or used?—The 30 gallons include the whole of the water supply for every purpose. It is not alone for the consumption of human beings.

3127. Do you know what proportion of that quantity would be consumed for trade purposes?—No, but I know that it is large.

3128. Do not you know what proportion is used for domestic purposes?—I cannot say.

3129. Have you ever made any experiment as to what any number of persons or any family would use if they did not waste any?—I have.

3130. What volume should you say would be used?—For all purposes, taking the period of a month, about 11 gallons a day per head.

3131. If the same persons or families were simply to use water and not waste it, you think that 11 gallons a head would be enough?—Yes, I do.

3132. Can you detail to us how you tested that?—By management, in a cistern in one of my own houses.

3133. Did you adopt some mode of registration?—Yes, from morning to morning—it is an intermittent supply—I gauged the quantity which had been delivered into the cistern.

3134. In your own house?—Yes, in a house that I own.

3135. Do you consider that you made your experiment with sufficient care, so that it may be taken as a reliable experiment?—I do.

3136. Do you consider that the supply is ample for all their requirements?—Yes, they always have water.

3137. Were there any parties in the house to which you have alluded who were accustomed to take a morning bath?—No, it was comparatively a poor house.

3138. For bath purposes the volume must be added to?—Yes.

3139. Mile End Road does not, I believe, come into the New River district?—No; it is in the East London district. The whole of Mile End is, and Whitechapel, St. George's-in-the-East, Limehouse, Poplar, Bethnal Green, Hackney, and part of Shoreditch. I speak of the water supplied to the East London district.

3140. At what date did you make your investigation?—September 18th, 1866, and other days.

3141. How many days did it occupy you?—Five.

3142. Were you at all acquainted with the river and the sources of water supply before making that investigation?—I knew something of it. I had been over the ground previously.

3143. You did not then know it so intimately as you do now?—No.

3144. In making your inspection did you find the sources of pollution more injurious or less than you had anticipated?—Infinitely greater.

3145. You found that the pollutions were larger than you had anticipated?—Very much so.

3146. Did any person accompany you when you made the inspection?—No official.

3147. Did you communicate at all with the authorities of the river Lee or the New River Company previously to making the inspection?—I did not.

3148. Did your board send a copy of your report to the East London Waterworks Company?—Yes.

3149. Did the board receive any reply after their reception of it?—I am not aware that they did.

3150. Are you aware whether any part of your statement made in this report has been disputed?—I am not aware that any part of it has. I attended a deputation of the vestries and district boards of Whitechapel, St. George's-in-the-East, Limehouse, Poplar, Hackney, Shoreditch, Bethnal Green, and Mile End—altogether eight—which waited upon the East London Water Company.

3151. What took place at that interview?—We met the board of directors, and requested to know whether they proposed to make any alteration in the quality of their water, and we were informed that they intended to go to Parliament this session for power to take water from the river Thames, in addition to that which they have from the Lee. They also told us that they intended to ask for power to compel the various towns in the Lee valley to prevent their sewage from contaminating the water; but they did not propose to go to any expense in the latter case themselves.

3152. Do you know whether they have taken steps to fulfil their promise to you?—Yes, they have, so far as the advertisement of their intention goes.

3153. Previously to your making this investigation as to the water supply, had you made any personal examination into the seats of cholera in the several areas that you have enumerated?—Only within our own district.

3154. Which is that?—Mile End.

3155. At which points did you make your investigation?—I will point them out on the map (*describing*).

3156. Whereabout did the cholera rage the worst during the last spring and summer?—In our own district it was nearly equally distributed over the whole area.

3157. Where had it first commenced?—It first commenced at the eastern end of the district, at the south-eastern corner—Stepney.

3158. What road is that (*pointing to the map*)?—The Mile End Road.

3159. Did it commence at the corner formed by the crossing of the Mile End Road and the Regent's Canal?—No, it was at our eastern boundary, near to Bow, that is where it commenced.

3160. At about what date did it first break out?—I think it was on the 13th July; it began at West Ham, and passed the next day into Bow; the following day it visited us at Mile End.

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3161. Did you about that time have any complaints made to you as to the quality of the water supplied to the inhabitants?—None.

3162. From your own knowledge have you reason to believe that the East London Water Company had been supplying a different kind of water from that which had been ordinarily pumped into the district?—I have strong reason to suspect it now from what I have seen.

3163. From what source do you think that water was obtained which you believe was different from the water usually supplied?—From Bow Creek, or that part of it which is now navigation, immediately below King's lock.

3164. Have you any reason to know why that water should have been drawn upon at that time?—There was a broken main which passed under the old river, and which had been known to the company to have been damaged, as I am told, for 18 months.

3165. Did that broken main interfere with their getting the filtered water which they usually supplied?—The filtered water passed through that main and the main passing under the old river, and being cracked, the water from the river, which at high tide is driven up over a little penstock, was really mixing with the water of Bow Creek.

3166. Then you have reason to believe that the main supply pipe laid down under the old river, from some accident, or wear and tear, or something else, had cracked, and to that degree that it was capable of admitting the foul water from the old river above it?—From the investigation that I made I was led to believe that it was the main pipe leading from Lee Bridge works to Old Ford works.

3167. If that main pipe drew water from that source, would that water be contaminated by the sewage of West Ham and the sewage of other districts flowing into the creek above and below that point?—Not by the sewage of West Ham, but the whole of the other districts.

3168. Why not by the sewage of West Ham?—Because that is turned into Bow Creek, a long way down, just at the tide's end.

3169. Then it would be by sewage from portions of the district situate above?—Yes. There are a number of factories on the banks of the river, and the water is always in the most foul and filthy state.

3170. Why do you think that contaminated water might have been pumped in from that source?—From the fact of the pipe being laid under contaminated water and having a fracture in it.

3171. Do you know at what time the fracture occurred?—I do not know, but I have been told that it was about 18 months since.

3172. And no steps had been taken to repair it?—They attempted once to do it, but not successfully.

3173. How did you obtain your information upon this subject?—There is a lockkeeper who lives on the spot, who communicated it to me through a friend.

3174. Is the lockkeeper a servant of the river Lee trustees?—He is; and he is quite prepared to give you this information; he was an eye witness to the whole; it was below the lock, and about half a mile above the crossing of the North London railway.

3175. Did the East London Water Company about that time take any steps to rectify that state of things?—They did.

3176. What were the means they resorted to?—By putting a jacket of lead round the pipe.

3177. Is that jacket of lead on the pipe now?—I believe it is.

3178. It is serving its purpose now?—I believe it is.

3179. (*Mr. Harrison.*) At what depth is it below the bed of the river?—A very short distance indeed, scarcely 18 inches; I mean the top of the pipe below the bed of the river. It was exposed when I was there.

3180. (*Chairman.*) Have you inspected the filter beds at the pumping station above, and the pure water basin, and the conduit below?—I have not recently done so, but I know them well.

3181. (*Mr. Harrison.*) Do you know what the level of the water in the reservoir is at Lee Bridge; is there a considerable lift to the level of the water in the covered reservoir at Old Ford?—I do not know.

3182. Be good enough to point out on this map where Blackwall is?—It is there (*pointing out the same*).

3183. Is that part of your district?—No, it is in the Poplar district.

3184. Is any part of your district below the high-water line?—No.

3185. Do you know whether a part of Poplar is or not below the high-water line?—A portion of it is below the high-water line.

3186. Do you know whether any part of that area was submerged by sewage in the spring and early part of this summer, in consequence of the flap valve getting out of order?—I do not know that; I have not heard it spoken of.

3187. Is the main sewer of the Metropolitan Board carried through your district?—No; it passes through Limehouse just below our district; Limehouse is next to the river, and the main sewer passes down below the Commercial Road.

3188. Are the old sewers from your district passed into the new sewer which has been constructed?—I do not think they are connected yet, but the work has progressed just up to the point for connexion; I do not think it is yet made.

3189. (*Chairman.*) Are there any private wells or pumps in your district?—Yes, several.

3190. Are there any, or many, privies with cesspools?—There are 800 in our district at the present time.

3191. Have you reason to believe that any of the cesspool matter can, by possibility, contaminate any of the wells from which water is drawn?—Yes, I have good reason to believe it, because this case occurred in Jubilee Street; there were six persons who died, I believe, of cholera there on its first outbreak, and we found upon inquiry that many of them had been taking and using the water from a yard belonging to a greengrocer who had died, and that water was from a surface well surrounded by cesspools.

3192. Can you give any other instance?—No other case which was so clear as that was.

3193. What is the subsoil in your district, is it gravel?—Yes, gravel on clay.

3194. Is it porous gravel?—Yes.

3195. What is the character of your sewers and drains, are they made of brick or pipes or both combined?—Lately all our main sewers have been made of brick, the smaller sewers are made with pipes.

3196. Are those pipe sewers so tight as to induce you to believe that the sewage cannot get out of them into the subsoil?—I cannot undertake to say that that is so.

3197. If there were any pumps near to any of your sewers or drains, might not the water be contaminated by them?—I think very likely it would be so.

3198. During the last spring or summer, after the cholera had broken out, was the necessity for taking means to close those pumps ever discussed?—Not until the cholera had broken out,

3199. Were any steps then taken to close them?—They made them incapable of use by taking away the handles and the buckets.

3200. Where they private pumps?—Yes.

3201. Were any remonstrances made by the owners?—Yes, but we disregarded them, and what we did was done at our own risk.

3202. Has the use of the pumps been restored?—Not at present.

3203. Are there any private wells at present in use?—Not to my knowledge.

3204. Have you taken any means to diminish the number of the cesspits or cesspools by serving notices

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on the parties?—We are doing that very rapidly indeed.

3205. By whom are they cleansed at present?—By the owners of the property—the cesspits.

3206. Do they do it voluntarily, or have you to repeat the notices?—They have lately done it when they get foul.

3207. Are any of them so situated that the refuse has to be brought through the body of the house?—Yes, in almost every instance.

3208. During the time that that operation is going on, in what condition will the atmosphere be?—Very objectionable, indeed, very foul.

3209. Have you ever known sickness to be caused by the emptying of these foul places?—I have not.

3210. Have you ever heard of it?—I cannot say that I have. As soon as we discovered that there were so many cesspools still in existence, I received directions from the vestry to deodorize them all by using carbolic acid, which I did, and I have kept them flooded up to a recent day.

3211. What amount of disinfectants in point of value have you used this summer?—I think about 350*l.* worth.

3212. The vestry have voted that amount, and the disinfectants have been used at their expense?—Yes.

3213. Did you use the powder as well as the fluid?—We used the powder of the lime, and the fluid acid.

3214. Did you supply carbonate of lime to the poorer inhabitants for their own uses?—Very largely.

3215. Did you compulsorily limewash any of the filthy houses?—Yes, a large number.

3216. Did any beneficial results follow?—I cannot say.

3217. Did you examine the private waterbutts and cisterns to see whether they were clean or foul in any cases?—Yes.

3218. In what state did you find them?—Generally in a very filthy state caused by the individuals themselves neglecting their own sources of supply.

3219. Did you in any cases cause those receptacles to be cleansed?—In many cases we ran the water out, and had them scrubbed out.

3220. How do you suppose they had become foul?—Principally I think from children playing near them, and throwing filth in.

3221. What was the general character of the water supplied at the taps?—It had all the appearance of being pure.

3222. Was it usually bright or turbid?—It had a bright appearance.

3223. If it was bright and passed into a clean receptacle, I suppose it would be comparatively clean?—I think so, but from what I have seen of the contamination of the water, I should not be led to suppose that it was very good.

3224. From what you have seen since you have made this inspection?—Yes.

3225. Has that altered your opinion?—Yes, it has; I think it cannot be good water, being polluted to the extent that it is.

3226. Did you form any opinion as to whether it would be practicable to prevent that impurity?—I think there would be no difficulty at all if proper measures were carried out.

3227. Did you so report to your board?—No, I did not so report it to my board. I reported the facts without prescribing a remedy.

3228. Can you state what number of wells there are in the district?—I cannot tell. I do not remember that.

3229. You can perhaps obtain that information?—Yes. There are not so many now as there were some years ago.

3230. Has your vestry power to compel the owners of property by notice to put on a public supply of water?—Yes, under certain circumstances.

3231. Do they ever enforce it?—Yes, they do in some instances, but it has not been necessary in more than three or four.

3232. (*Mr. Harrison.*) Was the case that you alluded to of a death from cholera one of the early cases?—Yes. I think the greengrocer was almost the first person who died in our district.

3233. He and his family, as I understood you, were supplied with water from a well surrounded by cesspits?—Yes.

3234. The well was upon his own premises?—Yes. He had a water supply from the East London Water Company, but he had this well in addition.

3235. Did you ascertain whether the water from the well was used for drinking purposes, or whether the company's water was used for that purpose?—They assured me that they only used the water from the well for rough purposes, washing and things of that kind; but I found that the people in the district were in the habit of sending there to get a pail of water, thinking it was better than that which was supplied by the company.

3236. Do you think that many persons in that neighbourhood were supplied with water from that well?—I have no doubt of it.

3237. Were there many people in the immediate neighbourhood who suffered from cholera?—As I have already stated, there were six deaths, which took place within a very short distance, within 150 yards, of that place.

3238. (*Chairman.*) Knowing these facts as you do now, should you regard the East London Water Company as accountable for those deaths?—I do not; not for those. I think that, with other circumstances, which are inexplicable to me, the same thing might have arisen from bad water supplied from the East London Water Company, as from the bad water from this well, if it were so.

3239. Putting things honestly and fairly together, at the first outbreak of cholera, and taking the number of deaths which occurred, you think that you cannot attribute them fairly to the bad water supplied by the East London Water Company?—I do say so. These cases were not the first, but nearly the first which occurred. We had a death or two in the extreme eastern part of the district within a few days.

3240. Did the cholera in its course sweep through whole rows of houses, or step over intermediate places, and strike down here and there?—I found that it had been almost uniform over the whole district.

3241. Not visiting all the houses in one street, but one or two houses in a street?—Yes, in every street, visiting the poor and the rich alike.

3242. And one or two members of a family falling victims?—Yes.

3243. The cholera was rather sporadic than epidemic?—Yes.

3244. If you were to dot the map over with a pen with black spots, the district to which you refer would be pretty equally spotted over?—Yes.

3245. Did you notice whether the cholera was the worst in the very poorest district, or in the district more inhabited by the middle classes?—I do not think there was much difference. Some portions of the population were very poor indeed; but I do not think it affected them more than it did persons who had all the comforts of life about them.

3246. Did it affect the poorer classes as much?—I think it was as nearly equal as possible.

3247. It did not fulfil the conditions you would have anticipated by striking down the very poorest?—No, for in places where I should have looked for it to be the worst it did not appear till after it had affected a number of well-to-do people.

3248. Did you suffer at all from bowel complaint?—No.

3249. Did you take special care of your own health?—I think not.

3250. Were bowel complaints very general at that time?—Yes.

3251. Did any of your men suffer?—Only two.

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3252. What were they?—They were labourers on the road; old men.

3253. They might have been in a weak state of body?—They were, but they recovered.

3254. Were those men of sober habits, or otherwise?—They were tolerably temperate, I think, as ordinary working men. I should call them steady working men.

3255. Was your district as severely visited as Poplar?—No.

3256. (*Mr. Harrison.*) Stepney is close to your district, is it not?—There is no such place now as Stepney. Stepney now is divided into hamlets and parishes. Mile End is part of the old parish of Stepney.

3257. Is there not a registrar's district?—Yes, for Mile End.

3258. And another for Stepney?—There is another for the Limehouse division, Ratcliff, Wapping, and Shadwell. There may be one for the Stepney Union.

3259. (*Chairman.*) I believe the sewers and drains are not under your jurisdiction?—Yes, they are.

3260. It is the main sewerage that is under the Metropolitan Board?—Yes.

3261. Have you been carrying out much sewering and draining yourself in your parish?—Nearly the whole of our parish is now sewered. We have very little more to do.

3262. Are the sewers fully ventilated?—Yes.

3263. By open gratings at the surface?—Yes. I have tried charcoal, but I found that it did not effect the object.

3264. Do you cleanse the sewers by hand?—We do.

3265. What number of hands do you employ?—We have not sufficient employment for a regular staff at present. At the present time we have six men at work, but that will only last for, perhaps, a couple of weeks.

3266. Do you cleanse the sewers intermittently?—Yes; when it is necessary.

3267. Have you provided side entrances?—Yes.

3268. How many side entrances are there?—I think 23.

3269. What does it cost you, per cubic yard to get the refuse out of the sewer?—About 2*s.* 10*d.*

3270. How many cubic yards do you take out in a year?—The quantity is very little. The cleansing of the sewers altogether does not cost more than 80*l.* a year.

3271. What is the kind of material that is taken out?—Sand and gravel, which are washed in through the gullies.

3272. What is the shape of the main sewer?—They are all egg-shaped.

3273. Have you the means of flushing them by penstocks?—Yes, we have a few.

3274. Do you flush the sewers in that way?—Yes, we do.

3275. Do you think that your district will be benefited by the low level sewer that has been constructed?—Not in any way. We lie above it, and below the mid level sewer. Our district is drained now into the Thames.

3276. Will not that drainage be brought back into the low level sewer?—It will be so intercepted.

3277. Will not that be a benefit to you?—No, it will simply be passing the sewage into the low level sewer instead of into the Thames.

3278. Is it not tide locked now by being drained into the Thames?—Not in our district, we are above that.

3279. Into what district do you drain?—We drain through Limehouse in one portion, and from Ratcliff in another.

3280. Whereabouts on the Thames do your outlets discharge themselves?—There is one at Limehouse Hole, and the other is at Ratcliff.

3281. Are those outlets offensive at any time?—Very much so.

3282. Will they not be removed when the low level sewer is finished?—Yes.

3283. Your sewage will be taken in here (*pointing to the map*) and be pumped up at the Abbey Mills pumping station?—Yes.

3284. Are you troubled much with rats in your district?—Not in our sewers, I never saw such a thing.

3285. I suppose they cannot live in the egg-shaped sewers?—No.

3286. You know, I suppose, that in the flat bottomed metropolitan sewers there are plenty of rats?—Yes.

3287. Do you think that if yours had been made with flat bottoms you would have had the same trouble?—Yes. Ours are kept perfectly clean by their own action and the regular flushing that we give them.

3288. What is the least fall that you have in your mains?—The least fall that we have is 1 in 480.

3289. What is the greatest?—I think it is 1 in 240.

3290. Have you any difficulty in keeping them clean?—No.

3291. Have any complaints been made of a stench getting back into the houses that are connected with the drains?—We may have had one or two in the course of ten years, but I think not more.

3292. Do you ventilate by down spouts?—No.

3293. Are they connected with the tributary drains?—In nearly every instance.

3294. You could ventilate if they are connected without being prevented by trapping?—All our connexions are trapped.

3295. Do you bring the spouts down and connect them?—Yes, direct from the house to the sewer.

3296. Then the spout comes on to it?—Behind it, I may say.

3297. How many soil pans or waterclosets are there in your district?—The actual number is 12,000; there are 12,000 houses.

3298. What is the population?—80,000.

3299. Have you much trouble with them?—Very little. I know that in the poorer districts the landlords are annoyed by the tenants destroying the pans.

3300. In your opinion is it preferable to have waterclosets with the trouble connected with them, or to have cesspits with their abominations?—In my view there is no comparison, the watercloset is a remedy for the other, which is a horrible nuisance.

3301. Are you troubled with the waterclosets during a frost?—I never heard of anything of the sort; occasionally there has been such a thing in a very exposed place, but it is not general.

3302. Supposing the Manchester authorities told you that it was impossible to use waterclosets with a working population, what would you say to that?—My experience would lead me to the very contrary conclusion.

3303. And your experience has been upon a large scale?—Yes.

3304. Do you know the condition of the other parishes adjoining your district; have they waterclosets in the same proportion that you have?—Yes, they have, with the exception of Bethnal Green. I do not think they have got quite the same facility that we have, but the same system is being pursued as with us; they are going on.

3305. Are they abolishing cesspits and substituting waterclosets?—They are in all the adjoining districts.

3306. Are the vestry of your parish owners of all the dust?—Yes.

3307. Do you lease it to contractors?—Yes, and it will bring us this year 550*l.*

3308. If the dust was mixed with cesspit matter, would it bring you in as large an income?—We should have to use the whole of it and we should have to pay to get rid of it.

3309. Where a watercloset is used the dust is valuable, but if a cesspit is used the dust becomes of no value?—If we were to mix the soil and the dust together, then the two would have no value.

3310. But the dry dust is valuable?—Yes.

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3311. It produces you 550*l.* a year?—Yes, and not only that, but we actually get 500*l.* for the concession.

3312. Which is an available sum, instead of having to levy a rate for that amount?—Yes; if we were to mix the dust with the soil, I think it would cost us 2,000*l.* a year to remove it.

3313. This arrangement is, in your opinion, an advantage to you to the extent of 2,500 a year?—Just so.

3314. (*Mr. Harrison.*) Have you abundant means of supplying the poorer parts of your districts with water?—I think it is very defective.

3315. How are the people generally supplied; what means are there of collecting water?—A kind of receptacle is used in the poor districts, but they are very poor things indeed, such as half a butter firkin very frequently, or a broken tub; cisterns, as a rule, are not to be seen—not proper cisterns in the poorer parts of the parish.

3316. Have you taken the trouble on any occasion to ascertain the volume of water which these people have the means of collecting when the water is on?—I am just now testing it. I have had a tank made which I am having moved from house to house, to measure the actual quantity of water supplied to them from day to day, but up to this time I am not able to give you any information. When I have completed my examination I will send you a report. I am going through the whole of the district I have referred to at the instigation, or rather at the request, of the united vestries that I have spoken of.

3317. What is the smallest quantity you have yet met with?—The quantity stored is not more than 10 gallons per house for a whole house.

3318. Do you mean for a house containing nine or twelve persons?—Yes, most of them contain as many.

3319. That is quite inadequate, is it not, for the supply of so many persons in a house?—Yes.

3320. Where do those people obtain water from for their necessary purposes?—I cannot imagine. I think it must be their habit not to use water to wash their houses with or themselves, and the little they use is to make the tea they drink.

3321. (*Chairman.*) Supposing that your parish had parliamentary power or other authority to deal with a company on behalf of the whole of the inhabitants to supply water to them, having power to levy an adequate rate, and that the means of supply were at your disposal stored in a cistern or other arrangement, do you think you could so map out your district and so control the supply, purchasing in bulk, as to give them a very much better supply than they have now, and at a cost not much greater?—I think we could give them a better supply than they have now at less cost, and a constant supply.

3322. If your parish had that power and gave you the necessary assistance, do you see your way to managing the distribution of the water, so that it should neither be wasted on the one side nor be scanty on the other?—I do. I think there would be no difficulty in it whatever.

3323. You would be supplying water to the whole at a very much less cost than each individual could obtain it for himself?—No doubt of it, taking the ordinary price which the company are permitted to charge—sixpence per 1,000 gallons—and applying that to the consumption of an ordinary household, I am satisfied that we could distribute the water much to the benefit of the water-ratepayers.

3324. Then the distributing apparatus being the property, or rather, if not the property, under the absolute control of the vestry, so that you might dictate the best form of apparatus, you could give those poor creatures an abundant supply, and it would not cost them more than it costs them now?—That is my impression.

3325. And it would be clearer water?—Yes.

3326. You would see that the tanks were kept clean?—I should not put up a tank in a house at all. I am now making an application to the company for permission to put up a block of houses of my own, and I propose to put a cistern in the centre, the water to be supplied by meter to that cistern, and then I shall supply my tenants.

3327. I meant, that each house should have a full supply, but you would make such an arrangement that you would be able to supply it to them at a much less cost than putting a cistern in each house?—Yes; and there would be no waste.

3328. (*Mr. Harrison.*) Would there not be an advantage as well in case of fire, from having a tank such as you describe?—Yes. We know that a pail of water would frequently extinguish a fire, when for want of it a house is destroyed.

3329. Would you put the tank at such an elevation as to be able to throw water over the houses in case of fire?—No, I should not be able to do that; it must necessarily be at the tops of the houses to throw it on to a house on fire, and I think it would not be advantageous for a water supply to the inhabitants, the pressure would be greater than was necessary, which would consequently lead to waste.

3330. In the case which you mentioned just now of there being inadequate means for the collection of water, and where the poor inhabitants had only 10 gallons to a house, was a house charged for the water supply according to its rental?—Yes.

3331. It was no fault of the water company that the supply was not larger, but from a defective arrangement in the house; it was the landlord's fault?—Precisely so. I believe there are many instances in which the time for which the water is turned on is inadequate for the supply. I know that there are many instances where the time for which the intermittent supply is on is not sufficient for the Saturday and Sunday requirement.

3332. How do they arrange the length of time for which the water shall be turned on?—What the plan is I do not know, but it appears to be for about 20 minutes; that seems to be their regulation, that each district shall have the water supplied for that time.

3333. Are many of the poor people in your neighbourhood employed in such a way that none of the family are left at home?—No; it frequently happens that the children are locked up in the rooms, while the parents are out, the whole day.

3334. How is the water kept in those houses?—It runs into a tub in the back yard.

3335. When that tub is filled what becomes of the overflow?—It runs to waste.

The witness withdrew.

Adjourned to Tottenham on the 18th instant.

TOTTENHAM.

W. Hall, Esq.

18 Dec. 1866.

Tottenham, Tuesday, 18th December 1866.

PRESENT:

ROBERT RAWLINSON, Esq., C.B., IN THE CHAIR.

JOHN THORNHILL HARRISON, Esq. | Professor JOHN THOMAS WAY.

WILLIAM HALL, Esq. (Tottenham), examined.

3236*. (*Chairman*). Are you chairman of the Local Board of Tottenham?—I am.

3237*. How long have you been resident in Tottenham?—32 years.

3238*. How long have you been connected with the local board?—As medical officer I have been connected with it more or less from its formation.

3239*. Has the local board carried out certain sewerage works, waterworks, and house drainage to a considerable extent?—Yes.

3240*. Do you know what becomes of the sewage after it leaves the sewers?—It passes into our works.

3241*. Have you any disinfecting works?—Yes.

3242*. Can you give the Commission any general statement as to the health of the district before and after the works had been carried out?—I can most decidedly. I made a report, which perhaps came under your notice before those works were introduced.

3243*. Have you a copy of that report here?—I do not think I can refer to it, but it was sent to you, for I observe that in some of your reports you have made extracts from it.

3244*. What was the character of the disease that prevailed in this district before you undertook your works?—Endemic fever was certainly the great characteristic of this locality.

3245*. Since you have carried out your works have you any reason to believe that the health of the inhabitants has improved?—Vastly; for the first few years after the completion of those works I thought we had almost banished fever, but within the last four or five years we have been suffering from overcrowding, which has brought it amongst us again, but it does not haunt the same localities that it did before the works were completed.

3246*. Do you think that fever is now more attributable to overcrowding than to any other cause?—Decidedly.

3247*. Can you briefly describe the locality in which fever now prevails, if there is any?—We have just got a few cases, but it is nothing now in comparison to what it was. The locality in which we have it principally is in the district where some speculating Jew builders have run up a number of miserable habitations, where there are in some 16, 18, and 22 persons living in little four-roomed houses—the Whitehall estate, I think it is generally termed.

3248*. Have you not, as a local board, power to regulate the mode in which the houses shall be erected?—No.

3249*. Are not the plans submitted to you?—Yes, but we have no power to say of what area the rooms shall be.

3250*. Have you no power to say how many inhabitants shall live in them?—We have, I believe, under a recent Act of Parliament some little power.

3251*. The last Public Health Act gives you additional power?—We expect that, but we have not put it in force just yet.

3252*. Have you framed your byelaws?—Yes.

3253*. In accordance with the regulations provided by the Local Goverment Act Office?—Yes.

3254*. Have they been confirmed by the Secretary of State?—Yes.

3255*. I assume that they do not give you sufficient power to prevent overcrowding?—No.

3256*. How are the common lodging houses regulated?—Very well.

3257*. Are they looked after by the police?—Yes.

3258*. Until recently the law allowed you to regulate a common lodging house as to overcrowding?—Exactly so; we have not tested the law upon that point yet.

3259*. Not under the new Act?—No.

3260*. Do you compel the landlords of the houses to take a supply of water from your works; do you serve them with notices?—Yes, we have power to do that, but occasionally where we have known of it, there has been a great difficulty in providing the supply of water that we could wish to have; when we have known them to have a supply of their own, we have not enforced it. I think it is now pretty general.

3261*. Have there been any complaints of the want of a water supply in any of those places where fever has prevailed, or has it been fostered do you think by the want of a proper water supply?—Upon this very estate to which I have alluded the owners are enabled to evade us. The Act says that they shall have a water supply, but not what supply; they will put on a half-inch pipe perhaps for 30 houses, and you may guess from that how much each house can get.

3262*. Have you had any complaints made as to any pollution taking place at your outfall works?—I may say that there have been numerous complaints.

3263*. Have any complaints been made by the river Lee trustees as to the condition of the outfall water before it goes into the river?—There are certain proceedings pending now upon that point.

3264*. Have the river Lee trustees given you notice of action to restrain you from letting the overflow pass into the Lee?—Yes, and the clerk to the board will give you evidence upon that point.

3265*. Have you been at all interfered with in your works by anything that has been recently done on the river Lee, either by the trustees or by the East London Waterworks Company?—We are seriously interfered with just now by the river Lee trustees. they have obtained a sort of *ad interim* injunction.

3266*. Have any public works or intercepting conduit interfered with you at all?—There is an intercepting ditch for the drainage of the parishes above us, which is a great nuisance to this parish. I believe it was made by the East London Waterworks Company, it is what we call the Catchwater Dyke; it comes from Ponder's End through our parish, and is emptied into the river Lee just above our own works.

3267*. Do you take any water from the Lee for your supply?—No; we do not unfortunately; we take it from wells.

3268*. (*Professor Way.*) Is the water hard?—No; it is water from a deep bore-hole.

3269*. Why did you say "unfortunately"?—Because it has put us to much greater expense, for the river Lee trustees have not been accommodating to us.

3270*. (*Chairman.*) You do not get so much volume?—We think that we ought to have some advantage from the Lee.

3271*. (*Professor Way.*) You cannot take it on account of the opposition of the River Lee Trust?—The East London Waterworks Company I believe have an engagement with the River Lee Trust, and the New River Company too.

3272*. You could not have the river water if you wanted it?—No; not under the present arrangement.

3273*. (*Chairman.*) Are you aware that the New River Company have power to supply water from the river Lee to the adjoining parishes for a considerable district upwards, far beyond you?—I do not know what area their powers extend over.

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3274*. Have you ever entered into any negotiations with the New River Company as to a supply of water?—Yes, and with the East London Waterworks Company too.

3275*. Did both negotiations fall through?—They did on account of the charge. The New River Company does supply the outlying portion of our parish now; the Wood Green portion of it.

3276*. (*Professor Way.*) Do you remember the old works for precipitating the sewage when Mr. Higgs introduced them?—Yes.

3277*. Was that any time before these works were put in hand?—No.

3278*. Were the two things going on simultaneously?—Yes.

3279*. Are those precipitating works in operation now?—Yes, in a modified form.

3280*. It is upon that that the injunction hangs, is it not?—Yes; we have recently sewered the Wood Green district, which is a very populous district indeed, on the other side of the parish. We had made arrangements to deal with the sewage at our works as well as with the sewage of this part of the parish, but the river Lee trustees say, "You shall not bring any addition to the works there," and it is on that question that it turns. The sewers are all laid down, and the parties have made their connexions, but they cannot use them.

3281*. Then the law proceedings do not affect your original works?—No.

3282*. (*Mr. Harrison.*) You stated that the effect of your sewerage works had been to improve the general health of the parish of Tottenham. Have they also diminished the death rate of the parish?—I should say that they have, but our death rate depends a good deal upon this circumstance perhaps: this is a parish to which many little foundlings are sent out of London to be nursed, and the number of them that die add of course very much to the number in the mortality table; but even with that addition our death rate is much below that of London.

3283*. I understood you to say that the improvement in the public health was attributable to your having taken the sewage away?—Unquestionably.

3284*. That does not touch the question of what the state of the public health might be in the neighbourhood of the sewage works where the sewage was dealt with?—No.

3285*. (*Chairman.*) Have you any idea of the number of deaths that annually take place among the children so sent into the parish and not born in it?—I really could not be certain, but I have seen a great deal of it.

3286*. (*Mr. Harrison.*) Your position is this, if I understand you, that the percentage of deaths is always very large during infancy, or that among children under five years of age there is a very much larger proportion of infants in consequence of foundlings and illegitimate children being brought into the parish than would ordinarily be found in parishes where there was no such unusual influx?—That is the case, I think, in most of the parishes in the neighbourhood of the great metropolis. I believe the death rate is not a fair criterion of the health of this parish.

The witness withdrew.

Mr. WILLIAM HEATH (Tottenham) examined.

Mr. W. Heath.

3287*. (*Chairman.*) You are a solicitor practising in Tottenham?—No; I practise in the city, but I am clerk to the board of health here.

3288*. What length of time have you been clerk to this board?—For about 15 years, from its first establishment in 1850.

3289*. For what length of time have you known Tottenham?—For about 20 years.

3290*. Do you know the river Lee?—Yes, very well indeed.

3291*. Do you know it sufficiently well to be able to speak to its condition before the works were carried out here?—Yes, I do.

3292*. In what condition was it then?—I should say that as far as this parish is concerned the amount of filth and drainage of various kinds which flowed into the Lee was larger than it is now. The ditches were in the worst state generally.

3293*. Was the refuse from the houses at that time passed into the ditches, and so sluggishly passed down those ditches into the Lee?—Yes; the overflow. The place was sewered by the old-fashioned cesspools, and the overflow from them found its way into open ditches, and discharged itself into the Lee navigation.

3294*. The overflow being in a putrid condition?—Yes.

3295*. After festering in the surface ditches it slowly crept along and got into the Lee ultimately?—Quite so.

3296*. The Lee was then more foul than it is now?—Yes, it was.

3297*. Have you any idea what addition has been made to the population since the local board was established?—I think nearly 50 per cent. Its population in the last census but one was about 9,000; that was in 1851, and in 1861 it was 13,000. In some instances I may say that the drains were made from the houses into those open ditches, so that it was not simply the overflow from the cesspools.

3298*. That was before the board was established?—Yes. In 1851 the population was 9,120, and in ten years afterwards, at the last census, in 1861, the population was 13,239.

3299*. Can you form any rough estimate as to what it is now?—I think it has increased very largely indeed, and particularly in the Wood Green district; it is not less now than 16,000.

3300*. The Lee, I suppose, is navigable through Tottenham?—Yes.

3301*. Does the East London Waterworks Company take its water below you?—No, above Tottenham; it is not affected by the state of the river Lee in Tottenham.

3302*. The parties who have been indicting you are the River Lee Trustees, and not the East London Waterworks Company?—Yes.

3303*. Are the East London Water Company joining with the River Lee Trustees in the proceedings?—I am not aware that they are; I hardly think so. The Trustees have already filed their bill in Chancery, and have obtained an interim injunction pending the hearing of the cause, which will take place in a few weeks. The interim injunction does not extend to the drainage of the parish generally, but simply to the Wood Green district. We laid out about 7,600*l.* in sewering that district; it is now an outlying district, but the population has increased so rapidly within the last few years that it became necessary to provide some drainage for that locality as well, and the board laid out the sum of 7,600*l.* in laying down a main sewer from their works to Wood Green. We were about commencing to connect the houses with that main sewer when we were stopped by the interim injunction.

3304*. Can you state about the date at which the board commenced their works, and the sums of money they have borrowed?—We commenced the works shortly after the board was established; the first thing we did was to obtain a plan on a large scale, laid down by the General Board of Health, of the entire district and that occupied something like nine months. The board was established in 1850; the works, I think, were in operation in 1852, and the main sewer was laid down in that year. Of course it took some time to make house connexions, which were made about the year 1853. Mr. James Pilbrow was the engineer then.

3305*. Did he devise the main sewerage and the waterworks?—Yes.

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3306*. How much money did you borrow for the waterworks, and the main sewerage, road improvements, and paving?—About 55,000*l.* and some odd pounds, including the roads.

3307*. What is the rateable value of the parish?—The rateable value in May 1850 was 42,816*l.*, and the rateable value in May 1861 was 58,047*l.*

3308*. Is it annually increasing?—Yes.

3309*. As you add new buildings and bring new property into operation you add to your rateable value?—Just so; it has increased in the last half year about 6,000*l.*; but that is hardly a fair criterion of the gradual increase, inasmuch as the Union Assessment Committee, appointed under the recent Act, held their sittings in Tottenham some time ago, and the assessable value of the bulk of the parish was considerably raised; therefore it can hardly be taken as a fair criterion; it does not show the gradual increase.

3310*. That gives an explanation of the sudden increase?—Yes, of 6,000*l.*

3311*. Has anything been done in your opinion to interfere with the efficiency of your sewerage outfall works?—The filing of the interim injunction has put us to very serious inconvenience, because as new houses are being built they have no means of drainage, and they are obliged temporarily to make small cesspools in the hope that something will be done.

3312*. Has anything been done in the way of works to make these works of yours less efficient than you think they were formerly?—Certainly not, they are as efficient now as ever.

3313*. I suppose you treat the sewage with lime, and take the sediment deposited out of the tanks?—Yes, the solid matter does not go into the navigation.

3314*. Have you been at all troubled with sewage and filth from the Catchwater Dyke from Enfield and Edmonton?—Yes, we have a good deal; a large quantity of filth comes down from there.

3315*. Does that pollute the river?—No doubt of it, very materially.

3316*. I suppose, if they deal fairly with all parties, they will indict the local boards of Enfield and Edmonton?—Certainly, and I may remark here that I am sorry the Commissioners had not an opportunity of inspecting the river Lee about a month or six weeks ago, when the water was drained out. If so, they would then have seen whether the nuisance complained of by the trustees resulted from the operations of our board, or what the real cause was. Between the outfall of this Catchwater Dyke and the works of the board there was an immense amount of filth in the bed and on the banks of the river between where the Catchwater Dyke enters the river Lee and our works

3317*. And some from Enfield and Edmonton?—Yes, and Ponder's End, not from our works, but all above our works. I would suggest to the Commissioners that they should apply to the trustees of the river Lee to have the water drawn off that they may see the condition of the bed.

3318*. Is the tenor of the injunction to restrain you altogether from passing your sewage into the river Lee or to restrain you from passing any additional sewage into the river?—It is to restrain us from passing in the additional sewage from the Wood Green district.

3319*. Your offence is not that you are going on as you have heretofore been doing, but that you wish to add to the original amount of that drainage?—Yes.

3320*. (*Professor Way.*) Do you propose to increase your means of dealing with the sewage, so as to comply with the terms of the injunction?—Yes, we have purchased an additional quantity of land, some of the surplus land belonging to the Tottenham and Hampstead Railway Company, and we bought it for the express purpose of constructing depositing tanks, and so forth, all of which will appear on the affidavits.

3321*. (*Chairman.*) Have you inspected the irrigation works at Croydon or at any other place?—I think our surveyor has, and I believe some of the members also have been there; I have not.

3322*. Have you at all discussed at the board that mode of disposing of the sewage?—Yes, it has been frequently discussed by the board, and an experiment has been made on a small scale, but I believe the opinion of the surveyor is that there would be some difficulty attending it on account of the peculiar nature of the soil, it being stiff clay. I know that that has been the prevalent opinion amongst persons generally.

3323*. Does land bear a very high relative value here for agricultural purposes?—Rather so.

3324*. Land immediately outside the town would fetch a price beyond its agricultural value?—Yes, it is looked upon, in fact, as building ground.

3325*. Should you have any difficulty in getting the necessary quantity of land?—Yes, extreme difficulty. I do not see any land that is available except the marshes, and some pumping apparatus would be necessary.

3326*. I suppose we may say that as a board you have not taken that question up very seriously?—No, but we have found the difficulty so great in obtaining land that we thought it almost hopeless. We have made applications to the Metropolitan Board of Works to take us into their system of sewerage.

3327*. Have you made a written application to that board?—Yes, there is an application pending now. A letter was laid before the Metropolitan Board of Works last Friday.

3328*. Will you furnish this Commission with copies of your applications and of any written replies you may have received?—Yes.

3329*. Can you state now the tenor of their reply?—We have received no written replies at present; the negotiations have been principally through our surveyor up to this time, but a short time since the matter was very serious, the question of the drainage of this and the surrounding districts has been considred, and this board called a meeting of the surrounding parishes, some eight or ten of them, to consider the general question of the drainage of that particular area. A committee was appointed to consider the question, and a meeting of the committee was held about a week or 10 days since, but only four of the parishes then united in the matter; the other parishes, from various causes, withdrew after the original meeting, and there were, I think, three parishes, and the visiting committee of the Colney Hatch Lunatic Asylum, who united in making a general application to the Metropolitan Board of Works for permission to allow Mr. Bazalgette to give an opinion as to the best means of draining the three parishes of East Barnet, Tottenham, Hornsey, and the Colney Hatch Lunatic Asylum, which I should state had been complained of very much by the Edmonton board as having been a source of great nuisance to that parish and a small part of our parish.

3330*. Are you of opinion that a combination of the parishes and townships in the district would be the most effectual method of carrying out the intercepting works that might be found necessary?—Decidedly so.

3331*. Do you think, with your knowledge of the legal powers which exist, that it would be necessary to have any new machinery to bring all the parties concerned in?—Yes; I am afraid that there are no existing powers to enable it to be done, and that it would be necessary to obtain an Act of Parliament.

3332*. If the river Lee in its entirety were put under a conservancy board with a view to suppress nuisances throughout its length and breadth, and to compel combined action, do you think that would be a benefit?—Yes.

3333*. If the necessary works were carried out in the most effectual way?—Yes.

3334*. With combined action on the part of a number of parishes which might enable them to carry out more efficient works than if they acted singly?—Yes, quite so. I imagine it would be necessary in that case to take in the whole valley of the Lee from Hertford, and not to confine it to the few parishes that were assembled together. We confined our operations to those parishes the fall of which is through our own parish, and which were suffering with ourselves, and being joint sufferers we limited our inquiry to those particular parishes. In my opinion any general scheme should embrace the whole valley of the Lee.

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3335*. Did you find difficulties in dealing with the small number of parishes which are affected like your own?—Yes, and so great that I think they are insurmountable, nothing but action on the part of the Government, which would compel parties to come in, would be effectual.

3336. (*Professor Way.*) In that case you would be independent of the metropolitan system altogether?—Quite so, that is, if they refused to take us in. Looking at the large increase of the population that is likely to spring up within their present area, I believe it is thought that their sewers are not sufficiently large to take in sewage from other districts. I believe that that is Mr. Bazalgette's opinion.

3337. (*Mr. Harrison.*) How far does that intercepting sewer extend up the valley of the Lee?—It comes down I believe from Ponder's End to Tottenham Mills, about a quarter of a mile above our works.

3338. The district throughout the whole distance between this and Hertford is becoming populous by degrees?—Yes, and of course the nearer you come to London the more rapidly the population is increasing.

3339. The houses are almost continuous now to Hertford, are they not?—Hardly so, but as far as Ponder's End they are. I may mention that there is a very large amount of filth, which flows along the ditches into the river Lee between this and Hertford, from Waltham, Cheshunt, and Ponder's End.

3340. Have any complaints been made by your board to the East London Water Company as to the intercepting sewer?—No; it was made by virtue of an Act of Parliament, and we did not think it was worth while to make any complaint upon the subject; there was a special Act passed, although we think, perhaps, that the powers given by the Act have been exceeded. No doubt the intention of the Catchwater Dyke was to provide for the drainage then existing; it did not contemplate carrying the sewage directly into the Catchwater Dyke.

3341. That not only takes the sewage but the flood water of the district above?—Yes.

3342. So that all the water falling upon the district adjacent to that passes into it, and into the river Lee, below the point from which the East London Waterworks Company take their supply?—A great deal of it does—that which is not carried off by the other ditches and streams.

3343. (*Professor Way.*) Is any use made of the Lee water below Tottenham for domestic purposes?—To a certain extent I understand it is.

3344. It does not furnish a water supply of any consequence?—No; not on any large scale.

3345. The complaint against you would be, not of fouling the water for the supply of the town, but of a general fouling of the water?—Yes.

3346. The injunction which is pending refers to the question of the Wood Green sewage?—Yes.

3347. And that will be tried on its merits?—Just so.

3348. If that decree is made perpetual will that affect the question of your other works or will it not in point of fact condemn the principle?—It would place us in a difficulty, as one part of the parish only would be drained, and in fact a great portion of the expense which has been incurred in draining the other part of the parish would be rendered futile.

3349. You have done something with the Wood Green district other than the method you are pursuing in the other?—Yes.

3350. If the Vice-Chancellor should decree that you shall not do what you have already done with the rest of the sewage, shall you not have to resort to some other plan?—Yes.

3351. You will have two systems under your jurisdiction; dealing with the sewage by precipitation has been condemned inferentially, and probably the improved method of dealing with the sewage in the case of Wood Green will be prohibited?—Yes.

3352. Will not that be a very awkward condition of things for you?—Yes, very awkward indeed. The fall from the Wood Green district is entirely in this direction, and if that is drained by the old system of cesspools, the overflow must get into the ditches and contaminate them, and a large portion of the expense incurred will be utterly useless. I think there ought to be a general system of some kind applicable to the entire parish.

3353. When were the works that have been executed first carried out?—Some few years after the board was established. I think in about 1854.

3354. Twelve years ago?—Yes, just after the house drainage was carried out, and private improvements. In the first place we laid our main sewers and our water mains simultaneously.

3355. Were they arranged for the probable increase in population?—Yes; a certain amount of increase of population was anticipated, I believe, by Mr. Pilbrow, but not sufficient to meet the requirements of the case. We have had to increase our works, and to enlarge some of our water mains.

3356. I am referring to the precipitating works?—They have not been enlarged.

3357. Have you found any difficulty from the size of them with the increased quantity of sewage consequent upon the increased population?—I think they would be improved if there were some additional depositing tanks, and we have recently bought about an acre of land for that purpose.

3358. Was that with reference to the Wood Green district?—Yes, and to the district generally.

3359. (*Mr. Harrison.*) Was it proposed by you to deliver the sewage after passing it through the process into the river Lee by a new outfall?—No; by the present outfall, there is only one.

3360. (*Professor Way.*) Do you consider that you have a prescriptive right to carry the drainage into the Lee?—Yes; we have a prescriptive right to take the drainage into the river Lee; it always went there. We say, as far as this particular parish is concerned, that the amount of filth which goes into the navigation is far less now than it was at the time of the establishment of our works. I ought to mention as to the Wood Green district that before this sewer was laid down recently all the drainage from the Wood Green district was passed through our ditches into the river Lee. That was before it became increased by the increase of population, and I should not give a complete idea as to the drainage of Wood Green, unless I said that a much larger quantity of drainage comes down our ditches from a large part of the parish of Hornsey and South Hornsey. That was the subject of the lawsuit between this board and the sanitary authorities at Hornsey sometime ago. We filed a bill against them because the nuisance had become so intolerable, and a large amount of sickness had been caused at Wood Green by a large sewer that they carried out in connexion with the Muswell stream, and we filed the bill against the sanitary committee. Unfortunately there was no local board established there, the sanitary committee being the only committee chosen and appointed under the Nuisances Removal Act. When the case was called on before Vice-Chancellor Wood, the difficulty that we experienced was this, that there was no public body against whom we could proceed, and the law was in such an imperfect state, that all the Vice-Chancellor could do was to make a general decree that the local authorities at Hornsey should bring no additional sewage through Tottenham. But we were obliged to put up with the existing sewage, which was a very great nuisance; this was before the passing of the recent Act, but under that Act we shall probably have enlarged powers.

3361. Is not that an additional reason why some general legislative measure should be passed for a conservancy of the entire river Lee and its tributaries?—Yes, decidedly so, because that nuisance which is

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very great now is increasing every year from increase of population.

3362. Are you not doing for Hornsey what the river Lee trustees are doing for you?—Not now; we were doing so. We took proceedings against them, because we thought that the complaint which was made by the trustees of the river Lee arose, not so much from what we were doing as from what other persons were doing, because they sent their sewage through our parish.

3363. Is there anything further that you think you can add to your evidence?—I think not.

The witness withdrew.

Mr. Peter P. Marshall, C.E. (Tottenham), examined.

Mr. P. P. Marshall, C.E.

3364. (*Chairman.*) You are surveyor to the local board of Tottenham?—Yes.

3365. How long have you acted in that capacity?—For about nine years.

3366. What is the area of the parish of Tottenham under the jurisdiction of the board?—4,624.

3367. It is a very large area?—Yes.

3368. Are the whole of the highways within the parish under your charge?—Yes.

3369. Do any turnpike roads pass through it?—Yes.

3370. You have nothing to do with trustees of roads?—No; we have not.

3371. You have a system of sewerage I assume in Tottenham?—Yes.

3372. Was that laid out in the first instance by Mr. Pilbrow?—Yes.

3373. Has there been any other surveyor between him and you?—No, there has not.

3374. You have taken up the works as they were left by Mr. Pilbrow?—Yes.

3375. All that has been done since you have done?—Yes.

3376. Were you surveyor at the time when Mr. Higgs devised and carried out his disinfecting works?—No; they were in operation when I came here. Mr. Higgs was then living, and carrying on the works.

3377. Do the works remain now as they were established by him?—Yes.

3378. Was there not a large liming tank in which he treated the sewage?—Yes, and that is there now; in fact, everything stands as he left it.

3379. Is it used now as it was then?—No.

3380. You do not use the large liming tank?—Not the upper one.

3381. Do you carry on the liming and disinfecting process in a similar manner to what he did under the terms of his patent?—No; it is not the same, we do not use the upper tank, but we put in the lime.

3382. Do you use disinfecting material in a similar manner, and as much?—Yes, quite as much.

3383. Do you know what price Mr. Higgs anticipated getting for the sediment when the sewage was so treated by himself in the first instance?—I think it was about 5*l.* per ton that he expected to get.

3384. Was any of it sold for that price?—I believe there was. When they sold us the works we sold the remains of deodorised sewage that were left there when Mr. Higgs' people broke down. There was a very large quantity in various forms left on the premises, and they said they would like to take it away, and there was a sale by auction, but I believe that the amount that was got for the whole did not pay for the expenses of the auction.

3385. The trustees of Mr. Higgs' estate asked for leave to dispose of it, and it was sold by auction?—Yes; I should mention that the whole affair fell into the hands of Messrs. Baxter, Rose, and Norton, who supplied the funds to establish the process, and when we bought the works from Mr. Baxter he said that he should like to have the remainder of the manure disposed of, and we ordered Mr. Richards, the auctioneer, to sell it, but it appears that he said that the less we said about it the better, for there was not enough received to pay the auctioneer's expenses.

3386. Do you know upon what terms the works fell into your hands?—We bought them absolutely as they stood.

3387. Did you pay anything for the patent right to use the disinfecting material?—No; it was not asked for.

3388. Do you know what proportion the sum paid by you bore to the first cost of the works, did you pay the first cost, or only a part of it?—We paid nothing like the first cost.

3389. Do you know what the first cost was?—No further than that Mr. Baxter said he had spent upwards of 2000*l.* I think we gave 500*l.*; the land belonged to the board.

3390. You had allowed Mr. Higgs to put up his works there?—Yes.

3391. You gave 500*l.* for all the buildings as they stood?—Yes.

3392. And you have gone on using the ordinary liming tank since?—Yes.

3393. Do you dispose of the sediment now for agricultural purposes?—Yes, we do.

3394. Do you know what weight you take out per week, or month, or year?—Not exactly; but the quantity does not come to very much. I think we have got out perhaps 50 tons when we cleaned it out, and we thought there might be from two to three tons a week.

3395. That would make about 100 tons a year?—About that; that is weighing it when it is rather dry. The sewage deposit loses in weight very considerably by drying.

3396. Have you any difficulty in getting rid of it now?—No, not when it is ready to cart, but we cannot get any remunerative price for it.

3397. What do you get for it?—We generally sell it in a heap to any person who is handy to cart it away, and they will give from 5*l.* to 8*l.* or 10*l.* for it, according to the quantity we have.

3398. Does that amount to 1*s.* or 1*s.* 6*d.* a ton?—Perhaps that, or 2*s.* 6*d.* We extract a great deal before it passes into the tank, which is rather valuable manure; it has never been treated with lime, it is fresh, and it is considered more valuable than the other part.

3399. How many gallons of sewage a day on the average have you to deal with?—The amount varies at different times, but the pipe is an 18-inch pipe, and taking it as running at about 13½ inches of water, that gives about 700,000 gallons in 12 hours.

3400. Is it running all the 24 hours?—Yes; sometimes it is not so high as that, and sometimes it is fuller; in wet weather it sometimes runs quite full; in the summer time I have seen it considerably below that, probably delivering only half that quantity.

3401. Have you any means of dealing with the full pipe of your settling tanks, or do you allow the sewage to run through the tank?—Yes; lately we have, right into the river, in the same way as the other does.

3402. It takes its chance of taking out the sediment then?—Yes; through a sort of filter that we have.

3403. Is the liming process carried on night and day?—No.

3404. What power have you at work in mixing the lime?—We throw the lime into a little tank outside, and it mixes itself in with the sewage.

3405. What weight of lime do you use in a day or a week?—In the summer time we use more than in the winter time. I think in the summer time it is a cubic yard a week.

3406. (*Professor Way.*) Does that weigh half a ton?—Yes, quite that; that is in the very worst period, the hottest time; we used more this year than ever was used before.

3407. (*Chairman.*) From what amount of population does the sewage flow into and through the tank?—From the whole population of the lower district, we estimate it at about 7,000 or 10,000.

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3408. What number of waterclosets would there be for that population?—There is a watercloset on the average to every house, with the exception of the very small ones; sometimes we have a waterclost to two or three or more houses; but I think I might say there are 2,000 waterclosets.

3409. Connected with that system?—I think so. This is a survey that I made of the old works with a sketch of some proposed new tanks (*handing in and explaining the same.*)

3410. (*Professor Way.*) Is the lime put in by hand?—Yes; there is a man there both day and night.

3411. And you get a quantity of solid matter in the tank?—Yes, it very soon fills up.

3412. (*Chairman.*) What can you get a ton for it?—We sell them the two; a man will not take the one without he gets a little of the other, and we sell them off in lots.

3413. How much a year does it cost you to work these outlet tanks?—It costs us a little more than the wages and the lime at present. I should say that it costs us perhaps 100*l.* per annum now.

3414. Does the lime cost you 100*l.*?—No, we employ a man, and we pay him about 12*s.* or 18*s.* a week; another we pay 1*l.* a week, the two together and the lime will come to about 150*l.* a year at the outside.

3415. What return does it make you?—Very little.

3416. 20*l.* a year?—Not much more than that; it is an unprofitable affair, if we had worked the tanks it would have been still more expensive.

3417. You mean according to Mr. Higgs' first process?—Yes, because the sewage has all to be pumped up into the upper tank.

3418. What is lime worth per ton in Tottenham?—About 1*s.* a bushel.

3419. How many bushels are there in a ton?—About 36.

3420. Does it cost you about 36*s.* a ton?—Yes, we use the ground grey lime.

3421. What do you pay for that a ton?—About 12*s.* a cube yard; that is about half a ton.

3422 (*Professor Way.*) You say that you sometimes use half a ton in a day?—Yes, during the summer throughout the parish.

3423. On the average do you use a quarter of a ton a day?—I do not think so.

3424. (*Chairman.*) Are there any cesspools remaining in that district, the greater part of which drains down to the outlet?—None almost.

3425. You may speak of that as the sewer drain and watercloset district?—Yes, completed.

3426. (*Mr. Harrison.*) Do not the New River Company carry out the same system of purification at Hertford?—I have not seen the Hertford works, but I believe they are somewhat analogous.

3427. Have you taken any opportunity of examining the effluent water from the Hertford works in order to compare it with the water from your works—No, I have not.

3428. (*Chairman.*) Have you ever tried sewage irrigation below your outlet?—Yes.

3429. Upon what area of land?—About 40 acres; we obtained the consent of the occupier to lay down some irrigating sewers, that was about two years ago.

3430. Did you supply the sewage by gravity, or had you to pump it?—We had to pump it up to a certain height, and let it flow by gravitation over the land.

3431. For what time did you continue the experiment, and at what time of the year?—We began, I think, in the beginning of the summer.

3432. Of what year?—It is now two years ago; in 1864 we pumped the water up through the main that we laid down for the purpose, and allowed it to flow through channels cut on the contour of the hill, on to stiffish clay soil, and the great difficulty was on the part of the people who owned the land; they would not allow the grass to be cut more than once, and they will only permit us to irrigate it at their will and pleasure. The application of the sewage has been very satisfactory to every person as far as both purifying the sewage material, and increasing the growth of the grass, but during the winter months, or indeed as soon as the occupier got the hay off, horses and cattle were put into the field, and they poached up all the ditches, so that we could not carry on the system.

3433. You irrigated the natural grasses of the meadow?—Yes.

3434. No particular cost was gone to to prepare it specially for irrigation?—Nothing but cutting the irrigating channels that were necessary to conduct the sewage along the contoured face of the hill.

3435. It was successful until it was interfered with by turning the cattle on during the winter; they trod down your channels, and paddled up the surface?—Yes, they made a mess of it; the occupier did not attend properly to it.

3436. If that small piece of 40 acres had been under your own control to deal with as you thought best, do you think you saw in that experiment results which might have been secured continuously?—I am perfectly certain of it.

3437. You could have got a large increase of produce and have carried on the works so as to purify the sewage?—Yes; if we had had a sufficient area of land, and had had it under our own control, it might have been adapted for the purpose very perfectly. Our sewage might have been cleared. There would have been no smell and a wonderful growth of grass.

3438. If that could have been brought about, I assume that you would have advised your board to apply the sewage to the land, and after that to sublet the land, and the sewage to be worked under stipulations that you might dictate?—Yes, that is the view I take of it, and, indeed, the only way is for the board to get possession of the land and make the necessary works, and then afterwards offer them to the highest bidder. I believe that they would receive a sufficient return to pay them for the expense.

3439. Would it not save them the present outlay they are making on disinfecting works?—Yes, I think there is no doubt of it.

3440. Would it not also prevent them from getting into litigation with the river Lee trustees?—Yes. The only difficulty is our close proximity to London. There is a most violent prejudice on the part of the people here against sewage irrigation, and not only amongst the people who live near it, but amongst the farmers generally in the neighbourhood; they will not use it. We offered to lay it on to a farmer's land, and he said that he was quite satisfied it would kill his crops if it was allowed to run over his ground.

3441. (*Professor Way.*) Your proximity to London will ultimately be an advantage to you as offering an outlet for your produce?—Yes, but that is more than counterbalanced by the terror that people have of it.

3442. But that, I should think, is only transitory?—I think not.

3443. (*Chairman.*) Have you witnessed the Croydon mode of irrigating land?—Yes.

3444. Recently?—No.

3445. Have you seen the irrigation as carried on at South Norwood?—No.

3446. Do you know that the sewage there passes on to stiff clay?—I believe it does. We found that the clay and the grass so clarified the sewage as to make it as clear as crystal—so clear that one member of the deputation tasted it, and could not taste anything in it; but the value of land here is so great that owners would ask for land for the purpose 1,000*l.* an acre, and they are so terrified and alarmed lest it should injure other places in the neighbourhood in a building point of view that if we are going to have a sewage farm I am sure we must get sufficiently far away from this neighbourhood.

3447. (*Mr. Harrison.*) If you were to carry the sewage towards the marshes would it be the same?—The marshes, being common land, are very much used for recreation grounds, and I apprehend there

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would be great difficulty in getting permission to turn them into sewage meadows, for then they could not be used as recreation grounds.

3448. (*Chairman.*) Any more than you could use them for grazing purposes?—No.

3449. You say that any smell there might have been in the sewage was immediately absorbed. Was it in the summer time when you carried out the experiment you have mentioned?—Yes, and we found that if the sewage was properly applied to the land there was no smell; if an excessive quantity was put on it ran forward and collected in pools from the inequality of the ground, and if not properly levelled there might be a smell then.

3450. (*Mr. Harrison.*) Are you aware that a bill is likely to come before Parliament in the ensuing session for the enclosure of these common lands, promoted by Mr. Bailey Denton, the engineer?—There is, I believe, a proposal to drain the valley, and he intends to go to Parliament to obtain a bill to drain some of the low-lying grounds in the neighbourhood of Stratford and Bow. I pointed out to him the advantage it would be if a large sewer was constructed there to continue it up the valley, and so take in the whole of the drainage on both sides. We pointed out the nature of our difficulty as we found it, and we thought the only relief would be to let the sewage be taken to Barking, and thence on to the Maplin Sands. Under these circumstances I believe he has given notice of his intention to apply to Parliament for a scheme to unite the whole of the parishes under one common board, and he proposed to go as far as Waltham. There we found that the East London Waterworks Company had devised a scheme to intercept the sewage of the valley on both sides, and we proposed to catch the sewage there and bring it down through the valley to Stratford, which pumps its sewage direct into the Lee now, and so on to Barking, that it might be dealt with.

3451. (*Chairman.*) Have you any plan showing any proposed works that you have to intercept and carry away the refuse sewage of your own district or the combined districts?—I have made a sketch (*producing the same.*) We find that we are exposed to three great evils.

3452. Have you laid down any scheme for dealing with the sewage upon any plan?—I have laid it down on this inch Ordnance map, which shows the whole of the district outside the metropolitan boundary.

3453. Where do your intercepting sewers begin, and where is it proposed they should end?—I will explain (*describing on the map*).

3454. Does your parish abut upon the metropolitan area?—It does.

3455. You are, like West Ham, just outside the metropolitan area?—Yes; it was proposed to intercept the Lee sewage as it flows from Cheshunt on the west side of the Lee, because the East London Water Company had in contemplation a system of sewerage to intercept the sewage above that, which would join this sewer about Waltham Abbey. We proposed to intercept all the sewage from Enfield, Enfield highway, and the various villages that lie on the main road to London, Tottenham, and Edmonton, and also to receive into the same sewer the drainage from Colney Hatch Lunatic Asylum, which is at present a matter of litigation, and also from Hornsey, which has no outlet in the way of drainage, from Barnet and other districts, there being a natural watershed towards the river Lee.

3456. From the west?—Yes. The eastern catchwater was to go up the eastern side of the river Lee, beginning at Waltham Abbey, to follow the river Lee and take in Sewardstone, High Beach, Chingford, Chapel End, Walthamstowe, and that district which is becoming rapidly populous with no means of drainage. Then it would form a connexion with the sewerage that had been brought from the west side of the Lee, and the two would unite in one channel at High Hill Ferry, upon the west side of the Great Eastern Railway.

3457. Through what district would it then go?—Through the town or village of Stratford, and direct across the Plaistow marshes.

3458. By an independent outlet would the sewage be carried to Barking Creek?—Yes, it would be low down enough to take all the drainage of the low lands there.

3459. To be discharged into the Thames at Barking Creek?—Yes; either into the Thames in the same manner as the metropolitan system does, or to lift it up by pumping into the Maplin Sands scheme, and so go to the Essex marshes.

3460. (*Professor Way.*) What volume of water do you imagine would be taken down in that way?—I have not calculated that.

3461. Do you know what provision is being made, beginning from Barking and going to the Essex Sands, as to the size of the culvert to be constructed?—I may remark that we do not propose to take the storm water.

3462. (*Chairman.*) Only the dry weather flow of the sewage?—Yes, and as little of the other as we can help. We consider, supposing the Maplin Sands scheme would not do, that it would bring us to a point where we could irrigate; it might be turned more to the north, and so get into the low lying lands of Essex.

3463. (*Mr. Harrison.*) Has this scheme assumed any definite shape?—We called a meeting, and notice was given of an application to be made to Parliament for a bill to enable all the parishes interested to combine and form a central sewage area. It was proposed that they should carry out some scheme, we did not say what, for the purpose of making an outlet for the whole of the district, and it was intended that they should all be rated according to their value, and it was thought that the powers of the present Act of Parliament would be enough to enable them to carry out the works. We had a meeting here in Tottenham of the persons who were interested in the matter, and we found after the meeting had taken place, that few of them were inclined to incur the expense of going to Parliament, or to take any course, and I believe that now an application has been made to the Metropolitan Board of Works to ask whether there is any prospect of getting an outlet into their system of sewers. Mr. Bazalgette has been requested to come down here and report upon the matter.

3464. Has the East London Water Company taken any steps to extend their intercepting system above the present point?—Yes, they have given notice, and have deposited plans for a new system of sewers, to have their outlet in the present Catchwater Dyke, which passes through our parish. They begin at Ponder's End, and take the sewer along the high road in Ponder's End towards Waltham Cross; they also take a sewer along the valley to catch the sewage from the Ordnance factory. They then cross the river Lee, and extend their sewage pipes to Waltham Abbey, so that their proposal is to bring all the sewage from Enfield, Ponder's End, Waltham Abbey, and that district, into the Catchwater Dyke that runs through our parish.

3465. Is that Catchwater Dyke complained of by the people in your parish now?—At times it becomes a considerable nuisance, and is complained of.

3466. When the water is low in the summer time?—Yes.

3467. Have you found it to be objectionable yourself?—Yes, and when the Government inspector saw it he said that he thought it was a very serious nuisance—Mr. Morgan.

3468. When was that?—In the last summer.

3469. In what month?—I think it was in July.

3470. Is it part of the East London Water Company's scheme to cover the sewer?—I do not think it is.

3471. If their proposal is carried out to bring sewage from places above Waltham, will not that increase the nuisance arising from the intercepting sewer?—Very much indeed.

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3472. (*Professor Way.*) Are you aware that the Metropolitan Sewage Company propose ultimately to deal with the sewage in the whole line of their culvert?—Yes.

3473. Would it not be something like taking coals to Newcastle, to take your sewage to a place where the ground is already occupied by the metropolitan sewers?—Yes, but we cannot apply it here about.

3474. If the metropolitan sewage is diverted to the Maplin Sands, you would not be allowed to discharge your sewage into the river after that had been done?—No. I believe as to the Maplin Sands scheme, that they would be very willing to get more sewage than they have if another system could be devised. We cannot dispose of it so close to London as we are now, and if we tried to send it over the heights into Essex, we must pump it over.

3475. That is if you accumulate the sewage from a number of towns?—Yes; we have sketched out a plan for the purpose of disposing of it by gravitation, by intercepting it at certain points. Our outlet is very little above high-water mark.

3476. (*Chairman.*) Do you know about what length of main sewers you have in Tottenham now?—I cannot answer that exactly.

3477. Are the sewers permanently ventilated?—There is no ventilating apparatus, so called, beyond the connexion of the drain water pipes at intervals with the sewers at high levels, and that we find effects ventilation.

3478. Have you not found any necessity for permanently ventilating them?—No; we have found our sewers remarkably free from smell when opened, because the flow is so rapid through them.

3479. What is the size of the largest of them?—18 inches; it is an earthenware pipe.

3480. Are there any sewers made of brick?—None.

3481. Then Tottenham is entirely sewered by earthenware pipes?—Entirely.

3482. How many years have they been in operation now?—I suppose upwards of 12 years.

3483. Has there been any bursting in that period?—We have had a settlement in the small pipes frequently but not in the mains. We have had as many as upwards of 40 houses in one part of the district, which drained into a 7½-inch pipe, and that was very liable to stoppage, so we removed it and put in a 9-inch pipe.

3484. I believe nearly all the roads throughout Tottenham, which is of great length, are macadamized?—The parish highways are of gravel; the main road is macadamized.

3485. None of the roads are paved?—None.

3486. I suppose there is a large amount of grit formed on the surface of the main roads by traffic?—Yes.

3487. Looking at the character of the district, which is tolerably flat, what is the fall in your outlet sewer?—Very slight; in one place it is one in 1,000, and in another one in 600.

3488. What is the fall generally in your other gradients?—They are all rather flattish; about 1 in 300 or 1 in 700.

3489. What number of gullies is there?—Not one; we do not permit any surface water to go in.

3490. You pass it into the natural watercourses of the district?—Into the old watercourses of the district.

3491. Do you find a difficulty in carrying it off?—Yes; as the district gets inhabited and population increases, it is a very difficult matter to preserve those old watercourses; indeed, it forces upon us a double system almost.

3492. Do you think that that double system would have its advantages if you had to deal with the sewage proper?—I think it would have in that respect.

3493. Does much subsoil water find its way into your system of pipe drains out of the gravel?—I apprehend that it does in those pipes which have been laid down in the old district. As to the ones I laid down I know that it cannot get in, because I laid them down to avoid that.

3494. You know what volume of water is supplied to the inhabitants for domestic purposes, and the quantity that issues from the sewer's mouth. Can you form a notion as to whether much additional volume finds its way into the sewers as compared with what is pumped into the district?—Yes, we sometimes have the pipe quite full.

3495. (*Mr. Harrison.*) Are you speaking of 12 hours?—Yes.

3496. (*Chairman.*) Are the down spouts from the houses connected with the drains?—A good number of them are; I think we get a good deal of water from roofs and yards that we cannot keep out altogether.

3497. When were your waterworks established?—I believe at the same time that the sewage works were.

3498. What did they cost?—The original waterworks consisted of a surface well bore-hole and a small pair of engines, by which the water was pumped into the main.

3499. Was the water drawn from the chalk?—Yes.

3500. Have the works been added to?—Yes; the next addition was made by Mr. Pilbrow, who put up a larger engine and sunk two other bore-holes in a place a mile distant from the former one; then he laid a perforated pipe in a bed of gravel, which underlies the upper clay in the valley, and brought all the water into a tank and pumped from that.

3501. What was the quality of that water from the gravel?—It was very hard and full of iron, so full that every pipe and everything we had was affected by it.

3502. Did you abandon it?—We had no other supply that we could go to except what we got from the surface bore-holes, that is to say, delivering all their water about 10 or 15 feet from the surface.

3503. Have you constructed some additional works?—We have made a new well. In the summer the water from the land springs fell off, and we sunk a well and put down a new set of pumps to the depth of about 65 feet, and we have pumped water from that source during the present year.

3504. Have you gone down into the chalk?—Yes, it is an 18-inch bore-hole at a depth of 260 feet; we have been pumping with a set of three-throw pumps, and in 42 hours we have raised, I calculate, 400,000 gallons.

3505. Is the supply pretty steady?—Yes, we keep the water down at that depth.

3506. Is it as much in volume now as when you first began?—We do not find any difference.

3507. It gives you a steady supply?—Yes, it stands at about what I have stated.

3508. Do you consider that these works are successful?—Yes, as far as they go.

3509. What did those works cost you?—Upon the whole they cost us 2,000*l.* The new well and pumps cost us 2,000*l.*

3510. And by these means you obtain 400,000 gallons a day?—Yes; the new engine was necessary independently of the well, as we had only one engine before.

3511. Are the pipes at all affected by the oxide of iron that you have mentioned?—Yes; I can show you hundreds of yards of pipe which have been destroyed by it.

3512. Do you use that ochrey water now?—During the summer we have very little of it to use; what little we get we use; we use a portion of it now.

3513. Does that affect the other water by mixing with it?—No, it does not; it is only after it stands for some time.

3514. (*Mr. Harrison.*) At what depth is that gravel bed below the surface?—From 10 to 16 feet.

3515. In what direction does it extend?—Right across the whole valley of the Lee. When the East London Water Company were making a catchwater reservoir, they had to cut through this and form a

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puddle trench; they put up temporary pumping engines, and the water in the trench was as clear as crystal, but when it was turned into the Lee, and had mixed with the other water, it began to turn red, and you could see a distinct stream of red water. I believe it is not unhealthy, but it is hard. When they have been pumping through the ditches, the water is coloured by a ferruginous deposit of clay.

3516. Had you much trouble in keeping that water out during the construction of the works?—Yes, considerable, for there was a great deal of it.

3517. Is there any communication between that bed of gravel and the river Lee itself?—I think not.

3518. Why?—Because I think that if there had been they could not have kept the puddle trench clear with their pumping power if the water had come in from the river.

3519. Does the gravel bed extend at all to the westward under the town?—We come always upon it before we reach the London clay. We are getting it now about half a mile from the river.

3520. How far westward from Tottenham across does it extend towards Hornsey?—The beds of clay are so thick there that we have not been able to trace it, but it evidently has a declination towards the west.

3521. Does it get deeper towards the west?—Yes; it has been traced down the whole valley of the Lee. It seems to have been originally washed down from some upper ground and deposited in the Lee; it is much rougher when you get to the bottom than it is at the top; of course the river's action can be traced upon it.

3522. At present you say you are prevented from carrying out a system of sewerage in the increasing part of Tottenham, but what becomes of it in the meantime?—The parts which are not connected with our drains have overflows from cesspools, and these overflows go into the various streams.

3523. Are those cesspools constructed in this bed of gravel?—No, they are in clay in that neighbourhood. The gravel ceases as the sides of the valley rise, and we come directly on the London clay.

3524. Is there a bed of clay lying above the bed of gravel?—Yes, there is a considerable elevation in the Wood Green district, and that is caused by a bed of clay of considerable thickness.

3525. Does that bed of clay extend over the gravel bed at Tottenham and across towards the Lee?—There is a little clay on the top of the gravel always, even at the thinnest part.

3526. Is there between the bed of the river Lee and this bed of gravel a bed of clay?—I think so.

3527. In constructing the reservoirs they used puddle for the puddle trenches?—Yes.

3528. Where did they get the clay from?—There was plenty of clay dug up, and they deepened the puddle trench considerably, but whether they got enough out of the puddle trench to make the whole of the puddle I do not know, but there was a bed of loomy clay on the top of the gravel as well.

3529. And that they used?—Yes; there is a considerable quantity of clay; you may see it at this time for they are making a large quantity of bricks at the side of the reservoir. We have always found a little clay before you get on to the gravel, even at the thinnest part.

3530. (*Mr. Harrison.*) You say that whatever cesspits there are in the upper part of Tottenham they are formed in impervious clay, and therefore there cannot be any communication between them and the gravel bed below?—None.

3531. Is that the case also in Tottenham proper?—No; for instance, in the Page Green district, where an inquiry was made, there the shallow wells are in the gravel; you go through 3 feet of loam and clay on the top, and come to the gravel, and the cesspools that were constructed in that district of course were also in gravel.

3532. There would be a communication in that case between the cesspool and the water in the gravel?—No doubt of it. We have sewered the whole district in order to do away with the cesspools as far as we could; but some people I think in one or two cases retained them.

3533. This bed of gravel to a greater or lesser extent is in communication with some of the cesspools which exist in the neighbourhood?—In our neighbourhood it is not so; in Edmonton there are plenty of cesspools made in it.

3534. Should you not expect that the gravel bed would rise more or less with the valley?—It does.

3535. Then if there are cesspools in Edmonton made in this gravel bed would not they be apt to contaminate the water which you pump from it in Tottenham?—I have no doubt that there is a soakage from those cesspits into the gravel.

3536. Knowing that do you think that that bed of gravel is a proper source of water supply for Edmonton?—I do not think that it is good water, but they use it exclusively in Edmonton and everywhere round the district; they prefer it very much to almost any other water, and a number of people also use it here.

3537. (*Professor Way.*) You stated that it would be difficult at Tottenham to obtain land for the application of the sewage; would it be easier, do you think, to get land in two or three places than to get it all in one spot for the same purpose; for example, could you get 40 acres in one place and 40 in another and 80 elsewhere?—In Tottenham I do not think you could get an inch of land, and I have advised the board to go over into Essex, where we could get 500 acres of land as easily as one, and pump the sewage right over to that land.

3538. (*Chairman.*) I suppose it would be a question between the cost of pumping and making a proper conduit, if you could get land cheap at a distance, and paying a much larger price for it with all the difficulties you have named where it would pass away by gravitation?—I think we could separate portions of the sewage in the upper parts of the district; it could be delivered by gravitation if we could get land in the valley of the Lee.

3539. You think there would be great difficulty because of the cost and the prejudice which exists against it?—Yes; I am certain we could not get any land here. The only feasible plan is to collect the sewage because the variations in the fall are so slight, to get all the sewage down to a convenient point to deal with it, and carry it by gravitation to a proper spot.

3540. If you were by injunction forced either into one scheme or the other, would it by any means purify the whole of the Lee if it left out the other districts?—Certainly not.

3541. Do you think that after they had dealt with you by injunction they would leave all the impurities arising from other districts with increasing populations unmeddled with, would they not take take the same course with them as with you?—Yes.

3542. Looking at it in that light would it not be very advisable indeed that some comprehensive scheme should be undertaken for the whole of the districts which require the same improvement?—I have thought it over with great care, and I am certain that unless some comprehensive scheme is devised, there will be no other satisfactory means of getting rid of the evil, for if we get rid of our sewage we are immediately troubled with the sewage coming in from Hornsey, Barnet, and Colney Hatch, so that although we may purify ourselves we are liable to have the sewage from other places sent in upon us.

3543. I suppose you might have actions brought against you for pollutions in your area which do not originate with you?—We have had that, positively the very thing has occurred. We have now an action pending against us by the river Lee trustees, and we have commenced an action against Hornsey, and Colney Hatch has an action again Edmonton, and Edmonton has an action against us.

3544. (*Professor Way.*) If any scheme was to originate with the legislature as to the valley of the Lee, I presume it would have the support of your board?—Yes, most decidedly; but the difficulty we have to contend with is in the case of parishes that are rather remote, and which do not immediately feel the pressure and the want of drainage.

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3545. (*Chairman.*) Are not the East London Waterworks Company now making intercepting sewers further up the Lee?—Yes, I have given a sort of sketch of it; they propose to deal with the sewage from Ponder's End, Enfield, and Waltham Cross.

3546. The East London Water Company has given notice of their intention to apply to Parliament?—Yes.

3547. (*Mr. Harrison.*) Is there much large traffic to Tottenham upon the Lee navigation?—There is only one wharf, and I do not think there is a great deal, it is mostly to bring building materials and stone for the roads.

3548. Is the greater part of the traffic carried on by the railway?—I think, speaking of local traffic, that the road carries a great deal more than either of the two, the traffic has increased enormously on the roads for building purposes.

3549. How are the people of Tottenham chiefly employed?—A great number of them are engaged in London, and they have their residences down here.

3550. I mean the poorer people?—They are engaged in various ways, a number of them are occupied in various building operations that are going on here.

3551. Are there market gardens to any extent?—Yes, of very considerable value.

3552. Is the produce carried along the road to London?—Yes, it is taken to London in waggons.

3553. Is there much cattle traffic on the railway?—Before the cattle plague the traffic in cattle was enormous.

3554. In your judgment no very decided advantage is gained to Tottenham by the navigation being kept open?—I do not think there is much, it is of course useful for the conveyance of gravel and lime. I may mention that there is a large india-rubber manufactory, and some other factories in Tottenham, which employ a number of hands. We take the sewage from the india-rubber manufactory, and turn it into our sewers.

3555. (*Chairman.*) Is there anything further you wish to add?—Yes; I wish to draw your attention to Leighton, Leightonstone, and Walthamstowe, on the Essex side of the river Lee; no one has yet attracted your notice to those places. The schemes of drainage are of course very imperfect by gravitation, and there is no thorough system, at the same time an enormous amount of pollution must necessarily flow into the Lee, and I know of no way of disposing of it except through the channel of the Lee.

The witness withdrew.

The witness subsequently forwarded to the Commissioners the following Report:—

REPORT furnished by P. P. MARSHALL, Esq., C.E., Surveyor to the Local Board of Health of Tottenham, upon the SANITARY ARRANGEMENTS and the WATER SUPPLY to the District of Tottenham, Valley of the Lee.

The Public Health Act was adopted in Tottenham in 1852, about one-half—being the portion that formed the High Street, on the main road, running parallel with the Lee—was then sewered on the earthenware pipe system. The largest main being 18 inches diameter, the smallest 6 inches.

The 18-inch main is about two miles long, and receives numerous subsidiary sewers, diminishing from 18 inches to the size above mentioned.

The whole of the surface or storm water is supposed to be shut out from these pipes, for it is intended that they should carry off sewage only, the land or storm water being confined to its original channels, whatever they may be. The result is that two sets of drains have constantly to be attended to and kept in good order.

The advantages of this system are the comparitive cheapness with which sanitary works can be carried out in rural and thinly populated districts, and the concentration of the sewage undiluted by rain-water.

The disadvantages are that with the increase of buildings the old open drains and watercourses get interfered with, and as they are mostly on private property and each owner only liable for his own portion it is impossible to get them maintained in a proper state of efficiency, or when it is necessary to have them covered to get the work properly done. Again, they become (as buildings surround them) foul and polluted, and, in reality, a second series of foul drains. Again, every house must have two sets of drains, there is, therefore, a constant endeavour on the part of builders to make surreptitious connexions with the pipe sewers and save the expense of another drain for surface water.

When these works were laid out the question of deodorizing sewage was brought into importance from the very existence of the drains themselves. The cesspool system, so long the only one applied to the collection of sewage in Tottenham, disposed of the solid matter without creating any necessity for a deodorizing agent, while the overflow, if it polluted the ditches and streams, did not then attract much attention.

The concentration of the whole sewage of the district to one outfall raised the question of deodorization. The value of sewage as a material for manuring the land also attracted much attention, and various processes were patented for its deodorization and solidification. Mr. Higgs proposed to precipitate the solid matter suspended in the sewage at Tottenham by the application of lime, and held out sanguine prospects of a large remunerative return from the sale of the solid precipitate when dried and sold in the form of sewage guano.

Tottenham being the first important district sewered on the earthenware pipe sewer system afforded an excellent opportunity for a trial of the patent process. Mr. Higgs saw that with nothing but sewage to deal with the question of deodorization and profitable returns could be best tested, and he succeeded in inducing some influential persons to assist in erecting the necessary works. Accordingly at the outlet of the 18-inch main sewer pipe a sunk tank capable of holding a day's sewage was constructed, with a steam-engine to lift the sewage into an iron tank of nearly similar dimensions which was placed above it. The sewage was then treated with lime, the deposit was run out into shallow squares to dry, made into bricks, dried, ground, and then offered to the public as Tottenham sewage guano.

The liquid was allowed to pass off through the valves in the upper tank, and when the process was properly carried out the sewage water was clear and colourless, but the sewage matter deposited by the lime would not sell, and, although a clear and colourless liquid was drawn off, that liquid still contained all the obnoxious elements of sewage. This would probably have been of little consequence under the circumstances, as the river Lee was at hand to receive it; but the pumping and liming could not be carried on without considerable expense, and as the manure manufactured was considered valueless by those who had tried it, the whole process came to a standstill. Mr. Higgs died, and the works became the property of the local board of Tottenham.

Precipitating by lime is the only method at present adopted, and the tank is cleared out periodically by hand labour. During the winter very little lime is used, but in the summer time three or four bags a day are mixed with the sewage.

The same system has been extended to Wood Green, and the greater part of the whole district has been sewered.

The River Lee Trustees have obtained an interim injunction to stop the extension of the system, and Mr. Bazalgette, Engineer to the Metropolitan Board of Works, has been requested by Tottenham and the neighbouring districts to report upon the question of outfall.

Waterworks.

At the same time as sewerage works were commenced a system of waterworks was designed and carried out to supply the original portion of the district sewered. This has been, from time to time, much improved and extended. The principal supply is derived from wells sunk to the chalk, and some water from land springs in the bed of gravel overlaying the clay in the Lee valley; from 500,000 to 600,000 gallons a day is supplied.

Much leakage has been occasioned by the use of galvanized iron pipes for the smaller mains and house services, the water havin rapidly destroyed such pipes.

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The land spring water deposits a red earthy ferruginous deposit which discolours the water and chokes up many of these small mains and services. This water is also very hard.

Much still remains to be done to improve and complete the drainage of the district, but the great improvement to the general health of the district is well known. Building operations are being carried forward with great activity, and the price of land is steadily on the increase.

In the neighbouring district of Edmonton, where no sanitary works have been carried out, the reverse is the case, and although many grumble at the high rates in Tottenham, builders say that they dare not build where there is no sewerage or water supply.

Area of district.

The area of the district is given by the Ordnance Survey at 4,624 acres, but not more than one-third is built over.

Rateable value.

The rateable value is 91,000*l.* and has doubled within the last 10 years, and is now rapidly increasing.

Population.

The population at the last census was 16,000, but is now estimated at 18,000.

Houses.

The number of houses is 4,000 and they are increasing at the rate of 400 per annum.

Waterclosets.

The number of waterclosets is nearly as many as the houses, as all new houses are provided with them, and have either a supply from the board's works or from the New River Company.

Cost of fitting.

The cost of fitting up waterclosets varies much according to the length of piping required, the board have not of late made any compulsory alterations, nor is it necessary. Every cottage may now be said to have one. The board have never paid any portion of the cost of conversion, but have levied an improvement rate for the same.

Frost.

The recent frost does not appear to have seriously interfered with the use of the waterclosets. It was found necessary during the frost to supply water from hydrants in the street with a stand-pipe, and in one or two cases where the hydrant was opened or shut too suddenly, the main being under pressure, a pipe has been split. This occurred on a 12-inch and 4-inch main; the pipes, however, appeared to have been originally somewhat defective.

Heavy rains.

Heavy rains and sudden thaws flood portions of the district and inundate basements and cellars. When the water in the Lee is very high it is backed up in the main sewer, and the sewage recoils on the basements and kitchens.

Choked drains.

Choked drains frequently occur, owing to the very small pipes laid down and the large number of houses attached to them. We keep a small staff for the purpose of clearing and flushing them, but the cost of cleaning is small in comparison to the very serious inconvenience and annoyance that is caused to the ratepayers, as most of the small drains run through private property, so that gardens, walks, lanes, &c., have to be dug up and disturbed. We inspect all waterclosets regularly, and serve notices to the owners whenever they stand in need of repair.

NOTE.—The sewage works are too small for present requirements, and the board are only waiting the result of Mr. Bazalgette's report before some new arrangement is attempted.

Mr. GEORGE GUY (Tottenham) examined.

Mr. G. Guy.

3556. (*Chairman.*) What position do you hold in connexion with the Tottenham local board of health?—I am inspector of nuisances and turncock.

3557. How many years have you been inspector of nuisances?—About nine years. I have lived in the parish for 23 years.

3558. Of what do your duties consist?—I have to visit the different courts and alleys when complaints are made of nuisances and get the nuisances removed. I also go to the sewage works occasionally.

3559. Do you remember Tottenham before the works were established there?—Yes.

3560. What occupation did you follow then?—I was a sergeant of police at that time.

3561. Did you know anything at all of the condition of the ditches and streams in the vicinity of Tottenham?—I knew that the cesspools emptied into the different ditches, and that the sewage was conveyed into the river Lee in wet weather.

3562. Were those cesspools very foul?—Yes; many of them were very foul in low neighbourhoods, and the contents used to come up under the boards of the floors when they were over full.

3563. Were the ditches in a very foul state?—They were bad.

3564. Do you think that the river Lee is worse fouled now than when you first knew it, before any sewage works were established?—I could not say that, we conveyed our sewage fresh to the sewage works before it got into a putrid state.

3565. Have you anything to do with the place where the sewage is treated with lime?—I only go there occasionally.

3566. Are the men working there under your orders?—Under Mr. Marshall's orders.

3567. You are not the foreman?—No, I go to see how they are going on, and report to Mr. Marshall.

3568. What number of common privies are there in Tottenham now?—I think there are hardly any common privies, perhaps just outside the drainage district there might be one or two.

3569. Are waterclosets generally used?—In most of the houses.

3570. Have the old privies been converted into waterclosets since the board commenced its operations?—Yes.

3571. They were mostly cesspools and privies before?—Yes, formerly they were.

3572. Are there many pigstyes in the neighbourhood?—There are some.

3573. Have you removed many of them?—At times I have.

3574. Are there any large stables, or any other sources of nuisance, such as cow sheds?—Yes.

3575. Are they drained into your sewers or not?—The top water is I think.

3576. Are there any works of any kind that are liable to create nuisance?—I think not.

3577. Do the india-rubber works cause any nuisance?—We have never had any complaint about them.

3578. Do you ever inspect them?—No, but the sewage is brought into our pipe.

3579. Have you any difficulty with road scrapings?—No, the roads are scraped, and the parish authorities sell the scrapings.

3580. For what purpose?—For sand; the builders buy it for sand for building purposes on the bye roads. The high roads belong to the Metropolitan Trust I believe.

3581. What do the people do with their ashes?—We have a brickfield handy, and many of the poor people keep a horse and cart, and they collect the ashes and take them away.

3582. Does the board collect the ashes or not?—No.

3583. Do they leave the disposal of the ashes to the individuals themselves?—Yes.

3584. To do the best they can with them?—Yes.

3585. Do they find a ready sale for them to be used in the brickfield?—I think they give them away.

3586. Have you any charge of the roads as to cleansing them?—Mr. Marshall is the surveyor over the bye-roads.

3587. Have you not any control over them?—If there is any complaint I go to see what the complaint is, and report upon it to the board.

3588. Have you heard any complaints made as to the state of the roads beyond your boundary, the metropolitan roads, or any others; are they better or worse than yours?—I have not heard any complaints made of that sort.

3589. (*Mr. Harrison.*) Does the Metropolitan Board clear the refuse away from their roads in a satisfactory manner?—They scrape the roads on to the paths, and we have many complaints from the shopowners of the dirty state of the sides of the road in the highway; people have complained to the proper parties to get this removed.

3590. Have their complaints been attended to?—Not very freely.

3591. You have no power to enforce the removal of these scrapings?—I do not know, it never was tried. If they were summoned for a nuisance I do not know what it would turn to.

3592. (*Chairman.*) Is it your duty to visit occasionally the outlet works?—Yes.

3593. And if you found the local board accumulating their refuse there to a large extent, so as to become a nuisance, would you indict them?—I do not consider that there ever was a nuisance of that sort at that distance from any such thing.

3594. Do they ever accumulate a large quantity of the refuse taken from the depositing tanks?—We have a great deal at present, and the reason why we have it now is that we cannot get it away, because a new railway is formed, and it takes some time to get it carried in a cart.

3595. How many yards are there now?—I could not say.

3596. 100?—No, I should think not.

3597. Is there any smell from it?—I do not find it myself.

3598. Do any persons complain?—No person has any right to complain there, we are a long distance from any house—we have a man living on the premises.

3599. Do they complain?—Never. I have found Mr. Beardmore there, and he never complained to me.

3600. (*Professor Way.*) Is the man who lives there a man who is employed on the works?—Yes.

3601. If he complained he would be complaining against his bread and cheese, would he not?—I do not know; if it hurt him he would be foolish to stop there to affect his health.

3602. What wages do you give him?—30*s.* a week.

3603. And a house?—Yes.

3604. (*Chairman.*) What family has he?—I think that he has six children.

3605. (*Mr. Harrison.*) Have you ever visited the purification works at Hertford?—Never.

3606. (*Chairman.*) Or the purification works at Luton?—I have not.

3607. Or any other purification works?—No.

3608. You have confined your attention to your own works?—Yes.

3609. (*Professor Way.*) Do you know what farmers this material is sold to?—Mr. Ware, living just by, has bought some.

3610. When did he buy it?—At different times, and Mr. Goddard up here has a field, and he has bought some at different times.

3611. Have they to cart it away at their own expense?—Yes.

3612. How far off does Mr. Ware live?—Some of his land adjoins our works.

3613. Do you find that anybody comes from a distance to fetch it?—No.

3614. Do the same people fetch it time after time?—Yes.

3615. That is to say, those people who live close by?—Yes.

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3616. What land do they put it on?—I think that it is used for mangel wurzel and cabbages.

3617. Do they mix it with manure?—They mix it with earth, I think.

3618. (*Mr. Harrison.*) We have been told that in the lower part of the town the sewage is carried away by the watercloset system, but that in the upper part there is a difficulty in that respect, and that the cesspool system is continued. How are those cesspools cleaned out?—The houses have only lately been built. The cesspools are temporary. We are in hopes that we shall soon be able to connect them and to dispose of the sewage without any cesspools.

3619. Do you know any instances in your district where these cesspools have become a nuisance?—Not at the present time.

3620. In past times have they become a nuisance?—Yes.

3621. What steps have you taken to do away with the nuisance?—If any nuisance arises the parties are ordered to clean them out, and they generally attend to the order. It should then be taken away in a cart.

3622. Have you attended to the supply of water to the cottages in Tottenham?—Yes.

3623. Does that come under your inspection?—Yes.

3624. Is the supply a constant one or an intermittent supply?—In the summer time we have not had sufficient water to keep it on all the day, and therefore it has been on for so many hours in the day; but many of these little cottages have no means of catching the water for their use, because they have no cistern.

3625. Is it under your direction as turncock that the water is supplied to them?—Yes, I turn it on in the morning till 8 o'clock at night if the water will last out. If not, it is turned off and is conveyed to another part of the parish during the summer time.

3626. How long do you allow it to remain on when you are short of water?—We keep it on as long as we can, several hours a day.

3627. Do you know how much water that will allow the different people to obtain?—No, but I should consider that there is enough for their use when I turn it about.

3628. Have you examined the different houses to see what means they have of storing water?—Yes, I know pretty well what they have. All the new houses have cisterns, and the old houses have what is called the high pressure.

3629. And the constant system?—It was intended for a constant supply.

3630. Do you examine the tanks into which the water passes?—Yes, I have done so.

3631. Do they attend to cleaning them out?—There is a red sediment in the water, which you will occasionally see at the bottom of the cistern.

3632. Are there overflow pipes from those tanks?—No, we do not wish them to have overflow pipes, because we might pump day and night if we had water, and it would be running away.

3633. There are ball-cocks?—Yes.

3634. And you think that there should not be any overflow pipes?—According to the present regulation there should not be.

3635. When the system is constant it is not a constantly flowing system, but a tap which gives out the water can be turned where the parties like to turn it?—Yes, and there is a great waste.

3636. (*Chairman.*) Is any water sold for trade purposes to the india-rubber works, or any other works?—No, the india-rubber works I think have their own supply, but we supply some for garden purposes.

3637. Is there any inspection of the leaking taps and pipes?—Yes, the board have lately engaged a young man to attend to that matter, to inspect the taps and pipes, and to report to them as to the waste.

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3638. And to repair them?—We call upon the owners to repair.

3639. What kind of taps and pipes are used?—They formerly used the screw-down taps and the galvanized iron, but it is now a leaden pipe, and a common water tap with a plug.

3640. Then you have done away with the screw-down tap?—There was not the pressure from the cistern. (*The witness produced some taps and specimens of pipe.*)

(*Witness.*) I prefer the screw-down tap, the plugs are apt to leak.

3641. (*Mr. Harrison.*) Since you have had the watercloset system established in your parish, have you had some severe frosts?—Yes.

3642. What is your experience as to the working of the waterclosets in the poorhouses during frosty weather?—Many people used to leave their taps to dribble a little to prevent the water from freezing but if it was shut off, most likely the pipe would burst round the tap.

3643. Have you found that if that precaution is taken the watercloset system, even in the poorest tenements, works well?—Yes.

3644. (*Chairman.*) When you used the galvanized iron connecting pipes, what action set up, did they choke up with this red matter, or did they rust away?—They choked up; many galvanized pipes I have found entirely choked up so that they could not get any water.

3645. Why do you use brass connexions, are they preferable to the wrought-iron?—It was Mr. Marshall's order, I like the galvanized iron best; it is most convenient.

3646. (*Professor Way.*) I suppose that you have frequent opportunities of seeing the precipitating works?—Yes.

3647. And the outfall into the river?—Yes.

3648. Is the outfall far from the works?—No.

3649. How far is it?—I should think that it might be 100 yards.

3650. In what state is the river at that outfall, and just below it?—The river is bad all through.

3651. Is there any milkiness, or excessive filthiness, at the position of that outfall?—It is rather white from the lime which we use. The river altogether is very bad.

3652. The discharge is white?—Yes.

3653. Is it generally so?—During the day when we are using the lime it is rather white, in the afternoon we do not consider the water much different from other water; there is not a great deal to do in the afternoon part of the day.

3654. Do you not put in any lime in the afternoon?—Yes, there is a man there to put in what is wanted, but the water in the afternoon is clear; we consider our work to be from 9 to 3.

3655. When there is most going into the sewers?—Yes.

3656. But still at times, if not frequently, the water does run away white from the addition of the lime?—Yes, it is a little coloured.

3657. Who superintends the addition of the lime?—It is ordered to be sent down when the men want it.

3658. I mean the addition of it to the sewer?—The man who stands at the works.

3659. He is under the directions of Mr. Marshall?—Yes.

3660. And not under yours?—If anything was wanted when I was there, I should have to name it to Mr. Marshall.

3661. This lime is thrown in by hand?—Yes.

3662. How often does the man throw it in?—I cannot say.

3663. Does he do it once an hour, or once in half an hour?—Yes, less than that.

3664. (*Mr. Harrison.*) Have you had any complaints made to you, or have you made any complaints about the intercepting sewer formed by the East London Water Company?—We have not had any complaint from the East London Water Company that I know of.

3665. Have you had any complaints from anyone else?—We have had a complaint from the trustees of the river Lee.

3666. Have you at any time had occasion to complain of the condition of the intercepting sewer which the East London Water Company formed?—Yes, during the summer time it was very bad.

3667. Have people residing in the neighbourhood complained of its condition?—I cannot say that people living there have complained. I have been down there, and have myself found it very bad all along through the marshes.

3668. What steps have you taken when you have found it in that state?—There was no remedy. It was an open ditch, and the drains were emptied in from other parishes, there was no way of altering it. I understand that the East London Water Company made it for the accommodation of the neighbouring parishes.

3669. Under an Act of Parliament?—Under an Act of Parliament.

3670. (*Chairman.*) Do you know whether the people were supplied with plenty of water before the board of health came here, or not?—I used to live in Marsh Lane myself, and there was a well there which flowed, but after I had been here a few years it stopped flowing, and I had to put a pump down the bore-hole.

3671. Before the operations of the board of health the people had wells and also cesspools?—Yes.

3672. And the cesspools and the wells were sunk into the same soil?—I should consider so myself, from now and then our finding a bored well, but the surface wells would have been in the gravel.

3673. And the cesspools must have been in the gravel?—Yes.

3674. (*Professor Way.*) Have you heard many regrets at the introduction of the officers of the board of health?—I think that a good many would speak very highly of it, because I have heard them say that when they went to the common closets, they never got sweet during the day and that their clothes smelt; whereas now they can go in and out with comfort.

3675. You do not think that the inhabitants of Tottenham at large seem to have the objection which the gentleman at the end of the table seems to have to the water supply?—I cannot say. I think that they are generally satisfied.

3676. (*Chairman.*) Have you anything further to offer to the Commissioners?—No.

The witness withdrew.

Mr. Peter P. Marshall, C.E., further examined.

Mr. P. P. Marshall, C.E.

3677. (*Chairman.*) You used wrought iron pipes in the first instance for your domestic supply?—That was the system when I came here.

3678. This ochrey water appears to have acted very injuriously, both externally and internally, upon those pipes?—Yes.

3679. Have you any idea what was the length of life of a pipe under those conditions?—Many of those pipes which you see here had been in about six or seven years, and some of them longer; but after they had been in about six or seven years I should think that they were in a state in which they were incapable of conveying the water.

3680. Were they eaten and perforated as the one is which I hold in my hand?—Yes, and much worse than that.

3681. Then a great proportion of your leakage and loss of water may have come from the defective state of the supply pipes?—Yes; that I have reported to the board upon several occasions.

3682. Have you removed the whole of these services?—No; our attention has generally been called to the pipes by the people ceasing to get a supply from them, and we found that the ochrey deposit filled up the pipe entirely, so that in some places no water could come through, and when the pipe was pulled out to be opened we found holes in it, and that it had decayed away. In other instances we found the supply disappeared, and we found that the water had passed away through a hole in the pipe into the gravel, and of course the gravel itself destroys the pipes. On the outside we found that the galvanizing process had no effect at all in preserving them.

3683. The galvanizing was so much waste?—Yes.

3684. Does the gravel act equally injuriously upon the cast-iron main?—No, it does not seem to affect the cast-iron mains at all. There is the operation of scaling on the surface, but not anything like the effect which is produced upon the wrought iron. We find the deposit in the cast-iron main the same as in the wrought-iron pipe.

3685. (*Professor Way.*) Did it act upon the pipes which were galvanized or not?—Yes, I think that those which were galvanized were rather worse.

3686. (*Mr. Harrison.*) Is there free acid in this ochrey water?—We had it analysed the other day, and I do not think that there is any acid referred to in the analysis.

3687. (*Professor Way.*) Except carbonic acid which keeps the iron in solution?—Yes.

3688. (*Chairman.*) What do you now use for your house services?—Lead. We compel every person to use lead of a certain weight.

3689. Do you know what is the relative cost of a house service made with iron and of one made with lead?—I understand that the price of a lead pipe of good quality and of proper weight, such as we specify it must be, is about 1*s.* 9*d.* a yard. That is ¾-inch pipe, and I understand that the same in wrought iron would cost about 1*s.* per yard.

3690. The wrought iron would have no value when it was taken out as an old pipe, but the lead would have considerable value as old lead?—Yes; the lead when it is taken out is comparatively as good as when it was put in.

3691. Is the lead at all injuriously acted upon externally or internally by this ochrey water?—I have made some inquiries into that subject. Before we supplied the district, they supplied themselves with this ochrey water, and in the district old lead pipes have been taken up which must have been in for 50 or 60 years, and apparently they have not been damaged.

3692. Then this is a district in which wrought iron services are impractible, and you are compelled to resort to lead?—Yes.

3693. As the cheapest and the most enduring?—Yes, and the water has no action upon lead.

3694. It does not dissolve it?—No.

3695. Have you a person whose duty it is to inspect house services, and to see whether the taps are left on or are in a leaking condition?—Yes, we have a man appointed for the purpose, whose duty it is to go from house to house and ascertain the state of the water supply.

3696. Have you found any diminution in the volume of water taken from you in consequence of those inspections and those operations generally?—I cannot say that it has made any perceptible difference, owing naturally to the fact that there is great difficulty in proceeding against the people.

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3697. If you are pumping in the volume which you name do not you feel certain that a great proportion of that water is going to waste?—Yes, I feel quite satisfied of it.

3698. And does not every gallon wasted represent so much fuel wasted?—Yes.

3699. And working expenses wasted?—Yes.

3700. Do you not think that it would be very advisable, if practicable, to diminish that waste by proper supervision?—Yes. I attribute a great quantity of the waste to the existence of these galvanized mains, which exist to a great extent. I think that the annual saving which would result from taking up the whole of them and having proper mains put down in their place would more than compensate the cost.

3701. (*Mr. Harrison.*) Does it not affect the supply to the people as well as the expense to the board?—It does, and in places where leakage has taken place, that is the way that our attention has been brought to it. We find on examination that the pipe does not deliver the proper quantity of water, and that it is incapable of doing so.

3702. It more or less affects the people where these wrought-iron pipes are laid?—Yes; and the whole of this district has been more or less laid on with them.

3703. Could you give us some exact information as to the volume of water taken by the inhabitants?—Yes; I am preparing to give you a statement of the quantity delivered. We can only ascertain it by calculating the quantity delivered and the number of people whom we supply.

3704. In your case you cannot rely upon any calculation of the sort, because your leakage in many places is much more than your delivery?—Yes; but from the returns which I have had from many other towns they seem to have the same result; they supply as much water as we do per head, and in some places more.

3705. (*Chairman.*) Are you supplying any water for trade purposes?—Hardly any.

3706. Do you supply any of your customers by meter?—None at all. We found that the ochrey deposit prevented the meters which were in use from revolving and measuring correctly.

3707. (*Mr. Harrison.*) So that this ochrey water which you take the trouble of pumping appears to be a very doubtful source of supply; in the first instance, in consequence of the pollution in Edmonton, as well as in Tottenham itself, and after you have taken the trouble to pump it, it eats away your pipes, and it seems that after your putting in meters to measure what you deliver in some cases it partially stops the supply to the people, and in some cases stops it altogether?—Yes; you are talking of the gravel water.

3708. Yes, it is the gravel water which does the mischief?—Yes.

3709. And if the gravel water were taken by itself it would do more mischief than it does now?—Yes, and in the first instance we had scarcely anything but the gravel water.

The witness withdrew.

Edward Thomas Busk, Esq. (Edmonton), examined.

E. T. Busk, Esq.

3710. (*Chairman.*) Where do you reside?—I live in the parish of Edmonton, near Winchmore Hill.

3711. Are you chairman of the local board of health of Edmonton?—Yes, and I have been so since its formation.

3712. And are you a local magistrate?—I am.

3713. And also a barrister-at-law?—I am.

3714. How long has the Local Government Act been in force in Edmonton?—Since 1850.

3715. Have you carried out works of sewerage and water supply in Edmonton?—Partially, where required.

3716. Have you had any difficulties with your sewage recently, or at any time?—Not from our own water, only from the Colney Hatch Asylum.

3717. Do the Colney Hatch people drain or sewer into your district?—Yes; I should also explain that I am one of the visiting justices of the asylum, and we have now taken proceedings against that body, so that in my capacity as chairman of the board of health I have absolutely moved for an injunction against myself as one of the visiting justices at Colney Hatch, therefore I shall speak with delicacy with regard to

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anything which I may have to say with reference to that matter. At the same time I am bound to say that there is a very great nuisance arising from that source, or we should not have gone to law to attempt to prevent it.

3718. What population is there at the Colney Hatch Asylum?—About 2,400; there are about 2,000 patients, and about 400 attendants.

3719. Do they keep any stock of any sort, such as pigs or cows?—There had been about 30 cows at the farmstead until the outbreak a year ago of the cattle plague, and then the number was reduced to eight, and they are now increasing them again.

3720. Do they keep pigs?—They keep about 200 pigs. The pigs eat the offal; the lunatics leave a vast amount of food and it is turned in fact into pork.

3721. What area of ground have you for the asylum?—Between 70 and 80 acres.

3722. Is there any possibility of getting more ground adjoining the estate?—That was partially recommended, I think, by Mr. Lawson. We applied to you to attend to it, but your engagements would not allow it, and you recommended Mr. Lawson, and as a dernier resort he recommended the use of further land, but we were not sufficiently satisfied with the use which we already made of the irrigation there, to induce us, except in the utmost necessity, to adopt the farming system.

3723. Had you to multiply irrigation upon any of the land at your disposal?—Yes, considerably.

3724. In what way did you try the irrigation?—By hydrants; the sewage was all pumped up in the first instance by steam power, and it flowed over the land by hydrants, but the quantity which was used was not sufficient to absorb anything like the whole amount of sewage which comes from that spot.

3725. What crops did you irrigate?—We irrigated principally the grass land, and it was only available for certain portions of the year when the crop was in an early stage, it would not do to put it on in a great measure when the crop was advanced.

3726. Do you grow Italian rye grass?—Yes.

3727. Are you aware that with Italian rye grass you can go on dosing the land, and that it is of advantage to irrigate the roots three or four days before you begin to cut it?—Yes, we use as much sewage as we can upon the Italian rye grass, but the crops which are grown can only take it at certain seasons of the year.

3728. How many acres have you under Italian rye grass?—Not above three or four acres.

3729. Do you still feed your cattle from it?—Yes, with the horses, and partially with the cows.

3730. You turn it into milk?—Yes; it is cut from three to five times a year, according to the season.

3731. Does not that experiment satisfy you that it would be an advantage to have a larger area of land from which to get Italian rye grass?—There is great difficulty in applying the sewage. There are only eight hours in the day when it is pumped on. The working hours of a man are but eight hours, and only during that time is he engaged in applying it to the crop, and it does not take more than half while it is being applied, and that is only one third of the whole 24 hours, so that that is only one third of the half which is used.

3732. Then the fact is that you have a material which is commercially valuable when properly applied in agriculture, but although you have utilized one third of the half, namely, one sixth, you do not feel justified in attempting to utilize the whole?—No, because the expense is very great.

3733. Do you think that the expense is greater than the result?—Yes, we feel that to be the case, but it is difficult to measure it; we have a great deal of labour.

3734. (*Professor Way.*) Is the sewage all pumped by hand power?—It is all pumped by steam power.

3735. (*Chairman.*) You have placed your patients at Colney Hatch, and I assume that the asylum is a county asylum?—It is.

3736. Is it for a single county?—It is for a part of the county, one establishment is at Hanwell and the other at Colney Hatch.

3737. And all the expenses are met by a county rate?—By a lunatic rate, and collected at the same time as the county rate.

3738. Do you not think that it will become the duty of the magistrates to utilize this sewage, if it disinfects it at the same time, although it may not be a profitable operation, and you may be compelled to face an extra expense?—That is why we have gone to the Court of Chancery, to see whether we cannot prevent their putting any of their sewage into our brook.

3739. You are now speaking as chairman of the Edmonton local board?—Yes.

3740. And you say as chairman of the local board that your local board have gone to the Court of Chancery to restrain the magistrates from passing the sewage from the asylum down into your brook?—Exactly so.

3741. They may do what they like with it, if they will not put it there?—Certainly. We took a similar proceeding against another neighbour, our northern neighbour, Enfield. Some few years ago we obtained an injunction against them to prevent their passing any of their sewage into the Edmonton brook, and in consequence, they had to make a lateral pipe drain from west to east into the intercepting brook belonging to the East London Waterworks Company, which you have already heard about.

3742. Are there many cesspits or cesspools in Edmonton?—The system is by cesspools. We have to do only with the overflow from the cesspools.

3743. Then you are satisfied as a local board to accept the arrangement of cesspools and to arrange your drainage for taking away the surplus water, or overflow from those cesspools?—Yes, having the constant surveillance of all the cesspools, to see that they are properly emptied at regular times, and that no evil arises from them. That is our system, and I will go to results. We find that our health is nearly equal, if not quite equal, to that of our neighbours, both north and south, namely, on the north, Enfield, and on the south, Tottenham. The death rate also, I believe, is rather inferior to that of either of those parishes.

3744. Did you hear the remarks with regard to the death rate of Tottenham, that it is unduly increased by numbers of children sent in to be nursed from London?—I heard that observation made by the chairman of the Tottenham board, and I must confess that I was not prepared to hear it, because though there are several cases of that sort, and although as chairman of the board of guardians, I hear a good deal of these illegitimate children, I should not have thought that there had been a sufficient influx of that class to affect the death rate materially. I think that I can say positively that that cause does not exist in our parish, which is only two or three miles from Tottenham.

3745. From your knowledge as chairman of the board of guardians you do not think that that fact is of sufficient importance to influence very materially the death rate at Tottenham?—Certainly not in our parish. I would rather confine myself to that than to speak of Tottenham. The chairman of the Tottenham board may be right, but I was astonished to hear it.

3746. What mode of water supply have you in Edmonton?—Two sources, one from the New River, there being a main from the river at the upper part of the parish at Bush Hill, which supplies what we call the lower, but which is really the upper part of the parish of Edmonton, and also a system of separate wells.

3747. Are the wells deep wells?—They are principally, or I should say entirely from the gravel. There are a few artesian wells which are sunk very low for a constant flow of water, but the major part of the wells are from a gravelly subsoil.

3748. Do they produce this red ochrey water which we have heard of?—No, I am not aware in my own experience that it exists materially in the wells, but I know that it does exist on the surface of the soil, and

injuriously, for agricultural purposes. It has a curious tendency to stop up the earthen pipes which we use in agriculture for land draining. I have several places which I have drained, and every four or five years the pipe gets stopped up with this glutinous sort of ochrey water, which as it flows down seems perfectly pure and clear, but it contains a colouring matter which gives the water a ferruginous appearance. Forty years ago my father had this water analysed, thinking that there might be a chalybeate in it. The analysis was then conducted by Godfrey and Cook, of Southampton Row, but they could find no iron in the water. This was water taken from comparatively the surface, it being one or two feet deep. I cannot say from what that bright colouring matter was brought.

3749. (*Professor Way.*) The water frequently comes out colourless, and forms this deposit, and then runs away colourless?—Yes.

3750. You would find the iron in the first instance, but not in the last?—We had a spring which we thought chalybeate.

3751. The water deposits the iron as it flows?—It may be so; I am not a chemist, and I merely tell you the practical result of what I have noticed. I should also state that when the board was first established, we thought that the flushing system would not suit a parish of our description. We have a surface of very nearly 8,000 acres to deal with, and we thought that any thorough system of drainage was not applicable to a parish, the population of which was scattered over so large a surface as ours was; it would have been ruinous to have attempted such a system. This proceeding has been found to answer remarkably well, and it suits the pocket still better, for our rates have never exceeded 10*d.* to 1*s.* in the pound. In Tottenham they are 3*s.* 4*d.* in the pound. As a Justice I have to sign all the summonses, and in Tottenham the proportion is very much greater than in Edmonton. We don't oppose a thorough system of drainage where you have your houses sufficiently concentrated, but we are spread over a large surface, and it would not do in our parish to put a large main drain throughout the whole of it.

3752. (*Chairman.*) At the Colney Hatch asylum was there at any time a swallow hole or an absorbing well to drain into?—Yes.

3753. Did the magistrates consult Mr. Bailey Denton as to their sewerage?—No, it was Mr. Blencairn.

3754. Have you thought over the question of one body having one jurisdiction over the entire valley of the Lee, so as to enable local authorities to get rid of nuisances without all this private litigation?—I have thought it over many times, and I think that there is no other way of getting out of the difficulty, because there is no legal power at present to compel the parishes who are affected by the nuisance to unite, unless they voluntarily do it, but I do not think that there is any chance of their doing so. I am speaking of the main drain through the Lee valley.

3755. I suppose that you know sufficient of human nature to know that a permissive power, letting persons stay out or come in, might defeat the object in view?—That is my opinion.

3756. And that, however beneficial the scheme, it is hardly likely that all parties will acquiesce in it?—I certainly do not see much prospect of it.

3757. Are you sufficiently near the river Lee to be liable to be charged with polluting it?—Yes; the old river Lee is our eastern boundary, and the navigation river, which is taken out of it, runs through the eastern part of the parish. I have a considerable portion of land immediately on the banks of the Lee; but, as I have already stated, our own sewer and that of the Colney Hatch asylum do not at all affect that portion of the river Lee, because they go into the Catchwater Dyke, which was dug under an Act of Parliament passed, I think, in 1853—the East London Waterworks Act. It was constructed to catch all the sewage which was emptying itself from the western side of the Lee, and to carry it down into this parish of Tottenham, and the outfall of that Catchwater Dyke happens to be in the lower part of the parish of Tottenham.

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3758. (*Professor Way.*) Do not the people of Tottenham complain of its passing through the parish?—It begins in Ponder's End, which is in Enfield parish; it comes through the whole of Edmonton parish, immediately parallel and contiguous to the Great Eastern Railway, and diverges from it at the Angel Road Station. There it takes an eastern direction, and then again flows to the south, and empties itself into the river near the mills at Tottenham. But I have never been aware of any nuisance which existed there. At the outfall there may be a nuisance, but where it flows I have never been aware of any nuisance, neither have I heard the railway authorities or the gentleman who has been for many years at the station, and lives on the bank of the Catchwater Dyke, say that there has been any disagreeable smell from it.

3759. Is that in Edmonton?—That is in Edmonton parish.

3760. I suppose that it gets worse as it flows, and is worse when it comes down here?—Yes, partially so. My own opinion is, that if the parish of Tottenham, instead of draining into the river Lee, had gone into this Catchwater Dyke, the river Lee Commissioners would not have had a leg to stand upon; but they carry their sewage direct into the river Lee, and not into the intercepting cut.

3761. (*Mr. Harrison.*) With regard to the law suit which is pending, do the Tottenham board propose to carry the sewage by a new outlet into the river Lee, or do they propose to pass it through their purifying system, and to leave it as it was to be carried to the present outfall, so that there will not be a new outfall into the river Lee?—I say that if they had taken it into the Catchwater Dyke I do not think that the river Lee commissioners could have interfered with them; that is a mere matter of opinion. It was a statutable cut made on purpose to catch the western drainage.

3762. (*Professor Way.*) That cut could not be objected to in law?—I think not. The only difficulty is that the word "now" is introduced into that statute and there is thought to be a difficulty from that word "now." It is the Act of the East London Waterworks Company, and they have never made use of it. The word "now" refers to 1853. Some legal mind seems to apprehend that difficulty.

3763. Are you not talking of a dry matter of law?—Yes.

3764. The evil would be the same whether the sewage went into the one cut or the other?—Yes, the evil would exist without doubt, and an evil it is.

3765. I suppose that we are all interested in getting rid of the fact, and not supporting these evils?—Yes, I do not see how the evil is to be got rid of except by continuing this intercepting sewer. Ware is now the greatest nuisance to the river because the whole of the sewage of the town of Ware, which has a considerable population, runs unmixed and undiluted into the river Lee.

3766. (*Chairman.*) Then if the river Lee trustees do not choose to make fish of one and flesh of the other they must forthwith commence action against the town of Ware?—Yes. The sewage of Hertford is already purified by the New River Company, but the New River Company take their source of water supply above the place where they have brought it down. After that purification they allow it to run along an open conduit for a mile or a mile and a half before it runs into the river Lee. It goes through a preparation of lime, and the works are very elaborate and very expensive; it takes the smell away, but they have a great difficulty in getting rid of their deposit as they have at Tottenham.

3767. It is not quite so valuable as guano?—Certainly not. The late chairman of the New River Company took a lot of it to his farm, which is a few miles distant, but he did not come another year for it. I am not a chemist, but in my opinion when the sewage is disinfected by lime the fertilizing quality of the sewage is very much taken away, it is deterio-

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rated. I will not say that it is wholly absorbed or destroyed, but it is very much deteriorated.

3768. (*Professor Way.*) It is not the lime which takes the value away, but the value goes away in the water?—That I will not undertake to say, but it is taken away from the deposit.

3769. You say that you have thought of the advisability of having some measure for the whole of this valley; would Mr. Marshall's scheme be such a measure; would not it be a partial dealing with works without accomplishing a benefit to the whole valley?—It certainly would. You leave Ware out and Hertford and Bishop Stortford. Bishop Stortford is on the river Stort, which empties itself into the river Lee at Rye House.

3770. If it was subsequently found necessary to deal with the upper parts of the valley, might it not be very difficult to make them fit on to this scheme?—I do not know that it would be. I think that the only way in which we can get rid of our sewage will be by taking it to the low level sewer of the Metropolitan Board of Works. I should also state that we cannot get any water supply from the river Lee, because the New River Company and the East London Waterworks Company have by an agreement taken the whole surplus water, which they want for supplying London, and therefore they would not grant it to any interlying parish for water supply.

3771. (*Mr. Harrison.*) Is not their power under an Act of Parliament?—Yes, there is an agreement. The New River Company supply themselves higher up above Ware, and the East London Waterworks Company supply themselves from Tottenham by Tottenham Mills.

3772. How are you supplied with water at Colney Hatch?—By a well which is sunk down about 160 feet into the chalk.

3773. How do you pay the New River Company for the supply which you take at Edmonton?—That is paid for by the different householders who take it according to the size of the house.

3774. Is it the New River Company's system of supply?—Yes; we have nothing to do with it; it is between the customer and the New River Company.

3775. Then the charge for water supply is not one of the rates included by you in the shilling?—Certainly not.

3776. What steps do you take at Edmonton for removing the matter from the cesspits?—Notice is given to the occupier or to the owner where there are poor cottages. The only difficulty which we have found in having them emptied when full is from the want of conveyance, but we have now a conveyance for the purpose, and have a regular system to have them emptied.

3777. How is the population of Edmonton as to density, as compared with Tottenham?—I should not say that it is quite so overcrowded, but the gross population, I think, is now 10,000 as against 14,000 in Tottenham by the last census.

3778. Is the population of Edmonton scattered over a much larger area than the population of Tottenham?—It certainly is with the exception of Wood Green, which is in the parish of Tottenham. That sewage was intended to be brought into the general system, which was explained by the surveyor, but unfortunately not being allowed to do that it does not take the natural course but flows back upon our parish.

3779. In comparing the death rate of Edmonton with that of Tottenham, the relative density of the population is an element which should be taken into account. If your population is scattered over a large area as compared with theirs, you would expect that your district would be more healthy than theirs?—Yes, but the only two cases which we have had of cholera in Edmonton we have found in the outlying and the highest district. However, that is a freak of the disease which we cannot account for. If it had extended very greatly, no doubt the lower parts would have suffered as much or more.

3780. Do you know at all what quantity of water the New River Company supply per head to Edmonton?—No, but I think that they have a regular supply. I have never heard any complaint of their supply where they have provided for it.

3781. You have mentioned what you consider to be the rate in Tottenham, can you give the details of that rate?—No. With respect to health I hear the accounts of illness every week, and the health rate is certainly quite equal, if not superior, in Edmonton to that of the adjoining parishes of Enfield and Tottenham.

3782. Are the people who reside in Edmonton of a superior class, taken as a whole, to those residing in Tottenham?—The labouring classes in Edmonton do not earn so much as in Tottenham, because there is a greater element of agricultural labour and less manufacturing. We have one manufacture, but it does not absorb any large number of people, they are principally agricultural labourers; some few go down as far as the Enfield Lock Works, but there are very few of them.

3783. Is there a large population of persons in the more comfortable classes of life in Edmonton?—I should say not; there is a larger proportion of lower rented houses in Edmonton than there is in Tottenham, that is to say of mere cottages.

3784. (*Professor Way.*) I suppose that in both places there are a great many persons who have business in London and who come to Edmonton and Tottenham to reside?—Yes.

3785. Are there more resident gentry in them than there would be in a purely agricultural district?—Yes, a sort of gentry. I am not aware of any real artisans in Edmonton who go backwards and forwards to London, but in Tottenham I believe there are a considerable number of that class. I should also mention (because it seems important that you should know it as a deduction was made from the statement of having the cesspools in the gravel) that our cesspools are not in gravel; the subsoil is gravel, but not till you get a considerable depth down. In all the valley there is alluvial soil for a considerable distance; then we come on to a very fine stratum of loam, varying from 10 to 15 feet deep, and then we come on to a bed of gravel, but our cesspools are not 14 or 15 feet deep, but only 3 or 4, and therefore they are not let into the stratum from which the water is taken. I will not undertake to say that it is perfectly impervious, but still it is not taken from the same stratum.

3786. (*Mr. Harrison.*) You think that the statement that the cesspools go with the gravel is a mistake?—I think so. At the asylum we have no gravel at all. We go down from the upper clay to the blue London clay, 80 feet, and we never touch the gravel, and that is only three miles west of this.

3787. Should you have any difficulty in obtaining land at Colney Hatch?—Yes, it seems to be nearly impossible. I do not think that we could get any there. There is one farm, but it belongs to Mr. Cline's trustees, and I understand that the tenant who is willing to let is not allowed to do so by the conditions of his lease; that is what I have heard, but there is no doubt difficulty in getting land.

3788. (*Chairman.*) Have you sewers for your water supply?—We have sewers wherever it is necessary.

3789. But there are cesspools?—Yes.

3790. (*Mr. Harrison.*) You say that you have a regular supply of water from the New River Company?—Yes.

3791. What becomes of it after it leaves the houses?—Some of it goes into the drains. Where required there is drainage from the cesspools, and from the house drainage, and that is carried into the intercepting sewer of the East London Waterworks Company.

3792. But for carrying away the water supply, after it has been used in the houses, have you a system of sewerage?—Yes, no doubt. We have no open ditches, it all goes into the intercepting sewer.

3793. (*Chairman.*) We shall have your surveyor before us?—Yes.

3794. Is there anything else which you wish to state?—No.

The witness withdrew.

Mr. ROBERT GOSSET (Edmonton) examined.

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3795. (*Chairman.*) You are surveyor to the local board of Edmonton?—I am.

3796. How long have you been their surveyor?—Ever since the commencement, in August 1850.

3797. What do your duties consist of?—I act generally as surveyor of highways and of sewers, and also as inspector of nuisances.

3798. What occupation did you follow before accepting the appointment of surveyor to this board?—That of an auctioneer and surveyor.

3799. You were not educated as an engineer?—No.

3800. Is there any system of sewers in Edmonton?—They have carried out various short sewers since the board came into operation, they are divided into several contracts.

3801. Did you design those sewers and write the specification?—Yes, I had the doing of it all.

3802. How much money have you spent?—On the average I suppose about 400*l.* a year for that particular description of work.

3803. Have you borrowed any money to carry out your sewage works?—None whatever.

3804. Then you have no debt?—None whatever.

3805. What length of highways have you under your charge?—About 33 miles of roads; of course that does not include footpaths.

3806. Do you repair them by men employed under yourself, or by contract?—By men employed under myself.

3807. How many men do the board employ?—On the average ten.

3808. Do you know what weight of stone or gravel you use per year?—In the shape of material about 5,000 yards a year.

3809. Would that be about 4,000 or 5,000 tons?—Yes.

3810. In scraping your roads, can you sell the road-scrapings?—I could do so, but the board decline entering upon that.

3811. What becomes of them?—They are taken by any person who thinks fit to take them away.

3812. The board give them?—Yes.

3813. How many waterclosets do you think that you have in your parish?—Very few, perhaps not more than 200.

3814. What is your population?—About 10,000.

3815. What is the area of your parish?—About 8,000 acres.

3816. If you have not waterclosets, what convenience have you for the population?—Cesspits and privies—privy cesspits.

3817. And ash middens?—Yes.

3818. Do the board empty those cesspits and ash middens, or do the people themselves empty them?—The people themselves empty them.

3819. Then whatever cost they may incur in emptying their ashpits and cesspits it will not come into any general account, to be measured against the rates of the district?—Not at all.

3820. Have you any water supply?—None.

3821. How is the district supplied with water?—By wells.

3822. Then I assume that the parties have to dig their own well, and supply their own pump?—They do.

3823. And any cost of that kind comes out of the pockets of the owners of property?—It does.

3824. And that would not appear in the rates?—No.

3825. So that if the Tottenham people have sewers and drains, and have a water supply, and pay for their conveniences by rate, it would apparently be so much against the Tottenham people, and in favour of the Edmonton people?—No question of it.

3826. But if you could put down the cost of the wells and of the pumps, and of forming these privies, and of emptying them, you would come to something like the truth?—You might do so. In our parish people generally appear to approve of having a control over their own water.

3827. They approve of having their own well and their own cesspool?—Yes.

3828. Do you know what is the cost of making a cesspool and a privy?—It of course depends upon the nature of it; generally a cesspool would cost 70*s.* or 80*s.* I should imagine.

3829. What will it cost each year to empty them?—Perhaps 10*s.*

3830. (*Mr. Harrison.*) How many times are they emptied in the course of the year?—Some of them require emptying every year, but some will go two years, and more than that.

3831. What would be the rateable value of the poor tenements?—The rateable value generally of the poor tenements I should suppose would be 6*l.* or 7*l.*

3832. How much would that be in the pound for the cleansing of the cesspit?—It would amount to something like 1*s.* 3*d.* or 1*s.* 6*d.*

3833. That is to be put in addition to the ordinary rates of Edmonton, if you wish to compare the expense to which Edmonton goes with that of Tottenham?—It would appear somewhat fair to do so, though you must not take the statement in its extreme sense.

3834. (*Professor Way.*) In the one case the town pays for the whole, and in the other case each of the individuals pays for himself; the sum may be the same or more in Edmonton than in Tottenham, and yet you know nothing about it?—I quite understand the proposition.

3835. In one instance the expense becomes public and is known, and in the other it is not known?—Just so.

3836. (*Chairman.*) I suppose the fact will be that in the case of a cesspit, if the subsoil absorbs the material, it will take a longer time before it will fill?—No doubt of it.

3837. If it runs down into the gravel or the subsoil it takes a longer time to fill, and requires less emptying?—Yes.

3838. But if the well is pumping the water out of that cesspit it is relieving the cesspit at the cost of the well?—Yes.

3839. (*Mr. Harrison.*) What is the longest time for which you know of any cesspit remaining without being emptied?—I do not remember any to have remained longer than perhaps from two to three years; I am speaking from memory.

3840. And when it is emptied is there a large quantity of deposit taken from it?—Generally about an ordinary waggon load.

3841. After two or three years' collection?—Yes.

3842. Is there any liquid along with that deposit?—There is generally liquid.

3843. (*Chairman.*) As to the smell of that stuff when it is emptied, what kind of smell is it?—Very unpleasant.

3844. (*Mr. Harrison.*) Do you suppose that that waggon load represents the quantity of solid and liquid matter which has been turned into that cesspit during the two or three years?—I think so, with a very trifling absorption; I think that that would represent it generally speaking.

3845. You think that if you were to put a waggon under a single privy for two or three years, that waggon would hold the whole liquid and solid excrements of the people who use that privy?—It appears so to me as far as I have observed. I have not observed that there is any very deep saturation of the ground round about it after being emptied.

3846. (*Professor Way.*) Have not most or many of these cesspools at Edmonton overflows?—Most of them have overflows; all near our covered sewers have overflows.

3847. Then it is only a case of holding the solid?—Yes.

3848. It gets very solid?—Yes.

3849. (*Chairman.*) Is there anything which you

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wish to add?—I may say, with reference to the water, that we had a complaint some short time since of a well which we considered the worst, and Dr. Letheby's analysis showed that it was not bad.

3850. (*Mr. Harrison.*) What was your population in 1851?—There was not a great deal of difference, I think that it was about 9,000 or something over 9,000.

3851. Have you any establishment in Edmonton in connexion with the London unions for the purpose of rearing children?—There is an establishment connected with the Strand union.

3852. How many children are brought up at that establishment?—I think between 200 and 300.

3853. Is that the only one?—Yes, and none of their drainage gets into the brook; they have a tight tank which they pump.

3854. Do they use it successfully?—Yes.

The witness withdrew.

Mr. William Ironside (Enfield) examined.

Mr. W. Ironside.

3855. (*Chairman.*) What are you?—I am surveyor to the Enfield local board of health.

3856. How long have you been their surveyor?—11 years.

3857. Have they carried out any sewerage in Enfield?—Yes.

3858. Who designed and laid out the sewerage?—Mr. James Pilbrow.

3859. Do you know what the main sewers have cost?—When they were first put in they cost about 7,000*l.*

3860. What is the population of Enfield?—At the last census but one it was about 9,000, and at the last census it was not much increased, it was between 12,000 and 13,000.

3861. Has it increased since 1861?—Not a great deal, it increased very little between the two censuses; how much it has increased since I cannot say, but I think not a great deal.

3862. Is the Enfield Small Arms Factory in the district?—It is partly in Enfield.

3863. Does it come under your local board?—No, that is quite under Government.

3864. Have they any drainage?—No, so far as I know, I do not think they have; they scarcely allow us to go in to look at it.

3865. Have you any water supply in Enfield?—Yes.

3866. Where is the water obtained from?—Chiefly from an artesian well at Ponder's End.

3867. Was it designed by Mr. Pilbrow?—Yes.

3868. And are there an engine and pumps?—Yes.

3869. Do you get as much water as you require, or more than you require?—We did not get so much as we required in dry weather four or five years ago, and we have taken some land springs about 16 feet deep.

3870. Does that give you as much as you want?—At the present time we are laying out nearly 6,000*l.* additional for water supply.

3871. What kind of water is the water from the land springs?—It is a great deal harder than the water from our artesian bore.

3872. Is it ochrey?—I have never perceived it to be the same as was shown here to-day by persons from Tottenham. We have galvanized iron pipes, which have been on for 10 or 11 years, and many of them are as clean and as bright as when they were put on; at the same time a few of them in places are affected, and I can scarcely understand it; it appears to me to be from the earth where they are laid, but there are very few affected.

3873. How many houses have you drained?—I am not prepared to say.

3874. How many waterclosets are there?—I should think about as many as we have houses drained.

3875. Are there any privies?—In the parish there are, but not in the town of Enfield and the town of Ponder's End; the parish is a very wide parish, it extends almost in a straight line of eight miles.

3876. The town of Enfield proper has been sewered and drained?—Yes.

3877. And the houses have waterclosets?—Yes.

3878. And you have done away with the cesspools there?—Yes, and also in the Ponder's End district.

3879. Have they there a water supply from the waterworks?—All who choose to have it, nearly all of them have it now. In the first instance it was objected to, it not being forced, but as a landlord loses a tenant he finds that he cannot get anyone to take his house until the water is laid on.

3880. Do you think that the tenants themselves prefer a watercloset to a cesspit?—I have not the least doubt of it.

3881. What becomes of the refuse when it passes from your sewers?—Our sewers first empty themselves into some settling tanks, there are six of them, there are two sets, three in a set, and the material runs out of one into the other, and after it has run through those beds it passes through two other tanks which are 20 feet by 8 feet, by 4 feet 6, but we fill them about four feet; it passes through a filtering bed of stone and ballast, which is taken out and washed about five times a year.

3882. Do you use lime to mix with the sewage?—No.

3883. What weight of material do you get out of your settling tanks?—I should think that we take out 150 tons every three months, all the year round; that material is taken out in a wet state.

3884. Do you dry it?—No, we take it out by manual labour, and fill it into waggons, and we take out about 25 waggon loads from every tank, that is 25 waggon loads about every five or six weeks. The board will not allow it to be put on to grass land, but the parties taking it are compelled to put it on to ploughed land, and it must be put on the same day or the day after.

3885. Do you give it to them?—Yes, the board give them something to take it away.

3886. In your opinion is it beneficial?—Yes, in a small way, but not to the extent which I supposed is would be. I was never more deceived in my life.

3887. What is the total cost to the Enfield board of so disposing of that sewage?—About 70*l.* a year in round numbers, 80*l.* at any rate overpays it. The washing of the ballast is the greatest expense.

3888. What becomes of the fluid which passes away from the tanks?—It passes down a stone ware glazed pipe into the sewer which was cut by the East London Waterworks Company for the drainage of Enfield.

3889. Does it go into the Lee below where they take their water?—Yes; that is what they call the sewage ditch.

3890. What becomes of the ashes from the dwelling houses?—Several people get a living by having an old pony and cart, and they go round and collect them, and take them to the different brick fields. I believe that the people who take away the ashes generally give the lower orders a penny or two for taking away their ashes. Where there are gardens they are no doubt put on the gardens; there is no difficulty in getting rid of them.

3891. Are your main sewers ventilated?—There are a few ventilating shafts in them, but not many: we have never found anything disagreeable in them.

3892. What is the diameter of your largest sewer?—We have one brick sewer 3 feet 2 by 2 feet 2 that is at Ponder's End; it takes in the storm water from a part of that district as well; it is only about 600 feet long I think. The next largest is an 18-inch brick sewer, and there are 15-inch glazed pipe sewers, and 12-inch and 9-inch pipes; a great part of the parish is drained by 12-inch and 9-inch pipes.

3893. What are your junctions for draining the houses, are they 6 inches or 4 inches?—We have nothing less than 6 inches.

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3894. Have you any trouble with those pipes choking?—No.

3895. Or bursting?—No; we have only, I think, had two bursts in the house drainage.

3896. Have you had any chokings?—Now and then we have closets choked in the traps, but not in the pipes.

3897. Do you consider your system of sewerage perfect?—Yes, very perfect indeed.

3898. When you open down to put in a junction do you find the drains clean or otherwise?—They have generally been as clean as on the day when they were put in, and in the foulest instance with a 12-inch pipe there was not more than 3 inches of water in it.

3899. It may have got out of the line?—Yes. There is a little settlement in one place, but it gets no worse, and goes out as clean as possible.

3900. What do you do with the road scrapings?—We are very glad to give them if anyone will take them, and if not, we have horses and carts and shoot them where we can, and we sometimes sell them to the bricklayers.

3901. For sand?—Yes.

3902. Do you know what has been the total cost of your sewerage works in their entirety, and of your waterworks in their entirety; I refer to the total cost of the main sewers, not including the house drains. What is your debt for main sewers?—The debt is now about 6,000*l.* exclusive of the new additional works, or something like 13,000*l.* including the main sewers and the waterworks.

3903. Do your people grumble much at the oppression which they are under from having these works?—They did a little at first, but I do not hear much of it now.

3904. In your opinion do they think that they are any better or worse off for those works?—I am quite convinced that they are a great deal better off, and I am certain that in the case of those who have not got the water, if it is within where they can have it, the landlords cannot let their houses without it. In several places where they have been beyond the hundred feet, they have come to the board to ask to have liberty to put it on.

3905. Has your board had any difficulty lately with regard to the outlet of the sewers; have you had any threat of actions?—Some few years ago the Edmonton parish got an injunction against us for running the sewage through their parish.

3906. How was it settled?—I believe that we were obliged to alter it; it was a case which I always considered was very badly managed. I thought that we ought to have beaten them.

3907. You think that your lawyer was not quite equal to the other lawyer?—I do not consider that he was up to his work.

3908. (*Professor Way.*) What is the nature of the water which comes away after the deposit of the sewage?—After it has run through the filtering beds it looks clear enough; it has rather a strong smell at times.

3909. Does it run into the intercepting ditch?—Yes.

3910. Then you do not plead guilty to running the whole of your sewage into this intercepting ditch?—Certainly not. We take away 250 waggon-loads a year out of it.

3911. You have given us 150 tons in three months?—Yes.

3912. That would be 600 tons in the year?—Yes. We take from 50 to 60 waggon-loads out perhaps every 10 weeks.

3913. You said that you were surprised at the little efficacy which that stuff had upon the land?—I was never more surprised in my life.

3914. Are you aware that the liquid of sewage is infinitely more valuable than the solid?—When we take it away it is like slop, that is the water and the thick together.

3915. When you take away 12 tons of this material you do not suppose that if it was dried up it would make even two tons?—I do not suppose that it would.

3916. So that it is a very deceptive quantity?—Yes.

3917. That might moderate your view, and would not prove that it was of no value?—Certainly. It is of value if the cartage is not too much. When we took this sewage out the board advertised for parties to take it away, and they could not get anyone to take it away, and I took it myself. I drew it from two and a half to three miles, and I found that it cost me a great deal of money. I weighed every waggon-load which I drew up. Three tons cost me from 8*s.* to 10*s.* I do not think that there is much difference between the thick matter and the thin.

3918. What is the area of the filter-beds?—There are six filter-beds, and they are 40 feet long, 6 feet wide and 4 feet 6 deep. Then there are two filtering beds of stone, into which we put the worst matter. They are 20 feet by 8 feet by 4 feet 6, but we only fill them 4 feet.

3919. That is for a population of 10,000?—But there is not more than half of our parish drained. You may put down 6,000.

3920. (*Chairman.*) The population of Enfield town and Ponder's End is about 6,000?—It is about that; it is the largest parish which there is round London. I think that there are between 12,000 and 13,000 acres of land in it.

3921. Do you know what your rateable value is?—It has been raised; now it is 60,000*l.* odd.

3922. Has there ever been any talk locally of cutting off the town from the parish?—I have never heard of anything of the sort.

3923. You maintain the highways over the whole of the parish?—Yes.

3924. And levy a rate over the entire area?—Yes.

3925. (*Professor Way.*) Do you know the method of precipitating by lime as practised at Tottenham?—I have seen it.

3926. Which of the two methods do you like best, the straining of the liquid as you do it, or the mode which they adopt at Tottenham?—Most decidedly the straining through gravel.

3927. In neither case do you take out the valuable material?—I am quite aware of that.

3928. And in neither case do you purify the water?—No.

3929. (*Chairman.*) You clarify the water but do not purify it?—Yes; I think that the only way to purify it is by irrigation.

3930. Have you seen any irrigation works?—Yes.

3931. Where?—At Croydon.

3932. Have you ever tried irrigation in your case?—No; we have had no opportunity of doing so.

3933. Is there any land below you which you could irrigate with the sewage?—There would be some difficulty in it, but I have no doubt that it might be done at less expense than we are at in dealing with our sewage. The East London Waterworks Company are bound to find us a sewer, and they have put it in. I am quite convinced that we do not put nearly so much sewage into the river Lee as we did ten years ago.

3934. You are less sinners now than you were at that time?—Decidedly; when all that we had consisted of cesspools and overflows, and so on.

3935. At all events whatever there is in your water when it passes away from your works it goes into the river Lee at the point where it enters?—Yes.

3936. And if there is any sewage in your water it goes in?—Yes.

3937. (*Professor Way.*) You say that the East London Waterworks Company were bound to give you this sewer?—Yes, by their Act of Parliament.

3938. Supposing that any action was taken would it be taken against your local board or against the

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East London Waterworks Company?—I am not competent to answer that question.

3939. (*Mr. Harrison.*) You have a right to discharge into the intercepting channel which they have formed?—Yes.

3940. And if there is any lawsuit it must go against them?—I should think so. Where our sewer discharged itself into the sewage cut there was a complaint at Ponder's End. We made a complaint to the East London Waterworks Company, and they put in some 2-feet pipes and carried it down a certain distance to do away with it.

3941. That cut was purposely made to intercept your sewage, so that it might not go into the river from which the East London Waterworks Company take their water?—Certainly.

3942. So that if you might not discharge your sewage into it it would not be doing the duty for which it was specially formed?—Certainly; it was made for the express purpose.

3943. How far is it continued up opposite to Enfield?—It is continued up to where our sewer joins it.

3944. Do the towns and villages above discharge into it?—Enfield highway discharges into it, but there are common cesspools and privies.

3945. Is Enfield highway in your parish?—Yes; and also Enfield Chace.

3946. Is it not sewered?—No; the populous part of Enfield, namely, Enfield town and Ponder's End, is sewered, but not Enfield highway or Enfield Chace.

3947. The New River passes through your town?—Yes.

3948. Is the water there very nicely kept?—Yes.

3949. And all sources of pollution are kept out of it?—Yes. I think that the New River Company are as careful of the water as they can be.

The witness withdrew.

Mr. W. Cakebread.

Mr. William Cakebread (Chipping Barnet) examined.

3950. (*Chairman.*) What is your occupation?—I am surveyor to the local board of Chipping Barnet.

3951. For what length of time have you been their surveyor?—Scarcely two years.

3952. How long is it since they adopted the Local Government Act?—Upwards of three years.

3953. What is the population of Barnet?—About 3,000 within the local district.

3954. What is the area in acres?—It is simply the town; they do not take the parish.

3955. Do you know the rateable value?—I could not state the rateable value of the town.

3956. Have you any system of sewerage there?—Not anything else than what previously existed, except that some sewers have been deepened; there has been one sewer constructed within the last year down the new road which leads to St. Albans; and 1,800 feet of surface drainage to take the water from the roads.

3957. Have the houses cesspools and privies?—The houses in Barnet consist in a great measure of small houses, and the principal part of these small houses have cesspools; pans and traps have been put in instead of the old system of cesspools to a number of houses, but the greater number of houses still use the old form of cesspool.

3958. Where does the sewage get to?—It goes in various directions.

3959. Does any of it get from the ditches into the Lee?—On the eastern side of the town the drainage passes down a number of ditches and goes to East Barnet, and of course enters the Lee.

3960. Is there any water supply?—No; there are no public waterworks; the hill is full of water.

3961. And you get it from wells and pumps?—Yes.

3962. Have there been any complaints as to the foulness of the ditches, caused by the overflowings from the cesspits and the ditches?—No serious complaints of any description.

3963. Are those ditches sweet in summer?—The local board have prevented, as far as it was in their power to prevent it, the stench from the ditches by covering them in, so as to carry the matter off by pipes.

3964. When it passes off by pipes where does the sewage go?—It passes down the different ditches, depositing this sewage, and before it reaches the water which we call East Barnet brook the water becomes quite clear.

3965. And it then passes into the river?—Yes.

3966. And it then goes down to the Londoners for them to drink?—Yes.

3967. (*Professor Way.*) Mr. Beardmore says that it goes into a catchwater; is that so?—It passes into ponds before it is sent in the direction of Colney Hatch.

3968. That catchwater delivers below the intake of the East London Waterworks?—It goes on, I believe, to Colney Hatch, and in that direction.

3969. (*Chairman.*) It goes into the same catch drain which takes the Enfield sewage, and does not go into the East London Waterworks?—I am scarcely acquainted with the progress of it.

3970. Is there any talk in your board of making sewers?—Not otherwise than they are now making; they are continually making sewers where it is necessary. Lately I have had the management of upwards of 1,500 feet of drainage.

3971. Is the place at all growing in population?—Not the town of Barnet; the district is growing, but not within the area of the local board.

3972. Then that does not affect your works?—No; there is scarcely a possibility for the old town to increase.

3973. It has grown up so that it is as tight as it can be?—There is but little land available for building in the local district.

The witness withdrew.

Mr. C. Baxter.

Mr. Charles Baxter (East Barnet) examined.

3974. (*Chairman.*) What are you?—I am simply a member of the Nuisance Removal Committee, under the Nuisance Removal Act of 1855. Our parish of East Barnet is very small; we have no local board or authority of any kind whatever.

3975. What is the population of East Barnet?—At the last census it was below 900.

3976. Have you any cesspits or cesspools, or privies, or drains of any kind in the place?—The majority of the old part of the parish has cesspools.

3977. Do they overflow out into ditches?—The overflow goes into ditches.

3978. Does any of it get down into the streams of the district?—Yes, it gets down into the stream which the Commissioners have heard alluded to over and over again.

3979. And into the intercepting drain?—And into the intercepting drain in Angel Lane.

3980. What duties do the Nuisance Committee perform?—They are to inspect the cesspools or any yard or place which is likely to be a nuisance, and to see that their inspector carries out their instructions.

3981. Have you power to pay an inspector?—Yes.

3982. Have you a surveyor?—Not otherwise than the inspector.

3983. The same person fills both offices?—Yes; we have no power to borrow money for improvements or drains, we have only power to value the property

which we consider requires drainage, and by the Act of Parliament we can only levy a rate of 1*s.* in the pound upon that property, so that it is scarcely possible to make any drainage with that money.

3984. Have your board looked at the new Act of Parliament which was passed in the last session, giving enlarged powers to Nuisance Committees?—Yes, and the parish have taken it in hand; they have formed a board as they think in accordance with the Act.

3985. Has there been any complaint to your board of the ditches, as to the outfall of the sewers, or otherwise?—Not particularly in that respect. There is a strong complaint of fouling the stream in consequence of the considerable sewers which are in operation, over which our present committee has no authority. There is what we call a new part of East Barnet, which is increasing very rapidly. It is on the extreme west, adjoining Chipping Barnet. It is under the British Land Company; they bought an estate there, and they have laid it out, and an immense quantity of houses have been put up, and it is sewered. That portion of East Barnet is sewered very perfectly, and there is a good quantity of water upon it from an artesian well.

3986. Where does your outlet water go to?—Into this stream. They have four sewers discharging into this stream, and in one or two of them they have made great attempts to purify the sewage by the absorbing wells. They first bored one 300 feet, and now they have sunk one of four feet diameter.

3987. Did they sink it into the chalk?—No, but into the green sand.

3988. I suppose that you do not question what becomes of the sewage so long as it goes away?—Our only doubt is whether it will go away.

3989. You will be quite content to send it that way, if it will go away?—We shall be quite content with an outlet somewhere.

3990. It would not be an outlet, but it would be an inlet?—It would be a question whether it would go to our parish if it were so many feet deep.

3991. Is there any agricultural land near the outlet of your drain where the sewage could be put on?—Not without great difficulty, and not without great expense. I have made an attempt to put it over land, but the fact is, that nearly all our land is ornamental land, residential estates, and gentlemen's property, and it is very valuable for that purpose, and unless it was purchased right out at a great cost we should not be able to turn the sewage over it.

3992. At what does land now sell?—It is as high as 300*l.* an acre.

3993. For building purposes?—Yes.

3994. What did the British Land Company give for their land?—It is some years since they purchased it. It was contemporaneously with the establishment of the Great Northern Railway.

3995. How many acres have they?—I should think, at a rough guess, 300; it is quite as much as that.

3996. What number of houses have they put on?—There are over 500 houses in our parish.

3997. That would represent a population of 2,000 people?—I daresay that it is that number now. It has considerably increased since the last census.

3998. Then they manage themselves, drain themselves, and give themselves a supply of water?—Yes, and a very good supply of water indeed.

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3999. Have they a committee in the shape of a local board to carry it out?—No, they carry it out independently, and sell their land so as to cover the expense.

4000. Are they within your area; have you power to rate them for anything?—No, we have no power to rate any person, except in the case of houses which we improve by drainage, and then only to the extent of 1*s.* in the pound per annum.

4001. And they must add some nuisance which you can complain of legally in order for you to interfere?—Yes; we had occasion to complain of their sewage last year, and we used that authority, and without taking any legal steps. We represented to them the desirability of cutting off their sewage some 40 yards before it passed this brook, and they passed it through burnt ballast at our representation.

4002. They strained the solids out of it?—Yes.

4003. Does that go on now?—Yes, at all the mouths of their sewers, excepting at the absorbing well.

4004. (*Mr. Harrison.*) Do they sell the land upon which these houses have been built?—Yes.

4005. How much per square yard do they get for the land when they sell it for building purposes?—I could not exactly state that; very small plots were sold for 50*l.* at the last sale which they had.

4006. What would be the size of one of those plots?—Perhaps three times as large as this room. I am speaking very much at sea in that respect. It is not my forte at all.

4007. What is the agricultural value of land in the neighbourhood?—I may take it at two guineas just in our immediate neighbourhood. It is cold, stiff clay.

4008. (*Professor Way.*) What number of people do you say would drain into these absorbing wells?—Into that one sewer, where the absorbing well is, there would perhaps not be more than 50 houses.

4009. That is 200 people?—Yes.

4010. Supposing the principle to be carried out do you know that the drainage, so draining into those wells, would go through some porous beds of some kind if they succeeded at all?—If they succeeded at all it would.

4011. And those porous beds in all probability would be the beds where water would be obtained from deep wells?—Exactly so.

4012. So that for the sake of carrying off the sewage of 200 people the drinking water of 2,000 people or more might be poisoned?—It does not appear that that is at all likely, for it does not answer at all; it was tried at the Colney Hatch Asylum, and I believe that it is a failure in both cases.

4013. Presuming it to be successful do you, as a person knowing how water supply is carried out for a population, think that that is a proper system?—Hardly.

4014. Supposing it to be carried out, where would the wells be?—The water I think would not be so pure.

4015. Do you not think that it is a system to be reprehended by every possible means?—I think so.

The witness withdrew.

Mr. J. G. B. Marshall, M.A.

Mr. Joseph Gilbert Blair Marshall, M.A. (West Ham), examined.

4016. (*Chairman.*) You are engineer to the local board of West Ham?—Yes.

4017. How long have you been their engineer?—About seven years.

4018. Do you remember the area of the district?—I do not at this moment remember it exactly, but it has been so often ascertained and published that it is a notorious fact; it is about five miles long by four miles wide in round figures.

4019. West Ham has been sewered?—It has.

4020. Where is the outlet?—Near Bow Creek, on the river Lee.

4021. What is the population of West Ham?—I should think that it is at present some 60,000.

4022. What is the number of houses which you have drained?—We have drained about 8,000 houses, out of the whole number of 10,000 to 11,000.

4023. In draining those houses have you substituted waterclosets for open privies?—In every case.

4024. Have you much trouble in managing those waterclosets to keep them clean?—I may say none; we seldom know what trouble is in that respect.

4025. Is the water supply in the hands of a company?—Yes, we depend upon the East London Waterworks Company entirely.

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4026. Do they supply the entire district?—They do.

4027. Is there any difficulty in obtaining water from them for the supply?—I can hardly say that there is; of course there are complaints, as complaints will arise everywhere, but I do not think that the company are unreasonable; generally we have an abundant supply.

4028. Is your district growing?—Very rapidly indeed.

4029. You have plans I suppose laid before you?—Yes, every fortnight.

4030. Have you any idea of how much it has grown between 1851 and 1861, and from 1861 to the present time?—Yes. I forget it now, but I did reckon that matter a few days ago.

4031. It is growing rapidly?—Very rapidly. I may say that every fortnight we have proposals to build at least 50 houses on the average all the year round.

4032. What is your present rateable value?—It is 160,000*l.* in round figures.

4033. What is your present debt for main sewerage and other purposes?—It exceeds 100,000*l.*; I should say that it approaches to 110,000*l.* or 112,000*l.*

4034. Some of that would be for private improvements, for street formation?—Yes.

4035. Do you know how much out of that sum is for street forming?—Probably 20,000*l.*

4036. Those would be private improvements?—Yes, recoverable from owners of property.

4037. Then your main debt is upon the sewerage?—Yes, that is the ratepayers, main debt.

4038. A great portion of the sewage I believe is pumped into the Lee?—We do pump a great deal, but at the same time not the greatest quantity; we also discharge by gravitation.

4039. About what does that pumping cost you a year?—About 1,000*l.* a year in round figures.

4040. Have you tried irrigation upon any portion of the land in your possession?—Only upon an experimental scale; we have a portion of land adjoining the pumping station, where we have made some experiments.

4041. On what area?—About an acre.

4042. What result did you get from the irrigation of that acre?—In rye grass we produced five most abundant crops, some of which we converted into hay with bad results.

4043. Was the weather against you during the time that you were making the experiment?—Yes, three crops out of the five would be incapable of conversion into hay in consequence of the uncertainty of the season.

4044. What impression has that experiment left upon your mind with regard to irrigation, if you could cut your crops green and remove them and find a ready market?—The impression that the result would decidedly be profitable and most beneficial to the district, and my inference is that that is the proper thing to do with the sewage in the vicinity of London or other large towns where the crop may be immediately removed green.

4045. Do you think that if you had land enough you could dispose of your sewage in that district upon the land and not cause a nuisance?—If there was sufficient land we could dispose of every drop of the sewage in that manner. I have no hesitation in saying that if I had sufficient power and sufficient area I could convert every drop of the sewage into good wholesome food for cattle.

4046. Do you think that that area could be got adjoining your works?—It might be got, but it is more valuable for other purposes.

4047. That marsh area is especially valuable as accommodation land, is it not?—Yes.

4048. At what is that land now taken per acre?—3*l.* or 4*l.*, but it is being rapidly absorbed for commerce, and for the purposes of the City of London docks and habitations for dock people, and for ship constructors, and factories for chemicals, and all sorts of things. They are being spued out of London and across Bow Common, and they are being shot over the Lee, and they find convenient localities there; and for these purposes the land is more valuable than it would be for the growth of grass for cattle.

4049. What is your experience with regard to the mode of ventilation adopted on the the main sewers at West Ham?—I think that, practically speaking, it is perfect.

4050. Have you occasion to have some of the flatter sewers cleansed by hand at times?—We have had occasion to do so about twice in the seven years.

4051. Not more?—Not more.

4052. Do you know what the gradient of those sewers is near the pumping works?—Yes, it is very flat, one portion is horizontal.

4053. Do you find any difficulty in keeping that portion clean without manual labour?—We have never had occasion to touch it, but that is close by the pumps, and the draught is exceedingly rapid; it clears itself as clean as a whistle.

4054. Do you occasionally adopt the means which you have at many points for flushing?—Yes, but only very occasionally. We found it expedient during the last summer to wash out the sewers. I believe that we should not have had occasion to do so, except to please the people on account of the cholera. We did wash them down, there was so much sentiment in the affair that we did it to please the people.

4055. Have you had much choking?—Never with the main sewers.

4056. Do your drains much trouble you with choking?—Very seldom; it is quite an accident if a stoppage takes place.

4057. Have you had much difficulty where the sewers cross the navigable portions of the river Lee?—We have never had the slightest difficulty.

4058. Have you considered the question of the ultimate disposal of the sewage if it is to be kept out of the Lee and out of the Thames?—I have considered very carefully the subject of dealing with our sewage, that is to say our outfalls. Of course it is not at all satisfactory, though the discharge into the river Lee enters even so low down as the Thames, and we are under some degree of pressure to alter that discharge. Latterly we have been deodorizing by the application of carbolic acid and per-chloride of iron.

4059. Is it the fact that the Lee itself, supposing that you did not pass one ounce into it, is quite as foul as your sewage before you pass anything into it?—I should say that it was absolutely as foul; it looks as foul, and certainly no sensible impression is produced on the river Lee that I could ever detect, even when we are pumping into it in all times of the tide.

4060. The river Lee is a tidal river, and a large area of bank is exposed every tide?—It is so each tide.

4061. In what condition are those banks when they are so exposed?—They are covered with a slimy deposit of mud, of a most offensive appearance, and certainly with no agreeable smell.

4062. In hot weather, what kind of sensation have you, when walking near that mud?—I always have the sensation that I should like to be somewhere else.

4063. Then, before the river Lee can be made satisfactory, I suppose that it must be freed from this sewage, and something must be done to cleanse those mud banks, or to remove the mud?—Yes, or probably they would cleanse themselves.

4064. Do you think that any tidal channels of that kind ever cleanse themselves?—I question it, but I hope that they would become clean if the Thames was made clean and the upper part was made pure.

4065. Have you ever had occasion to consider the upland water of the river Lee?—Yes, it came specially under my attention.

4066. Is there a large growth of population at Silvertown?—There is an enormous population springing up there; there are some 500 people I suppose living there; there are houses for them, and large works are being built.

4067. Have you done anything for the sewerage of Silvertown?—Nothing; it is polluting the neighbourhood, and it is polluting the ditches.

4068. Have you had much surface flooding during these last heavy rains?—We have had no surface flooding of any magnitude this season, but last year, after the snow, we had the region between Tottenham and Stratford and Lee Bridge covered with water.

4069. Has it been so within the last three weeks or a fortnight?—Not to my knowledge; I am aware of several impediments on the Lee, but I am not prepared to attribute that flooding to any impediment within my knowledge.

4070. You are not the engineer of the Lee?—No; in the district of West Ham we have scarcely any surface flooding now, in fact, I may say, none.

4071. Have you any idea how many surface gullies you have?—We have about 1,500.

4072. They take away the water into the sewers and the sewers convey it down into the outlet?—They do.

4073. Have you had any floodings from the sewers being too full?—We have had a few overflows in cellars; I may say that it has never quite reached the surface of the ground.

4074. That is in some of the low cellars by Barking Road?—Yes, we had two or three occasions on which it occurred.

4075. The surface of the ground there is some six or seven feet below high-water line?—The surface of the ground there is 14 feet below high-water line.

4076. I think that you let all the persons who dug out the surface there, and made those cellars, do it upon their own responsibility?—We did not let them do it; when they have dug cellars they have done it on their own responsibility.

4077. (*Mr. Harrison.*) It is of no use raising the whole district several feet, and then when you do it for different persons to dig down again; they must do it at their own risk?—Yes.

4078. You say that London, as it were, spues out these large manufactories into the Ham marshes. What is the value of the land at Ham marsh; it is about 3*l.* an acre you have said?—It lets for that per acre; if you went into the market to buy it you must probably pay 120*l.* an acre for the marsh land.

4079. An increased price would be put on for the prospective value which it would probably have to the buyer?—Doubtless in consequence of its proximity to London.

4080. What is the value of the land when it is purchased for manufactories?—It varies very much. On the banks of the river Thames, or near the navigable streams, it fetches as much as 1,500*l.* to 1,800*l.* an acre. I do not say that you could buy the land at any time near the river for 120*l.* an acre; it is not the same land as I was speaking of when I gave you that price.

4081. You mean land further away from the river?—Yes, agricultural land, grazing ground.

4082. Supposing that manufactories were erected adjoining the river for a considerable distance below Bow Creek, what would then become the value of the Ham land within the land on which those manufactories were built?—It would probably then be worth, for building purposes, 800*l.* to 1,000*l.* an acre, sold in plots as ordinary building land.

4083. Considering the question of your inability at Ham to obtain this land for the application of your sewage, in consequence of its increased value, it seems to point out that that land subsequently may fairly be put to a considerable expense to carry the sewage from it to a great distance off in consequence of its great increase of value?—Doubtless.

4084. And that argument would work back into the whole of London. Any town which is so increasing that the rental is an imaginary value, so that the land cannot be obtained for irrigation purposes, may fairly be put to the expense of carrying the sewage beyond that limit to apply it to the land?—Undoubtedly.

4085. I think that the arrangement is that your outfall at present is merely a temporary one?—That is all.

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4086. Is it understood to be a temporary one?—It is understood to be of a temporary character; it is not a temporary structure, there is nothing temporary about it; it is a good and efficient, and is a well working, and well-constructed piece of machinery; at the same time its position and its circumstances can only be looked upon as of a temporary nature.

4087. And the actual understanding, if not arrangement, with the River Lee Navigation Company is to the effect that it is only temporary?—In point of fact that is so. I believe that there is a written understanding between the board of health at West Ham and the river Lee authorities, that when called upon the board shall do something. I cannot exactly say what; it is impossible to say at the present time what can be done, but the understanding is that the board shall do what can be done to make things better.

4088. Have your board considered what can be done?—They have. I have been instructed by my board to consider what can be done.

4089. What have you reported?—In the first place I was instructed to consider whether the sewage of the district of West Ham could be disposed of by discharging it into the low-level reception place of the metropolitan board, which is in the centre of our district at the Abbey Mills, leaving it to the metropolitan board to lift our sewage and dispose of it as best they could, and we paying them such terms as could be arranged between us. In considering that subject with their engineer we came to the conclusion that that was not the best nor indeed the proper thing to do; but considering that the metropolitan board themselves were under the obligation of sewering a part of the county of Kent, which lies on the north side of the river Thames, and which includes the populous place of North Woolwich, and that they were under the obligation to provide an outfall sewer and pumping works for it, and considering that the local board of the district of West Ham were under the obligation of providing for the sewage of what we call the district of Silvertown, that is the area lying between the Victoria Docks and the river Thames, and which is not sewered, and is a sort of isolated district cut off by the Victoria Docks from the other portion of our district, and considering that the low portion of the East Ham marshes would ultimately require sewerage, we after careful consideration came to the conclusion that the right thing to do was to make a good outfall sewer straight away from our present outfall works, picking up our works there, and carrying it right down to the banks of the river Thames near Barking Creek, in fact as far down the river as the metropolitan board has gone; that we should pick up our drains at the Barking Road, and carry our works down to the banks of the Thames, and there place a pumping station, at the same time carrying a branch sewer down through our Silvertown district, through the metropolitan works in the North Woolwich district, and also giving an opportunity for the district of East Ham to drain into it, and erecting on the banks of the Thames a proper pumping station with adequate machinery to deal with the whole, on a sufficiently grand scale to meet all the requirements of the various parties whom we should thus serve.

4090. Do you mean by putting the sewage on to the land or by delivering it into the river?—We have got to the point of lifting it, the question of what we should do when we have lifted it is a moot question. I cannot tell you what can be done, but if we can get there with our sewage we shall at least have done all that other people have been able to do, and all that anybody can tell us how to do with benefit. If we must throw the sewage into the river when we get it there we must do so; if other people must throw it into the river, so we must throw it into the river; but if other people can take it on to land, so we should have an opportunity of taking it on to land, and if other people can devise any means of utilizing it by converting it into gold dust or anything of that kind,

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then of course we should have the same opportunity of making it into gold dust.

4091. But I think that you told us that you had made an experiment on a small scale, and that the result of that experiment was that you could make it into gold dust?—My experiments undoubtedly persuade me that the right thing to do with it is to convert it into rye grass, for the nourishment of the horses and cattle of London, and of the cattle which now browse on the Essex marshes, because of course there it would be in the centre of the Essex marshes.

4092. Could you now get land at that distance down the river at a reasonable rate for the application of the sewage to it?—I think so.

4093. If so, would it be a wise thing for your board to take steps to do so at once?—I think so, but whether the board would do it is another matter. I should certainly advise them to do it.

4094. (*Chairman.*) I suppose that the board generally give you advice?—They give me more than advice.

4095. (*Mr. Harrison.*) You do not mean to say that you do not find that they are advised by you?—I very often find them indisposed to go into anything of a speculative kind, any scheme of any great magnitude; in fact they like to keep their enterprises pretty well at home.

4096. As to the occupation of a site of land at Bow Creek, does not your sewage form a considerable part of the polluted water which passes into Bow Creek?—I think not. Our sewage is discharged in two ways. The first mode is by gravitation, when the tide permits. I take it that it runs away with the tide, out into the open stream of the Thames, into a large volume of water. Then we pump. When the tide returns it very soon shuts up our discharging opportunity. It shuts up our self-acting sluices, and then we fall back upon the use of our pumps, and we use them with a little discretion as to how we shall throw the sewage into the tide, we take care as much as possible that it shall only be done when the tide is flowing out, and we calculate upon the sewage going with the river, not up the river but down.

4097. By gravitation it passes out when the tide is receding, and when the tide rising stops the outlet there is no discharge at all for a certain period?—That is so.

4098. When the tide begins to recede again after its flowing you pump so that the sewage shall go into the water when it is receding from Bow Creek?—Yes. Our sewers retain it for a certain time till the water gets up to high tide.

4099. (*Chairman.*) They form a tank?—Yes.

4100. (*Mr. Harrison.*) So that by management in that way you think that very little of the sewage from your discharge goes back up the river Lee?—Very little.

4101. Have you attended much to the supply of water to the poor tenants in West Ham?—I have had occasion very particularly to attend to it; in fact, in carrying out the drainage of the houses, which we have done very generally, in every case where we lay in a drain to a house we insist on the owner providing a tank to hold water to flush the closets, and to supply the house at the same time. We have taken advantage of the opportunity, and concurrently with the laying of the drains we have insisted upon the houses being properly supplied with water for the tenants.

4102. What sized tank can you supply?—About 3 feet by 18 inches, by 15 inches deep, or thereabouts.

4103. Upon the average how many gallons a day would it supply to the household?—From 30 to 40 gallons.

4104. Is the system at West Ham intermittent?—Yes; there is some constant supply throughout the district, but as a general rule it is intermittent. The supply is turned on in the morning, and the cisterns are filled. We trust to Providence after that.

4105. You take the supervision of the tanks of the poorer tenants, and you make it obligatory upon the owners of the property to supply such tanks as are necessary?—We have not taken the supervision, because that is in the hands of the water company who supply the water, but we have taken the opportunity of compelling owners to supply water to tenements where a water supply did not previously exist. In a great many cases we have done so.

4106. Is the power which you have exercised in that case one which you could legally enforce?—Yes. We have never exercised it unless we could legally enforce it, at least we have never in that case attempted to exercise it legally. We have exercised power in two ways. In the first place we have exercised moral power. When the owners of the property have had their drains laid in we cautioned them against having watercloset without water supply. In many cases we could not, from the limited powers of the Act, compel them to have water, but in many other cases we have been able to compel them to have it, and in fact by the co-operation of the waterworks company, by giving us special rates, in some cases we have been able to do it.

4107. Do you think that in all cases, if the local boards in the parishes of London co-operated with the water companies, they could enforce a similar system?—From my experience I should certainly say so, by forcing and coaxing.

4108. You find that where the coaxing system will not do the forcing system answers?—Yes; but just let me point out a very important hitch here. We have found that the price fixed by the Public Health Act, namely 2*d.* a week, is too limited. We find that the waterworks company's rate exceeds 2*d.*, and when it exceeds 2*d.* we are powerless. When a supply is wanted the company decline to give it. If we cannot supply it at 4*s.* 4*d.* a half-year to the tenements, we cannot compel the owners to supply it at all; that is too low a rate.

4109. (*Chairman.*) You would have power to compel the owners of property to take the water at the company's published scale of charges?—At the authorized scale of charges, decidedly. In some cases I have been obliged to ask for a special rate to enable me to report to the board that it was within the powers of the Act.

4110. In those cases you have referred to, where there is an overflow from the tank, is there a ball tap?—No. The waterworks company object to that; they think that the people might let the water run on to waste, and they object to put an overflow.

4111. (*Professor Way.*) You are, I think, an advocate for the application of sewage to land?—Not particularly an advocate for it.

4112. You believe, do you not, that it would answer to apply sewage to land. You say that this valley cannot be kept pure unless the sewage is intercepted, which no doubt is the case, but in intercepting it, supposing you go further up the valley, I presume you would be collecting all the sewage and bringing it down to rather valuable land before it was distributed?—Lower down, it may be valuable land.

4113. And subsequently it would have to be distributed again?—Yes.

4114. Would it not be better to deal with the sewage at certain spots where you would have all the advantages of the intercepting sewer, the object being to carry the sewage from the small towns to a point where it could be concentrated, and from which it could afterwards be distributed?—I may explain that as a matter of detail, adverting to this proposition, I omitted to notice, [and I am sorry I have not got it,] the written description by Mr. Bailey Denton; but if you will refer to it you will find that the point to which you have referred has not escaped our consideration. We propose, of course, as we come down the valley, to intercept all such sewage as we can find available for irrigation, wherever we can find land to apply it to. We propose at every point to deal with the sewage as we come down the valley in the most efficient way; but we know that we must have an ultimate outlet to take that which we cannot deal with in any other way. Anything that we can catch at a higher level up the valley and send down to the lower district, and there deal with, of course we should catch; but we know that we must have an outlet, and power to deal with that which gets to the outlet, which we cannot possibly deal with in an intercepting way.

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4115. The quantity that could be so distributed is now unknown?—Quite so; and the great difficulty is to get land in suitable positions, and, again, people will not have it. It is well enough for me to be an advocate for the production of rye grass, or celery, greens, peas, and vegetables of all sorts, which I have produced, but people will not have sewage irrigation near their habitations.

4116. (*Chairman.*) And yet they will make top dressings of putrid manure, which is 20 times more offensive?—Undoubtedly; and they will leave it there reeking in the sun for days and days, whereas this stuff would go away, and it would be all settled in six hours.

4117. (*Professor Way.*) Like most other popular prejudices, do you not think this will pass away in a few years?—I hope so.

4118. Consequently, you might hope to find within reach of all these towns land for the application of their sewage without taking it down to a place from which you must discharge it into the river, or set to work on a large scale to distribute it?—Yes; I hope that condition of things will come to pass, but I should never be able to get over the necessity for a good outfall sewer, and for this reason, that however complete irrigation may be in its arrangements, and however well you may have everything fitted for irrigation, still a heavy rain will sometimes come at the rate of three quarters of an inch in three or four hours, and then the water will run down into the lower regions. Acts of Parliament will not stop gravitation, and injunctions in chancery will not stop the river Lee. The water will go down, and of course it will carry dirt out of the sewerage and out of the streams from every source into the channel of the Lee, and if we drink that water it will be nonsense to say that we can drink it with impunity and without risk; it will be dirt if you let this water go into the river Lee at all.

The witness withdrew.

The witness subsequently forwarded to the Commissioners the following Report:—

REPORT furnished by J. G. B. MARSHALL, ESQ., C.E., Engineer to the LOCAL BOARD of HEALTH at WEST HAM, upon the Sanitary Arrangements of WEST HAM.

Stratford, 18th February 1867.

The area of the district of West Ham is nearly 5,000 acres.

The population is now about 60,000.

The number of houses about 12,000.

Of these there have been drained 10,000 with waterclosets; water supply dustbins, yard pavements and surface water, roof drainage and ventilation complete.

The houses are chiefly six-roomed cottage residences of artizans and their families, many of them I am sorry to say being improperly crowded to their roofs.

The cost of drainage, providing and fitting in sink, soil-pan, dustbin, and yard paving, may be averaged at 6*l.* per house; this cost is in each case defrayed by the owners or leaseholders, or in some cases by arrangement between them.

To the question, What per-centage of chokings or stoppages has there been in house drains, sinks, and waterclosets? I can only answer, "There is no such thing here as choking;" an occasional failure may take place from bad workmanship or neglect of the principles laid down for the guidance of the men and shown on the sheet of details, one of which is issued to every person who has to put in house-drains, &c.

An inspector from my office attends and sees every pipe properly jointed, and every portion of the work completed, before it is covered up, and the reducing discussed for the closet-pans, making every pipe-drain which is beyond the reach of a man's hand 6 inches in diameter, guards against anything getting into a pipe-drain which is likely to stop it. In all cases the pipe-drains are laid with uniform inclinations from the surface to the sewers, which prevents stagnation and ultimate choking.

The recent severe frost caused no mischief or extra expense after its disappearance.

My experience here as to the relative advantages of waterclosets over privies and cesspools is not a fair general guide, because in a flat marshy district like West Ham, with a clay subsoil always saturated with water, privy cesspools cannot exist; there must be an overflow somewhere. Here I found such cesspits discharging their contents into open ditches and polluting the atmosphere frightfully; the only cure was conversion into waterclosets; simultaneously with this alteration I have filled up the ditches and introduced means of supplying water for flushing and domestic use. I have also drained all yards, sinks, and roofs, using rainwater pipes as ventilators, for which they serve admirably, and keep the drains free from gases.* It is impossible fully to describe the beneficial effect of the alteration in the premises produced by these means. In many instances the inhabitants have become of a higher grade, and health and comfort must have been greatly improved.

Of course other evils of overcrowding, uncertainty of food and clothing—human improvidence—remain unabated; and diseases still exist, but not to the same extent and virulence as before the works existed. The mortality, which was formerly very high, would now be found moderate, if not very low, in certain seasons, were *the infant mortality* not so excessive as it is.

I have now only time to give these naked facts, but any information or opinions on points constantly under my notice are quite at your service; and of course you are at perfect liberty to make any use of them, either for your own purposes or for the public good.

J. G. B. MARSHALL, M.A. and M.E.

* The whole of the main sewers in West Ham are ventilated at several 100 manholes, the gases in all cases filtering through charcoal. Down-spouts are not therefore relied on. Sewers cannot be fully ventilated by down-spouts.—R.R.

Mr. WILLIAM DELANO (Tottenham) examined.

Mr. W. Delano.

4119. (*Chairman.*) What are you?—An agriculturist.

4120. Where do you reside?—I reside near Park station, in the parish of Tottenham.

4121. Are you officially connected with any of the local boards?—No, not with any of them.

4122. Are you a ratepayer?—Yes; I pay rates to the parish of Enfield, the parish of Edmonton, the parish of Tottenham, and the parish of Hornsey.

4123. To what particular points in connexion with this inquiry do you wish to speak?—I wish to speak upon the whole matter of the inquiry, and first upon the pollution by town sewage.

4124. Do you mean the pollution of the river Lee?—Yes.

4125. That is polluted from town sewage?—Yes, in certain places it is so, but the pollution from town sewage, I take it, is not now very great.

4126. I suppose it is a fact that all the sewage from the different towns and villages finds its way into the natural outlet of the valley by drainage?—Not of all the towns.

4127. I suppose it gets into the Lee ultimately?—Yes, ultimately; but very low down, below Tottenham. The Lee is almost a common sewer at its outfall into the Thames.

4128. Is the river Lee polluted by any other forms of refuse?—I take it that the river Lee proper would be affected a little by the towns on its margin, or at those places where the sewage of a town enters it.

4129. Have you been to Luton?—No.

4130. Have you been to Bishop Stortford?—Yes.

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4131. Have you inquired specially into the pollution of the Stort by the sewage of Bishop Stortford?—No, I have not.

4132. Nor into the pollution of the Lee at Luton?—No.

4133. Have you paid any special attention to the sewage of Hertford?—I believe it is intercepted by the works of the New River Company, and therefore there is very little matter, I take it, that comes in from Hertford; but when you come down to Ware, there I expect there is some feculent matter that comes into the river, and from other places in its course. I may say that I hope to see a water supply extended to this place. You have heard how yellow the water is, and I hope we shall have the water from the Tottenham Board Supply. If the East London Water Company will take the initiative, and make a sewer on each side, then I think there will be nothing to complain of as to contaminating the water.

4134. Where do you get your drinking water from?—From a well.

4135. Then you are not interested in a supply of water to Tottenham?—Only in the enormous expense the board will be put to in providing water.

4136. You say you have not been to Luton?—Yes.

4137. Do you know that there are many tons of poison discharged into the river there every year?—I have seen the evidence taken at Luton, and I do not understand that it is poison.

4138. What is oxalic acid?—Of course it is poison, but it depends upon the degree to which it is put in; there is such immense filtration going on down the river Lee, four or five miles below where it comes from, that it would come down here very clear indeed.

4139. Is the river Lee now polluted by sewage?—It is in certain places, from Ware, and the new towns that are being built upon the river near Waltham Abbey. On the other hand it comes down here pure and clear from the weeds; there are aquatic plants that take up all the impurities before the water comes down here.

4140. That is your opinion?—Yes.

The witness withdrew.

Mr. John Phillips (Tottenham) examined.

Mr. J. Phillips.

4141. (*Chairman.*) Where do you reside?—In the high road, Tottenham.

4142. You have been, I believe, a member of the local board of Tottenham?—Yes.

4143. For how many years?—About 10 years.

4144. What special points do you wish to speak to?—The state of the river Muswell.

4145. Through which part of the parish does that river flow?—It is near the centre, generally speaking.

4146. Does it receive the sewage of any portion of the parish?—Yes, of some portion at the present time.

4147. In what condition is it?—In the summer season it is in a very filthy condition indeed, both in appearance and as regards smell.

4148. Where does the outlet fall into?—In my younger time it used to be pure, or so nearly pure that I used to like to drink the water very much. My dinners were in those days frequently cooked with it, but now at times I have not been able to bear the smell of it, particularly in hot weather.

4149. What do you think causes the pollution?—Sewage.

4150. From what source?—From waterclosets.

4151. What is the name of the street or place where the houses exist from which the sewage comes?—I should apprehend that it would be from Wood Green and Tottenham, and considerably from Hornsey.

4152. Flowing down into the Muswell?—Yes.

4153. Where does it flow to?—Into the river Lee.

4154. Does it go into the Lee below where the East London Water Company take their water?—Yes.

4155. It pollutes the water of the Lee where it goes in?—Yes.

4156. Is that within the jurisdiction of the local board of Tottenham?—Not under the present state of the law as it appears to me. The river Lee trustees prevent us from connecting our new works, and the Hornsey board have not the power to alter the present state of things.

4157. Is it necessary that there should be some additional power or higher authority to deal with the question as a whole?—I think it requires some additional power. In the summer time the river I have spoken of is in places covered with a fœtid looking scum of a dark green colour, or a pea green.

4158. Are you aware that there are other streams in the valley of the Lee quite as impure?—I know that there are others very impure.

4159. But this is the most impure within your knowledge?—Just so

4160. You would naturally wish to see it dealt with so as to be rendered pure?—Yes.

The witness withdrew.

Mr. George Ross (Tottenham) examined.

Mr. G. Ross.

4161. (*Chairman.*) You are registrar of births and deaths?—Yes.

4162. What information have you to give about the river Muswell?—Some time ago a new cemetery was formed in this parish, and that cemetery was found to be very wet indeed. Some two or three times there has been an attempt to drain it, and the drainage of the cemetery flows into the Muswell, which I cannot think of without shuddering.

4163. You believe that some of the filtration from the cemetery may find its way through the subsoil into the Muswell?—Yes, I believe it does; it is drained into the Muswell.

4164. That tends to give it the appearance and smell which the last witness spoke of?—I presume so. The cemetery is nearer this end of the Muswell than the other. If Mr. Phillips referred to this end of the Muswell it would have a tendency to do so.

(*Mr. Phillips.*) I referred to a part higher up.

4165. (*To the witness.*) How long have you been local registrar?—From the beginning, since the Act came into force.

4166. Had you known the district before the board of health was formed, and down to the present time?—Yes.

4167. Taking the parish of Tottenham, and especially the town portion of it, what is your opinion with respect to the public health before and after the local board began to act; is it better or worse?—I cannot say that there is much difference.

4168. The population, I believe, has increased very much?—Yes, I believe it has increased very much.

4169. It was an agricultural district, was it not?—Yes, and very healthy.

4170. Now it is a town district?—Yes.

4171. And thickly peopled?—In some parts it is thickly peopled.

4172. Do you consider it remains healthy now with a population so largely increased?—Yes.

4173. Have the operations of the board been beneficial or otherwise?—I do not observe much difference.

4174. Has there been much fever in the last eight or ten years?—There has been fever occasionally, more or less, in different localities now and then.

4175. Have you ever furnished a detailed statement of the mortality of Tottenham?—Yes; every month I send to the local board a detailed statement of all the deaths that have occurred, and I have done so for the last few years.

The witness withdrew.

Adjourned to to-morrow, at 10 o'clock, at Hertford.

Hertford, Wednesday, 19th December 1866.

HERTFORD.

W. M. Armstrong, Esq.

19 Dec. 1866.

Present:

ROBERT RAWLINSON, Esq., C.B., in the Chair.

John Thornhill Harrison, Esq. | Professor John Thomas Way.

William Matthew Armstrong, Esq. (Hertford), examined.

4176. (*Chairman.*) You are mayor of Hertford?—Yes.

4177. Is Hertford an ancient municipal borough?—Yes, it is very ancient. I produce the ancient charters of the borough, at least copies of them; there is one of Charles II., which is the principal charter under which we are governed. I also produce abstracts of grants with reference to the commons. The first is the 3rd of Charles I., a grant of Hartam, Kingsmeads, and Little Hartam. Then there is a charter of Charles I. as to the corporation of the borough, and a charter of Charles II., which is the principal creating charter, and which embodies the whole of the powers given to us as a corporation.

4178. I suppose you have passed under the hands of municipal reformers?—Yes; the boundaries of the borough were enlarged for parliamentary purposes.

4179. Under the Reform Act?—By the Municipal Act.

4180. This is a municipal and parliamentary borough?—It is.

4181. What is the area of the municipal borough?—I do not know.

4182. Is the area of the municipal and the parliamentary borough the same?—No; the ancient municipal borough is very much smaller than the parliamentary borough.

4183. And the area of the municipal borough was fixed, I assume, at the time of the reform of municipal boroughs by the Commissioners?—Yes, those boundaries were then defined.

4184. Now the parliamentary borough is much larger than the municipal borough?—Yes.

4185. Was that fixed during the passing of the Reform Bill?—It was fixed under the Municipal Corporations Act, which was passed subsequently to the Reform Act. The present municipal borough and parliamentary borough are co-extensive now, but the limits of the ancient borough are still different.

4186. Have you adopted the Public Health Act or the Local Government Act in this borough?—No.

4187. Neither the one nor the other is in force?—No; we have Acts of Parliament, our own private Acts.

4188. Do you know what the population of the municipal borough at present is?—6,769.

4189. Has there been any increase since 1851, or is it an increasing district?—There has been an increase, though not a very extensive one.

4190. Is there any business of any kind carried on here?—The principal large trades which are carried on here are the oil mills; there are two extensive oil mills; one is situated in Hartam, the other is at the other end of the town.

4191. How are you situated with respect to the river Lee or any of its tributaries; there are some mills, I believe, in the town?—The Lee passes through the town.

4192. The river Mimram, is it not?—The Mimram and the Beane fall into the Lee.

4193. Is Hertford sewered?—It is very effectually sewered.

4194. At what date was the sewerage carried out?—Since the Act of 1854, called the New River Company's Act. The town has been most effectually sewered, and all the sewage is diverted from the Lee and passes to deodorizing beds.

4195. Were those works carried out under the arrangements set forth in the Act of Parliament which you named?—Yes, the Act of Parliament is here, and the works have been carried out under the powers of that Act.

4196. Have you a surveyor in the borough?—I do not know that we have, we have an officer who is paid by the borough as a surveyor; he is a gentleman whom we generally employ as our surveyor.

4197. Is there any person who will describe the character of those works, or will you undertake to describe what the character of them is?—No, I cannot do that. I have directed that the plans shall be produced; a plan of the sewerage, a plan of the town, and a plan of the water supply to the town.

4198. Those works were devised, I assume, for the purpose of purifying to some degree the river Lee?—Yes, and they have produced that effect most completely.

4199. Is the sewage treated chemically so as to cause a deposit of any solids, or is it applied to land for irrigation purposes?—I believe, although I do not speak from any scientific knowledge of the matter, that the sewage passes into deodorizing beds, between Hertford and Ware, and then the liquid part of it finds its way back again into the Lee, after going through the disinfecting beds.

4200. The liquid is not passed over land for irrigation?—I think not; but as to the effect of this system of diverting the sewage, I may say that the water after it passes through the town is now in a very pure state. A few months ago the corporation thought it right to analyse the waters from three different parts of the town, from the new waterworks, from the centre of the town, the hydrants, and also from the place which we call the old waterworks, which is the water after it has passed through the town. Professor Taylor, whose report will be laid before you, has analysed those three or four different portions of water, and he gives a most favourable account; the water at the old waterworks after it passes through the town is said to be, I think, as good as any water need be for a town, and that is from the river Lee itself.

4201. Have you an analysis of the effluent water that flows from the sewage tanks?—No, that does not affect us at all.

4202. Do you know anything of the sanitary arrangements of the borough?—I have directed the sanitary inspector and the superintendent of our waterworks to be here, if you think proper to examine him.

4203. Will they speak to the number of waterclosets in use, or can you furnish us with that information?—I think it is very likely that our sanitary inspector can give you very satisfactory evidence on that point.

4204. Have you a public water supply in Hertford?—Yes, we have two.

4205. Do they belong to companies?—No, they are the property of the corporation. The whole supply used to come from the waterworks on the Lee, but a few years ago new waterworks were established above those, and the water is now taken principally from a well in Hartam; it is pumped up by machinery and supplied to the town.

4206. That is delivered under pressure?—Yes, there is a reservoir at the top of Port Hill, near Bengeo, to the north of the town; that is supplied from the waterworks; the water is raised to a reservoir on the top of the hill, and that is the source from which the town is supplied at high pressure.

4207. Do the corporation supply all the houses within the town, or have any parties got private wells and pumps?—There are a great many private wells and pumps in the town, but the water is supplied to those who will take it and pay for it.

4208. The waterworks are the private property of the corporation?—Yes.

4209. They are held in trust for the public. Do

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you devote the income to any public purpose if you have a surplus?—At present we are not in that situation.

4210. Did you borrow the money for the construction of those works?—Yes, 3,000*l*.

4211. Are you paying the working expenses and the interest of that borrowed money?—Yes; I think we are about clearing ourselves now, but I am not prepared to answer that question exactly.

4212. Have you any class of nuisances to complain of here, proceeding from any trades or other causes, whatever they may be, locally?—I think that Hertford is peculiarly free from such nuisances now; at the same time we have had considerable complaints with reference to the nuisance arising from the effluvia escaping from the man-holes of the large drains constructed by the New River Company, and that is not cured at present.

4213. Are those drains intercepting drains to take away the sewage?—Yes, those are the large drains that I have spoken to you about, constructed by the New River Company.

4214. You think that the drains are not sufficiently ventilated to carry off the effluvium and prevent the nuisance?—At the present time there is a nuisance which springs from the man-holes or some openings into those sewers.

4215. Have you made any remonstrance to the New River Company?—Yes. The town clerk has been in communication with the New River authorities for some time, and the opinion of counsel has bees taken upon it, which leads us to think that it will be remedied.

4216. Does the river Lee or do any of the tributaries of that river overflow occasionally so as to flood any land?—We have had floods occasionally, but not very lately.

4217. Has there been anything done to decrease the flooding by embankments, or any other improvements in the cuts of the river Lee?—Some few years ago a great improvement was made in the town by the enlargement of the waterway at Cowbridge, and the improvement of the bridge there, I believe, has had a very good effect in preventing the occurrence of floods.

4218. Is the river Lee ever the cause of nuisance in dry weather, or its tributaries?—Not that I am aware of.

4219. Not here?—Certainly not. The water of the river Lee has been analysed after it has passed through the town, and before it passes through the deodorizing works.

4220. Do you know what sources of pollution there are above your town on the Lee and its tributaries?—I cannot speak to that.

4221–2. Do you know that all the sewage of Luton passes in from a population of 20,000?—If it does it is effectually dissipated before it comes to Hertford.

4223. With regard to Luton, you would get anything that comes from there?—If it gets into the river there it does not come here; the river itself is pure now at Hertford; that is proved by the analysis of Professor Taylor.

4224. Is there any sheep-washing in the Lee?—Not within the borough, and I am not aware of any out of the borough.

4225. Evidence has been given that there is sheep-washing in the different tributaries, and that the arsenic used in dressing them is so powerful as to kill the fish to a great extent?—It is quite unknown to us here.

4226. And that a considerable weight of poison passes into the river at Luton which is used in dyeing and bleaching straw plait, and oxalic acid, and different other poisons?—Indeed.

4227. (*Mr. Harrison.*) Who obtained the Act of Parliament under which your town is sewered?—The New River Company.

4228. What was the benefit which the New River Company expected to obtain by carrying out sewerage works for the town?—I think you will get that evidence better from others than myself. I suppose it was with the view of purifying the water that they took from the Lee.

4229. Are they bound by their Act to maintain the sewers that they put down and to ventilate them?—I do not know that there is anything about ventilation specially provided for, but the Act itself is here (*handing in the same*).

4230. The oil mills and the corn mills which you mentioned create no nuisance?—There are two mills, one is above the town, and the other is below the town. I do not myself know exactly what the sewerage of those mills is, but the gentlemen or the owners of those mills will be here.

4231. You are not aware of any nuisance arising from them?—Not to the town. I believe that the sewage from the second mill called, "Baker's Mill," goes into the Lee, but I am not sure of that.

4232. What do you mean by sewage in that case?—What proceeds from the waterclosets, or filth generally.

4233. Not anything properly connected with the mill itself?—I am not able to answer those questions.

4234. Is there any manufacture carried on in the town at all from which pollution arises?—None that I know of. There are only two mills in the town, flour mills, and those two large establishments I have mentioned.

4235. (*Professor Way.*) You say that you cannot answer questions as to those other mills; are they linseed oil mills?—Yes.

4236. You are sufficiently acquainted with them, I suppose, to know that there are only two products from them, namely the oil and the cake?—Yes.

4237. And that there is really no waste?—I am not aware of any waste from those mills that goes into the Lee.

4238. You spoke of Professor Taylor's analyses; those were waters taken at three different places?—I think four different samples were sent to him.

4239. Were any instructions sent with them?—Yes.

4240. Was Professor Taylor's opinion asked on the general question, or as to the analyses of those samples only?—We sent up four samples of water from four different parts of the town, and requested him to analyse those four separate samples of water. He sent down a most careful analysis and a general description of the water. It is more than a mere analysis; it is a report, in fact, on the water supply of Hertford.

4241. I suppose the quantity of water which comes down the Lee to Hertford is very considerable?—Yes.

4242. What distance is Luton from Hertford?—It is about 22 miles.

4243. (*Chairman.*) By the windings of the river it is I suppose considerably more?—Yes.

4244. (*Professor Way.*) It is not very rapid, is it?—I cannot answer that question; in flood times it is.

4245. Still the distance between the two places would afford an opportunity for the stream to deposit anything that was in it?—I am satisfied that anything which enters the river at Luton of a deleterious nature does not come to Hertford.

4246. The distance being considerable the solid matter might be deposited?—Yes.

4247. I suppose that matters in solution are not really precipitated in that way?—I am not scientific enough to be able to answer that question.

4248. You have heard, no doubt, that the poisonous characters of the water are not referable to the large quantity of matter in the water, but to the very small portions of poisonous material which may exist, and which I believe are almost beyond the reach of chemical analysis?—If that is so, I suppose that it cannot be ascertained very easily.

4249. (*Chairman.*) Have you anything further to add?—No.

The witness withdrew.

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Mr. M. S. Longmore.

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Mr. Matthew Skinner Longmore (Hertford) examined.

4250. (*Chairman.*) How long have you acted as town clerk to the borough?—I was appointed town clerk last August. I had acted for my father, who was town clerk for 37 years, before. I had been in the habit of acting with him for at least 10 years.

4251. Have you known the town for the whole of that time?—Yes, I was born here.

4252. Are you a solicitor?—Yes.

4253. Have you an intimate knowledge of the Lee as it comes down and goes beyond the borough?—Yes.

4254. Can you describe the condition of the Lee when you first knew it as compared with its condition now; is it different?—I should say not; I mean in its course.

4255. Do you know whether the population has increased in the upper parts of the Lee beyond your borough?—No, I do not.

4256. You do not know that Luton has grown up considerably?—Yes, I know that.

4257. And that other places also have increased in population?—Yes.

4258. Some arrangement was made in 1854, I believe, by which your sewage was diverted from the Lee?—Yes, an Act of Parliament was obtained by the New River Company for that purpose, the Act of 1854.

4259. Was an arrangement made by the corporation with the New River Company to obtain that Act?—No, the corporation watched the bill, and of course took care that their privileges were maintained; and certain clauses were inserted in the bill by the wish of the corporation, but the Act was sought for by the New River Company.

4260. Before the Act was obtained did the entire sewage of Hertford pass direct into the Lee?—I should say a very large part of it did, but not the whole.

4261. This Act was obtained and works were carried out for the purpose of diverting that sewage?—Yes.

4262. Do they carry it down to the disinfecting works and disinfect it?—Quite so. Under this Act, after the New River Company had diverted the sewage, persons had a right to drain into the sewers, surveyors and private individuals; if they do not so they are liable to penalties after the company have diverted their drainage.

4263. There are penalties which prevent them from communicating directly with the Lee, but which compel them to drain into the sewers which are provided?—Yes.

4264. So that the sewage shall be treated before it goes into the Lee?—Yes.

4265. Have you waterworks?—Yes.

4266. Have you any plan of those waterworks?—Yes. I should say that these waterworks are the property of the corporation; they were erected by the corporation, and are worked by steam power.

4267. At what date were they established?—In 1863.

4268. Who was the engineer?—Mr. Gravatt.

4269. Were they constructed under the powers of an Act of Parliament or under your local powers?—The land upon which the engine-house is built and upon which the reservoir is placed was purchased by the corporation with the sanction of the Lords of the Treasury. The money was borrowed with the sanction of the Lords of the Treasury, and is payable off by annual instalments in, I think, 30 years, on mortgage of the borough fund.

4270. Was the money raised under the Municipal Corporations Mortgaging Act?—Yes, under the Municipal Corporations Act.

4271. There is an Act which enables the Lords of the Treasury to sanction the borrowing of money for special purposes which are to be named?—Yes.

4272. Did they send down any surveyor to make an inspection and report before they sanctioned the loan?—No. I think there was a counter-memorial presented from the ratepayers, and the Treasury sent down to the corporation the statements urged by the counter-memorialists with specific questions upon the matter. I think Mr. Ranger was sent down, and he made a report.

4273. Those works are now in successful operation?—Yes.

4274. Have you compulsory powers by which you can compel persons to take your water if you can supply it to them?—No. The arrangement is that the water is let to certain people by the corporation at so much rent per annum; it is regulated mainly by the rents of their houses, but I should say that under the last Sanitary Act that was passed last year there are powers enabling you to compel persons to supply themselves with water for sanitary purposes in case you can show that there is no water upon the property, but of course that would not enable us to compel them to take our particular water; but merely to supply themselves with water for sanitary purposes.

4275. Have you any written analysis of the water?—Yes. I will hand in Dr. Taylor's report (*handing in the same, which will be found printed at the end of the evidence of the witness*).

4276. (*Professor Way.*) Have you a copy of the letter that accompanied the samples sent to Professor Taylor?—I think I can find it. Speaking from recollection, the letter generally asked him to analyse the properties and qualities of the waters, but there was nothing said to Dr. Taylor in reference to any sewage that might empty itself into the water a distance from the town.

4277. (*Chairman.*) The paper which you have handed in contains an elaborate report and analysis of four samples of water from Hertford, and also a report of a chemical and microscopical examination of the vegetable substance contained in the water from the reservoir of the new works?—Yes.

4278. Had that vegetable substance caused any inconvenience in the reservoir to your knowledge?—No.

4279. Why was it submitted for special examination?—I think it was at the time when cholera was prevalent, and it was thought desirable that the water in the reservoir and the river Lee and from the hydrants should be subjected to a chemical analysis.

4280. Is your reservoir an open one?—Yes.

4281. Is it at a sufficient elevation to give you pressure?—Yes, considerable pressure.

4282. What is its size?—I do not know.

4283. Being an open reservoir, I assume that during summer a quantity of vegetation gets into the water, which you thought might be the occasion of mischief, and therefore you had it specially analysed?—Decidedly.

4284. Is this a plan of the waterworks that I have before me?—Yes.

4285. Is the service reservoir at Mole Wood?—No, it is on Port Hill.

4286. What is the well sunk into, is it chalk?—It is gravel.

4287. To what depth is it sunk?—About 15 feet, I am told.

4288. Have you acted at all under the Nuisance Removal Act?—Yes, ever since it was passed.

4289. Have you an inspector of nuisances?—Yes.

4290. Did you hear what the mayor said as to the defective ventilation of the sewers which had been made by the New River Company?—Yes, there is defective ventilation there from the man-holes, they are open. The kind of traps in the street under which the sewers pass are certainly considered offensive in hot weather. I drew the attention of the authorities of the New River Company to the subject, and certainly I consider that under their Act they are liable to keep the sewage free from that nuisance.

4291. Did you on behalf of the corporation ask them to close those openings?—No, I did not ask them to adopt any particular means of abating the nuisance.

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4292. (*Mr. Harrison.*) The New River Company were empowered by the Act to make some main drains through the town?—Yes.

4293. Leaving it to the corporation, through their surveyor, to make the branch drains?—No, they made the branch drains where persons had, up to the time of the passing of the Act, drained into the Lee; they made all the drainage complete, the branch as well as the main drains.

4294. Clause 28 says, "That from and after the "making and the completion of the several new "sewers and drains herein-before described in the "said parishes," &c., "it shall be lawful for all persons resident in the said several parishes and places "to drain their houses and premises, and for all surveyors and others having the superintendence of "the public streets, courts, lanes, and highways "in the said several parishes," &c., "to drain "the same by means of the sewers and drains by "this Act authorized to be made, and from time "to time to make such openings and communications "into the said intended sewers or drains as shall be "necessary for that purpose"?—Yes, that is for after purposes.

4295. Has the corporation carried out any of those branch drains?—No, but private individuals have to a considerable extent.

4296. Have none been carried out by the surveyor?—In some of the parishes the surveyors have done it.

4297. In forming those branch drains has sufficient attention been paid to ventilation?—I think so.

4298. Are there openings from them?—In some of them, but I am not quite certain about it.

4299. If there are branch drains formed and not ventilated you force all the foul gases to come out of the openings which have been formed by the New River Company in the main drains.—The 29th clause is in these terms: "That from and after the making "and completion of the several new sewers and drains "herein-before described in the several parishes," &c., "it shall be lawful for the company to enter upon "any house, buildings, and premises to collect and "intercept all sewage water from all sewers or "drains leading from houses, streets, or other pre-"mises in the said several parishes or places of "Bengeo," &c., "and which now discharge into the "river Lee or other streams leading into the same, "and to divert the said sewage water into the sewers "and drains by this Act authorized to be made in the "said several parishes and places by means of proper "and sufficient culverts or drains, to be made by "and at the expense of the company from the said "existing sewers of the said houses and streets," &c. That was a clause to intercept all the existing drains and sewers?—Yes.

4300. And permission was given by the 28th clause for any new sewers to be made and to be connected?—Yes, we are obliged to give the parties 24 hours notice.

4301. (*Chairman.*) Do you know whether those main sewers have required flushing or cleansing by hand since they were made?—Yes, certainly.

4302. Is that done by the servants of the company?—We have done them to a considerable extent.

4303. Your men, I suppose, enter by man-holes, and cleanse those sewers out occasionally?—I think not; it has been done by the water of the town.

4304. Have you had any complaint made since the outlet works were established as to any nuisance arising from the water or from the sediment taken out of those tanks?—I have heard of a complaint, but nothing decided; I have heard a rumour of it. I will now hand in the plans of the sewerage works which have been made by the New River Company (*handing in the same*).

4305. (*Mr. Harrison.*) Do the New River Company keep the sewers which they have constructed under this Act in repair?—Yes.

4306. Under which clause are they bound to do so?—Under clause 4. I consider that as they have constructed the works they are liable to maintain them.

4307. Under one clause there is special provision made in the case of one sewer in the Ware district; it says it shall be made and at all times be maintained and kept in good repair?—Yes.

4308. The other clause says, they "may" make and maintain, but there is no clause saying that they "shall," except in that special case?—No; but I contend that if they have made the works they must maintain them.

4309. The Lee is navigable to Hertford?—Yes.

4310. Is it navigable beyond at all?—I think not.

4311. How long has it been navigable to Hertford?—I cannot tell you that, but beyond my memory it was navigable, I believe, in 1570.

4312. Do you consider that the navigation is of importance to the borough of Hertford?—Yes.

4313. Do you find that it is useful and advantageous in competition with the railways?—I think it is.

4314. Is there much traffic upon it?—Yes, a considerable traffic.

4315. What has been the effect of the construction of the railways, having two different systems, with respect to the price at which you can obtain coals?—Coals are considerably cheaper than they were in consequence of the competition, but they are not very cheap now.

4316. Are coals brought by means of the navigation to any extent?—Yes, I should say they are.

4317. You think that the competition of the three systems, namely, the two railways and the navigation, is a benefit in that way to the town?—Certainly.

4318. If the navigation were done away with you would suffer from it?—I think so.

4319. (*Professor Way.*) Have you read this report of Professor Taylor's?—Yes.

4320. Do you remember generally what the conclusions at which he arrived were; there were four samples of water sent to him, and he finishes with a conclusion. Do you remember generally what it was?—Yes.

4321. Two of the samples were taken from the new works, one from the old waterworks, and one from the river Lee?—Yes.

4322. I was under the impression that these waters were taken from different parts of the Lee passing through the town?

(*The Mayor.*) No, only one was taken from the Lee below the town.

4323. At the old waterworks?

(*The Mayor.*) Yes; although it is nearly the centre of the town it is below where the drainage of the town would be.

4324. You will observe that he speaks of the samples as generally good and wholesome water, fit and proper for the supply of the town for drinking and ordinary domestic purposes. He then describes three of the samples, and finishes with a sample which he calls letter "A," and which sample is taken from the Lee?—Yes.

4325. Does that convey to you the impression that that water of the Lee contains something different from the water pumped from the other sources?—Yes, it does certainly.

4326. Leaving out the question as to how far that impurity goes, which he says is small, does that impress you with the notion that some kind of impurity of an organic character is contained in that water?—It might be so.

4327. Is not that what Professor Taylor says?—Yes.

4328. So far we may say that the water of the Lee is not absolutely a pure water?—I admit that there is some difference, certainly.

The witness withdrew.

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REPORT (referred to supra, Question 4275) OF ANALYSES OF FOUR SAMPLES OF WATER FROM HERTFORD.

The waters were delivered to me on Thursday, August 16th, 1866, by superintendent Jarrett. I was informed that they had been taken from their respective sources on the previous day. They were contained in stoneware gallon bottles well secured, properly sealed, and labelled. The examination of these samples was commenced on Friday August 17th. The four samples were numbered by me for the convenience of reference; they were as follows:—

No. 1. From the well at new waterworks.
No. 2. From the reservoir of the new waterworks.
No. 3. From hydrant in the street.
Letter A. From the river Lee at the old waterworks, Hertford.

Physical Properties.

The four samples were clear and bright, they contained no mechanical impurity, and deposited no appreciable amount of sediment on standing 48 hours. They had no smell upon opening the bottles, and no effluvia or gas escaped. When the waters were examined in tall jars Nos. 1 and 3 were colourless, but No. 2 and A presented a slightly yellowish colour, such as is sometimes produced by the presence of a small quantity of iron. They were all tasteless excepting A in which a slight taste was perceptible, such as might be produced by the accident of decayed leaves or grass getting into the water. The samples were aerated in about the same degree as good spring or river water; they contained free carbonic acid, and the ordinary elements of the atmosphere, namely, oxygen and nitrogen.

Chemical Constitution.

The usual chemical tests and processes applied to the four waters, showed that they contained only the saline compounds commonly found in good river and spring water, and in about the ordinary proportions. The principal ingredient was the carbonate of lime (chalk) with small quantities of sulphate of lime and chloride of sodium, and with still smaller quantities of magnesia, potash, oxide of iron, and silica. The sulphate of lime was in larger proportion in Nos. 1 and 3 than in No. 2 and A, and the quantity of lime deposited from Nos. 1, 2, and 3 was somewhat larger than that deposited from A. No. 2 and A produced with pure alumina a slightly coloured deposit, (oxide of iron), while in Nos. 1 and 3 the deposit was of a pure white. The four samples were especially tested for oxidizable or decaying organic matter, and for those gases which are imparted by leakage of coal, gas, sewage, or other offensive matters of a like nature. The result was that none of them contained any matters noxious to health. It should be observed, however, that in No. 2 and A the presence of some oxidizable substance was indicated by the test, (permanganate of potash) after the lapse of a few hours, and at the same time there was no such indication in the waters Nos. 1 and 3.

On boiling the four waters the carbonic acid which they contained was expelled, and after a time they become slightly, but in an equal degree, milky-looking from the separation of carbonate of lime. This is the special character of all spring waters which contain the carbonate of lime dissolved. No offensive effluvia were given off during the process of boiling, and the waters when filtered from the calcareous deposit were quite clear and considerably reduced in their degree of hardness.

Portion of Nos. 3 and A were distilled, and the distilled liquids obtained from them were further examined for any volatile matters which might have escaped detection in the entire water. In the distilled liquids of these two samples there was a trace of ammonia, but no volatile matter of an oxidizable nature or in a state of decay.

By evaporation of the waters, a solid chalky-looking and dry substance was obtained from each sample calculated for the imperial gallon of 70,000 grains; the weight of the dry residue in grains obtained from each sample was respectively in No. 1, 14·4 grains; No. 2, 20 grains; No. 3, 19·2 grains; Letter A, 14 grains.

These results show that the samples contain only the average weight of solid matter which is usually found in good river and spring water. No. 1 and A are almost identical, and the same may be said of Nos. 2 and 3. The differences between these last-mentioned samples (2 and 3) and No. 1 probably depend on local circumstances connected with storage and distribution.

The dry residue of each water was nearly white or of a greyish white colour. They were all darkened when heated to low redness, a fact showing the presence of some organic matter, and there was evolved from each a smell resembling that of burnt vegetable matter. The blackening of the dry residue by heat was most marked in A. None of the residues underwent fusion or gave off acid vapours. All evolved traces of the alkaline vapour, ammonia, showing the presence of nitrogen in the organic matter; there were also traces of sulphur, but the presence of this element was most marked in 2 and A. The residues contained in a concentrated form the salts found in the entire waters, but in addition alkaline nitrates were found in the residues of Nos. 2 and 3 and of A; in Nos. 2 and 3 these were less than in the water A. In operating upon a similar quantity of No. 1 no nitrates could be detected.

The proportions by weight of the mineral or fixed matter and of the organic and volatile matter contained in an imperial gallon, or 70,000 grains of each water may be thus stated for each sample:—

No. 1. Water from the Well New Works.

	Grains.
Mineral or fixed matter, chiefly carbonate of lime, with small quantities of sulphate of lime and chloride of sodium	12·0
Organic matter and matter volatile at a red heat	2·4
Total weight in grains in imperial gallon	14·4

No. 2. Water from the Reservoir New Works.

	Grains.
Mineral matter, as in No. 1, with traces of alkaline nitrates	16·8
Organic matter containing nitrogen and sulphur, and matter volatile at a red heat	3·2
Total weight in grains in imperial gallon	20·0

No. 3. Water from Street Hydrant.

	Grains.
Mineral matter, as in Nos. 1 and 2, but with more alkaline nitrates than in No. 2	16·0
Organic matter with nitrogen and sulphur and matter volatile at a red heat	3·2
Total weight in grains in imperial gallon	19·2

Letter A. Water of River Lee Old Works.

	Grains.
Mineral matter, as in Nos. 1 and 2, with alkaline nitrates as in No. 3	12
Organic matter with nitrogen and sulphur, and matter volatile at a red heat	2
Total weight in grains in imperial gallon	14

The hardness of these waters was determined by a solution of soap in alcohol, compared with an equal volume of distilled or pure water as unity; the relative hardness in degrees may be thus represented both before and after boiling:—

	No. 1.	No. 2.	No. 3.	Letter A.
Before boiling	10°	10°	11°	11°
After boiling			6·3	6°

Thus it would require eleven times as much soap to give a lather or detergency to water in a gallon of No. 3 or A before boiling as would be required to produce a similar lather or detergency in a gallon of pure or distilled water. A gallon of the boiled water of No. 3 or A would require six times as much soap as a gallon of absolutely pure water. This shows that the waters lose one-half of their hardness as a result of boiling. On Dr. Clark's scale of degrees the figures would be higher, but the proportions would remain the same.

Conclusion.

The result of this analysis shows that the four samples of water are good, wholesome, and fit and proper for the supply of the town for drinking and ordinary domestic purposes. Compared with the lake waters of Scotland, Cumberland, or Wales, they would be regarded as hard, but the hardness is not greater than that of river waters supplied to the metropolis and to the southern districts of England. The hardness is of a temporary kind, and is reduced to nearly one-half as the result of boiling. The hardness as it exists in these waters affects the question of economy in the use of soap for washing, it is not of that degree to render them unwholesome or unfit for drinking. Besides it must be remembered that the disadvantage of hardness is in a great measure compensated in a sanitary point of view, by the fact that as a rule waters of this composition do not exert any chemical action on metallic lead either in pipes or cisterns, and thus they are not liable to occasion lead-poisoning like waters which contain less saline matter and are therefore much softer.

The differences among these four samples are in a practical point of view so slight as not in any way to affect their qualities for domestic use or their wholesomeness for drinking.

Among the four samples, No. 1, by reason of the small proportion of saline matter in the gallon, and from its

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entire freedom from the oxidized products of organic matter (alkaline nitrates) takes the first place. It has evidently not been exposed to any source of contamination. Of Nos. 2 and 3; it may be observed that although they have a constitution similar to No. 1, they acquire from some source small quantities of mineral and organic substances which add to the proportion of solid contents after the water has issued from the well.

Of the letter A or Lee River water it may be said that its composition is very similar to that of No. 1, but it is inferior to it in these respects, the organic matter contains sulphur and nitrogen, and the mineral matter alkaline nitrates, showing that, as a result of exposure, this water has acquired nitrogenous organic matter, which by conversion into ammonia and subsequent oxidation has produced nitric acid. The nitrates are, however, so small in quantity as not seriously to affect the water for drinking purposes; the nitrates are generally found in river water in inhabited districts but commonly only in traces.

(Signed) ALFRED SWAINE TAYLOR, M.D., F.R.S.,
Professor of Chemistry and Medical Jurisprudence in Guy's Hospital, and Fellow of the Royal College of Physicians, &c.
15, St. James' Terrace, Regent's Park,
August 24, 1866.

REPORT (referred to supra, Question 4275) OF A CHEMICAL AND MICROSCOPICAL EXAMINATION OF A VEGETABLE SUBSTANCE FROM THE RESERVOIR OF THE NEW WORKS.

This substance was handed to me for examination by superintendent Jarrett at the same time with four samples of water, on which I have already reported. I was informed by him that it was taken from the banks or side of the reservoir.

It consisted chiefly of filaments of confervæ and other minute fresh water plants forming a kind of net work or sponge, partly bleached by exposure to light, and partly retaining its green colour. It was mixed with a quantity of mineral matter. This consisted in part of sand and earthy substances, and in part of the skeletons or mineral cases of numerous varieties of infusorial animals. The substance also contained a certain amount of moisture which it retained owing to its spongy texture.

It was submitted to a chemical analysis, and it was found to be thus constituted:—

Organic matter, filaments of fresh water algæ	31·4
Mineral matter consisting of silica, carbonate of lime, and alumina	40·0
Water or moisture driven off at a heat of 212°	28·6
	100

A microscopical examination showed that the filaments were chiefly those of the *conferva glomerata*, having a diameter of about the 1,500th of an inch. When the dry substance was heated a large quantity of ammonia and sulphur were evolved, and very offensive effluvia escaped. A grey ash remained after perfect combustion, which consisted of the mineral substances above mentioned, mixed with some oxide of iron. The dust shaken from the vegetable substance, when examined microscopically, consisted of dead navicula and other infusorial animalcula.

These confervoid substances are produced in all water at the expense of the elements of the air and water, whenever the water is *exposed to light*, and is at the same time stagnant. They can only grow in water if exposed to air; on the bank they wither and decay, they are also liable to decay in water, and thus affect it in variable degrees.

The chemical differences between No. 1, the well water, and No. 2, the reservoir water, appear to depend on the well water acquiring an impregnation or an addition of mineral and organic matter in the reservoir in which it is stored. This addition of foreign matter is not such in quantity or quality as at present to affect the properties of the water; but it would be desirable to preserve the water before distribution as far as possible in the state in which it is procured from the well. The free production of confervæ diatoniaceæ and other fresh water plants, leads in all cases to the formation of a thick, green scum which is liable to decay in hot weather, and as the plants contain a large amount of sulphur and nitrogen, these elements or their products are liable to be transferred to the water, and thus render it less pure. This growth of confervæ was one of the main causes of contamination of the water supplied to London before the Act of 1851. The reservoirs were open, exposed to light and to the reception of all atmospheric impurities. The Act required all reservoirs for the storage of water within seven miles of St. Paul's should be *covered over*. This has been attended with a material improvement in the water. The confervoid plants do not grow, or only to a slight extent, and the water is kept freely aerated by doors at the side of the covering roof.

There is another fact which requires to be pointed out. Whenever these fresh water plants grow in the water of reservoirs, infusorial animals appear in myriads. These are also subject to death and decomposition, and they thus become an element in adding to the impurities of the water. The confervæ are the food of these animals, and the prevention of their vegetable growths operates to prevent the production of these low forms of animal life.

I would therefore beg leave to suggest that the reservoir from which No. 2 has been taken should be *covered* or *domed over* like the reservoirs of London, taking care at the same time that there is free ventilation. This plan would, I believe, have the good effect of preserving the water No. 2, and keeping it in the state in which it is received (as No. 1) *i. e.* free from any additional source of animal or vegetable impurity. With regard to mineral matter, this is sometimes acquired by water from the cement or materials of which a reservoir is constructed. After a time, however, this source of impurity ceases.

When we speak of impurities in water, we must remember that no water which has once touched the earth can ever be found *pure* or entirely free from the salts of lime, or soda, or from organic matter. The purest lake water in the world, that of Loch Katrine, contains organic matter. I have had opportunities of examining water from the Geyser springs of Iceland in the north to the Yara Yara river in South Australia, and from Vancouvers Island on the western coast of North America to the river Jordan in Syria, and I never found any sample without mineral and organic matter. It is desirable, however, when water is selected for drinking purposes, that we should, as far as possible, avoid adding to the quantity of foreign matter already existing in it. River water is necessarily exposed to light and air, and is liable to suffer damage from drainage as well as from the growth and decay of vegetables upon the banks. Good spring or well water when once obtained is not liable to these accidental causes of contamination, and, when once received in a reservoir, it may by attention to certain points be distributed in as pure a state as it is at the source.

(Signed) ALFRED SWAINE TAYLOR, M.D., F.R.S.,
Professor of Chemistry and Medical Jurisprudence in Guy's Hospital, Fellow of the Royal College of Physicians, &c.
15, St. James' Terrace, Regent's Park,
August 24, 1866.

Mr. JOHN MARCHANT, jun. (Hertford), examined.

Mr. J. Marchant, jun.

4329. (*Chairman.*) Are you clerk to the River Lee Trust?—I am.

4330. Will you kindly explain to the Commission what the statutory powers of the Trust are?—Yes. I have drawn out a short statement, a sort of historical statement of the constitution and powers of the Trust, which I will refer to, and then hand in. (*The witness subsequently handed in a Paper, which will be found printed at the end of his evidence.*) The navigation of the river Lee is managed and governed by a public Trust, incorporated by the name of "The Trustees of the River Lee." They derive their powers from various Acts of Parliament, the earliest of which were passed in the reign of Henry 6th. The first Act, cap. 5, was passed in the third year of his reign, 1424, and the second, cap. 9, in the ninth year of the same reign 1430. Those two statutes empowered the Chancellor for the time being to issue Commissions for the purpose of clearing, scouring, and amending the river "Ley," which in both of them is stated to be "une des grandes rivers" of England. Then I would pass on to the year when the river was rendered navigable.

4331. (*Mr. Harrison.*) Between what points?—In those Acts no points are defined, but in subsequent Acts the navigation is defined from point to point. In the 13th year of the reign of Queen Elizabeth the river appears to have been rendered navigable, and the constitution of the River Lee Trust may be said to have been first established in that reign. In the

13th year of Elizabeth, 1570, an Act was passed, cap. 18, "for the bringing of the river of Lee to the "north side of the city of London." By this Act the Lord Mayor, commonalty, and citizens of London and their successors were authorized to bring the said river of Lee from the town of Ware to the north side of the city of London; and by section 4 it was enacted, "That the said Lord Mayor, commonalty, and citizens "shall have the whole jurisdiction, conservice, rule, "and government, as well as the said new cut river "and ground of each side, as also the royalty of the "fish and fishing of the same, and the profits of the "said ground, soil, and water to them and their "successors for ever." Power was also given by this Act for the punishment of offenders and persons breaking the rules and orders provided for the preservation and maintenance of the said river.

4332. (*Chairman.*) Was the section you have just read enacted for the purposes of the navigation, or for water supply, or both?—For the navigation only.

4333. The navigation and the fishing?—Yes.

4334. (*Mr. Harrison.*) Was power given to them to dredge the river and sell the ballast?—Yes. Then certain trustees were mentioned in that Act and appointed. I then come to an Act passed in the 12th year of the reign of George II., cap. 32, 1739, and certain trustees were added to the corporation.

4335. Had they a joint interest with the corporation?—Yes, they were local individuals. I may mention that there were to be "16 commissioners," who were to act with the corporation, "viz., four "of the city of London, and four of each of the "shires of Essex, Middlesex, and Hertford, having "lands, tenements, or hereditaments of the clear "yearly value of 40 marks, and not being London "traders." The power given to them was, "to "treat, agree, and compound for the scouring, "cleansing, repairing, and keeping of the said river "Lee." In 1739 an Act was passed, the 12th George 2nd, cap. 32, "For ascertaining, preserving, and improving the navigation of the river Lee from the "town of Hertford to the town of Ware, in the "county of Hertford; and for preserving and improving the said river from the said town of Ware "to the new cut or river made by the mayor, commonalty, and citizens of London; and for enabling "the governor and company of the New River the "better to supply the cities of London and Westminster, and the liberties and suburbs thereof, with "good and wholesome water." That is the first mention of a supply of water from the Lee. By this Act the course of the river was defined, and certain persons therein named were appointed for the putting in execution the powers and trusts by them reposed, by virtue of and in pursuance of that Act, for the purposes therein expressed. I may here mention that the body of Trustees consists of the following *ex-officio* members; the Lord Mayor, aldermen, and recorder of the city of London for the time being; the knights of the shire for the county of Middlesex, the members of parliament for the city of Westminster, the knights of the shire for the counties of Essex and Hertford, the members of parliament for the boroughs of Colchester and Hertford; the mayor of Hertford for the time being, and noblemen and gentlemen from time to time elected from the counties of Hertford, Essex, and Middlesex. The governor, deputy-governor, and treasurer of the New River Company for the time being are also *ex-officio* members of the trust.

4336. Does that constitution of the body of Trustees continue to this day?—It does. I then come to another Act which was passed in 1766, in the seventh year of the reign of George the 3rd, cap. 51, for improving the navigation of the river Lee from the town of Hertford to the river Thames; and for extending the said navigation to the floodgates belonging to the Town Mill in the said town of Hertford: that is the extreme limit of the navigation as at present constructed. By this Act the trustees appointed by the 12th George 2nd, cap. 32, together with several other noblemen and gentlemen therein named, were appointed "trustees "for the making, extending, improving, and main- "taining the navigation of the said river Lee from "the floodgates belonging to the Town Mill, in "the town of Hertford, to the river Thames, and "for putting this Act in execution:" and they were empowered to cleanse, scour, deepen, enlarge, or straighten the channel of the river Lee, and to make and maintain the new cuts therein described, and to build the bridges and works therein mentioned. That was the first period of canalizing the river Lee. By this Act the navigation was declared to be a free navigation for all the King's liege people, subject to the payment of such rates and duties which were thereby authorized to be levied. Then I come to another Act passed in 1779, the 19th George 3rd, cap. 58, which was an Act to authorize the raising of certain additional tolls which are mentioned there. Then in the year 1805 an Act was passed, 45th George 3rd, cap. 69, for the better preservation and further improvement of the navigation, defining certain heights of water and giving power to the Trustees to make bye-laws for regulating the lading of barges. It was also provided that no craft should carry more than 40 tons of freight. That provision has since been repealed, and now there is no limit to the tonnage that may be carried; it sometimes exceeds 80 and 90 tons. The next Act was passed in the 13th and 14th years of the reign of Queen Victoria, cap. 109, called "The "Lee Navigation Improvement Act, 1850." The principal objects of this Act were to enable the Trustees further to improve the navigation and dispose of the surplus water. The Trustees were incorporated by the name of "The Trustees of the River Lee," and were empowered to purchase and hold, and sell, demise, and dispose of lands for the purposes of that and the therein recited Acts.

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4337. What was the meaning of disposing of the surplus water?—That we may dispose of the water to companies and to individuals for a water supply. I may state here that there is a subsequent Act which vests the surplus water in two companies, namely, the New River Company and the East London Water Company.

4338. Is there any provision under that head of "disposing of the surplus water" for passing the water freely off the land?—No, that Act enables the Trustees to raise funds.

4339. In the Acts which you have mentioned up to the present moment there is no power given to raise money?—Yes; I think there is. Money has been borrowed; there was power to buy land in the Act of the seventh of George III., cap. 51, section 5. The Trustees were empowered to treat and agree with the owners and proprietors of land and property, and they were enabled to pay for that land and property either by way of purchase in a gross sum or by annual payments, and certain annual payments are still made by the trust.

4340. How was the money to be obtained?—The money to be raised was by annuities. The Trustees were enabled to create annuities for the purpose of raising money. Annuities were raised and have since been paid off. In 1850 the Trustees were empowered to raise on mortgage upon the security of the tolls and property of the trust 230,000*l.* Those borrowing powers have been exercised to a certain extent, and the money has been laid out in the improvement of the navigation and renewal of the works.

4341. (*Chairman.*) Is that the most recent Act under the powers of which you are now working?—Yes. There is an Act which has been passed since, the Act of 1855, which transferred the surplus water of the Lee to the two companies, but our own maintenance and working are under the Act of 1850.

4342. (*Chairman.*) The money which has been raised and expended has been raised and expended under the powers of the first of those Acts which you have named?—Yes.

4343. The debt, whatever it may be, is secured by arrangement under that special Act?—Yes. Then I

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come to the Act of 1855, the 18th and 19th of Victoria, cap. 196.

4344. Is that the most recent Act?—Yes. This is called "The River Lee Water Act, 1855." By this Act the surplus water of the Lee over and above the quantity required for the purposes of navigation was vested in those two water companies respectively, subject nevertheless to such rights as might not then belong to the Trustees. The daily quantities of water reserved to the Trustees for navigation purposes and not subject to any control by the water companies are as follows: first, they may pass through their locks from the highest point at which the water companies or either of them take their supply down to and including the first lock above Fielde's Weir (called "The Upper Reach") not exceeding in any 24 hours 576,000 cubic feet per diem.

4345. The companies referred to there being, I assume, the two water companies you have mentioned?—Yes, the New River Company and the East London Water Company. Secondly, they may pass from the first lock above Fielde's Weir exclusive down to and including Waltham Town Lock (called the Middle Reach), not exceeding in any 24 hours 720,000 cubic feet. Thirdly, they may pass from Waltham Town Lock exclusive down to and including Old Ford Lock (called the Lower Reach), not exceeding in any 24 hours 864,000 cubic feet. All water below Tottenham Mill not required by the two water companies at their drawing stations is reserved to the Trustees for navigation purposes. By that same Act the two water companies are strictly forbidden without the consent of the Trustees, at any time to draw from the river so as to reduce the water in any pond of the navigation below the customary head level of that pond.

4346. (*Mr. Harrison.*) That limits your navigation?—Yes, it does, but I believe that limit has never been attained. Below Tottenham Mill the whole of the water belongs to the River Lee Trust. The priorities of rights to take the water of the river Lee are very clearly defined by this Act and are as follows: first, the right of the Trustees to the upper, middle and lower daily quantities, and such further quantity as shall be necessary to maintain the water of the navigation on a level with the head levels aforesaid; secondly, the right of the New River Company to take 2,500 cubic feet a minute; thirdly, the right of the East London Waterworks Company to take 2,500 cubic feet a minute; fourthly, the right of each company to take, *pari passu*, 500 cubic feet a minute; fifthly, the right of each company, after notice, to take, *pari passu*, any additional quantity; sixthly, the right of the Trustees to surplus water below Tottenham Mill.

4347. You have the first claim upon the water up to the limits you have mentioned?—Quite so.

4348. The companies have power to take 2,500 cubic feet per minute at the same time?—Yes.

4349. If there is a surplus beyond what you require and they require, they can each divide it in equal proportions?—Yes.

4350. To any extent that that surplus may be?—Yes.

4351. Below Tottenham you have the entire control of the remaining water, whatever it may be?—Yes, that is so. These Acts which I have cited give the whole jurisdiction, conservancy, and government of the river to the Trustees of the river Lee, and they give them a priority of right to the quantity of water necessary for navigation purposes. That exhausts the constitution and statutory powers of the trust.

4352. (*Chairman.*) What are your executive powers as a trust?—We meet monthly and dispose of all the business which comes before the Trustees; the meetings are, in fact, general meetings; that is to say, all the Trustees receive notice; they are not committee meetings, but we deal with all questions affecting the navigation other than those of nuisance; that is to say, we have not power to deal with nuisances under the Acts.

4353. Where do the meetings take place?—At Hertford during part of the year, and in London during the session of Parliament.

4354. Are the Trustees a paid body?—No, unpaid.

4355. Is there any allowance made for travelling expenses?—None whatever.

4356. Each member of the trust travels to and from each place at his own proper charges?—Quite so.

4357. Do those meetings take place essentially for the purpose of regulating the navigation traffic and business of the river?—Yes, and to receive communications from traders and parties using the navigation.

4358. What is the present debt of the Trustees?—174,287*l.*

4359. You have power to borrow to what amount?—230,000*l.*

4360. You have not borrowed to the maximum that you are authorized by the recent Act to borrow?—Not by a sum of 55,713*l.*

4361. Then the money is borrowed, I suppose, from any individuals who choose to lend it?—Yes.

4362. Have the Trustees borrowed any of it from the Exchequer Loan Commissioners?—No.

4363. Is there any authority in the Act to enable the Exchequer Loan Commissioners to lend money to the Trustees?—I think not.

4364. Upon what terms have you been enabled to borrow that money as to interest, and what is the period allowed for repayment?—At 4½ and 5 per cent., upon terms varying from three to seven years.

4365. You have borrowing powers, and I assume reborrowing powers?—Quite so.

4366. You can pay off and reborrow to replace the the money?—Yes.

4367. Are you bound by the terms of the Act to repay that money, or may it remain a permanent debt?—We are not bound to repay it.

4368. You are not bound, when money is borrowed by the trust for water supply and other purposes, by Act of Parliament to repay it either in 30 or 50 years?—There is no limit in this case.

4369. It is borrowed upon the security of the tolls?—Yes. and other property of the trust.

4370. In the event of railway competition, or any other form of competition, or any alteration in trade, diverting traffic from the river, and reducing the income of the trust. is there any outside security to the lenders of the money?—We possess land and mills, and annuities, secured by Act of Parliament from the water companies.

4371. You have an income from the water companies?—Yes.

4372. I believe the amount was mentioned by your engineer?—Yes, 3,500*l.* I might mention just to qualify your observation, that in 15 years, from tolls alone, we have doubled our income during the period of railway competition, we have annuities secured by the Act, and we have mill property and land; a valuation of that has been made within a recent period, and it is a very large sum indeed; that is over and above the tolls.

4373. You have a profitable trade now, and one that has for many years back been growing?—Yes; this year we shall realize 1,000*l.* upon the river more than at any other period.

4374. I may ask you, perhaps, whether your traffic manager will attend to give evidence?—He will.

4375. He will, perhaps, put in the tonnage carried upon the Lee, showing the rate of increase, and also the income derived from that tonnage?—Yes, he will.

4376. Have the Trustees power to increase the rate of charge over and above what is at present paid, supposing that they resolved to do so, to meet their engagements?—Yes, they can considerably increase it.

4377. At the present time you do not charge the maximum rate that you are empowered to charge?—No; take, for example, these four items, coals, malt, flour, and sundries. Coals may be charged 2*s.* 2½*d.* per ton, whereas we charge 6*d.*; malt may be charged 2*s.* 1½*d.*, whereas we charge 1*s.*; flour may be charged 1*s.* 8¼*d.*, whereas we charge 1*s.*; sundries may be charged 1*s.* 9¼*d.*, whereas we charge from 1*s.* 3*d.* to 1*s.* 2*d.* We lower our tolls from time to time as the exigencies of trade or our finances admit.

4378. (*Professor Way.*) As a matter of policy?—Yes.

4379. (*Chairman.*) You are able now to offer good security for any money you may wish to borrow to improve your works?—We think so, and with a very considerable margin.

4380. In the event of your continuing to earn a surplus would the Trustees be authorized to pay off any of the mortgage bonds, or would they, instead of that, reduce the rate of tolls?—They have power to do either; they have power legally to pay off the bonds, because some of the debentures are overpaid; some parties prefer the security, and they allow them to remain. The Trustees would probably consider whether it was desirable to pay off some of their debt, or to lower the tolls for the public. As long as the trade remained in an increasing condition I presume they would pay off the mortgages in preference to lowering the tolls.

4381. In the event of the day coming when the trade of the district was found to be so profitable that they could wipe off their mortgage debt altogether, and have the whole income available, except for the payment of the salaries of their officers, does the Act point out any arrangement that might be made?—The navigation would become a free one absolutely.

4382. The tolls would then be reduced to a minimum to provide for the payment of the salaries and so forth?—Yes, there must be some revenue for that purpose, for maintenance and for repairs, but that might be met probably by the payments made by the water companies or by rentals.

4383. Can you explain to the Commission the special circumstances under which this town has been sewered and drained; has it been done by the river Lee Trustees or entirely by the New River Company?—Entirely by the New River Company, and for their own purposes; it was done under a special Act of Parliament obtained by them.

4384. Have the Trustees of the Lee been at all troubled by pollutions caused in the course of the navigation?—Yes.

4385. Have they ample legal powers to deal with parties who cause nuisances?—They have no legal powers other than the common law rights which individuals possess in such cases; they have no statutory powers to deal with nuisances. There is one section in our Act which enables them to inflict penalties upon parties who maliciously cast refuse into the river, building refuse and so on. The words are, "if any person "shall wilfully throw any gravel, ballast, stones, rub-"bish, or dirt" (*reading from the Act to the words*) "not exceeding three months."

4386. What clause do you refer to?—The 109th clause of the 7th George 3rd, chapter 51.

4387. Would the word "intent" in that clause so qualify the intent and meaning of that clause as to render it inoperative?—Perfectly so; I consider that that word "intent" entirely prevents the clause being operative.

4388. If you were to summon a man, would you not have great difficulty in proving what he "intended" to do?—It would be utterly impossible to prove it.

4389. That clause requires amendment, does it not?—Yes; I have never heard of an attempt yet being made to put it in force.

4390. (*Mr. Harrison.*) So far as the clause goes, would not the word "dirt" include sewage?—Yes, I think it might; but then it must be proved that there was a wilful intention on the part of the offender to obstruct and injure the navigation.

4391. (*Chairman.*) If the framers of the clause had been satisfied with saying that proof of having thrown solid refuse into the river should be sufficient, do you think you could have put the Act in force?—Yes.

4392. But when it puts upon you the onus of proving a man's intention it takes away the whole sting of the clause?—It does; the Trustees have very much regretted that they had not the power which the Thames Conservancy are able to exercise. I understand that they have carried those powers into operation—the powers given to them by the last Act of 1854; indeed I know they have, because I have supplied them with evidence, which has enabled them to obtain a conviction.

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4393. Might I ask you whether the Trustees have discussed recently the advisability of obtaining additional legal powers similar to those which are embodied in the Conservancy Act of last session for the river Thames?—They have in reference to that and many other objects, and it is thought desirable to obtain powers for the same purpose. The Thames Conservancy, since the passing of their Act of 1864, have taken proceedings in six cases, in which they have obtained convictions under the three-mile clause.

4394. What cases were those?—One was the case of H. Tallerman, who was fined 5*l.*; a man of the name of Stevens was fined 5*l.*; another of the name of Crossley was fined 5*l.*; in the case of Denton and Jutson the case was dismissed on their agreeing to alter their pipes; in the case of Batley and Butler the case was dismissed on their agreeing to alter their pipes; the case of Messrs. Abbott was adjourned till the following Friday to ascertain the result of a wall that was in course of erection. These were cases of nuisances on the Limehouse cut, the refuse being discharged into the river Lee.

4395. Was it solid refuse that was thrown in?—It was refuse from their manufactories, liquids and solids together.

4396. The proceedings in those cases were taken under the Act that was obtained in 1864?—Yes.

4397. Are you acquainted with the clauses generally in the Act passed in the last session for the future government of the Thames?—I have read it.

4398. It gives to the conservators, after notice, power to remove weirs, to take possession of locks, to remove or lower mill dams, and absolutely to prevent the sewage of any town or place from being thrown into the river?—It does.

4399. (*Mr. Harrison.*) Did the cases to which you have referred come under your notice as having a joint interest in Bow Creek with the Thames Conservancy?—Yes, they were our complaints in point of fact. We brought the matters before the conservancy, our officers were directed to give evidence, and convictions were in that way obtained, I think, in all the six cases; they all occurred in our district.

4400. Have they taken any action out of your district that you know of, or do they do so only when a matter is seriously forced upon their attention?—I am not aware.

(*Mr. Beardmore.*) I may be allowed perhaps to say that the Thames Conservators are constantly prosecuting offending parties; not a week passes without that being done.

(*The witness.*) I might mention other cases of nuisance. One or two of these cases we took before the police magistrates ourselves, and in the case of Tallerman we failed because we had not the power which the Thames Conservancy enjoy.

4401. (*Chairman.*) Is that the general character of the nuisances you have to complain of, polluting the waters of the navigation?—Yes; beginning with Ware, and down to the effluence of the Manifold ditch which conducts the water from the sewage works at Hertford, I think I may say that the water is extremely pure, that is to say, I am not speaking chemically, but to all appearance and taste. When we get below Ware lock the first real nuisance commences at the point where the outfall of the sewage water from Hertford takes place, that is the water which is brought there and which has passed through the deodorizing works at Hertford which were constructed by the New River Company.

4402. Do you know sufficient of the character of that effluent water to be able to say whether it has ceased to be the cause of nuisance, and therefore unobjectionable?—I think it is neither one nor the

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other, but I will say this, that it is most undoubtedly to the interest of the navigation that the water should be kept pure; that is necessary for the navigation. There must be a certain amount of solid deposit if you get filthy water, and therefore it will affect our navigation. In course of time it will silt up the bed of the river, and it does do so. We have, in consequence, to spend large sums of money in dredging out the sewage mud which accumulates in the river.

4403. Are you chemist enough to know that no disinfecting process or any treatment of that kind does anything but remove the solids; it does not touch the salts of sewage which are incorporated chemically with the water?—I do not know that of my own knowledge, but that is what I hear.

4404. (*Mr Harrison.*) After undergoing the process of clarification adopted by the New River Company is there any deposit in your navigation from the effluent water from the deodorizing works?—There is certainly an accumulation, whether it is a deposit of solid sewage which has floated down, or sewage in solution, I do not know, but I have observed that there is an accumulation of a black substance occasionally. In passing there you may see floating on the surface what appears to be at first sight floating sewage; it appears like nightsoil, but if you examine it you will find what it is; it is simply a confervoid growth which has risen from the bottom, and which has grown up from the presence of the sewage water. The sewage water seems to have fertilized the bed of the river. I have examined some of these collections and found that they were vegetable, not sewage. I suppose it is nature's method of clarifying the water.

4405. Is the water that is discharged from the works in appearance clear as it passes along and before it reaches the navigation?—I have seen it perfectly clear, and I have seen it also looking somewhat peaty, as though it had passed over peat of a brown colour; I cannot say that at all times, for instance, in hot weather, it is perfectly clear.

4406. Notwithstanding it appears to be quite clear as it passes from the works, when it reaches the navigation there is a deposit of some kind which gives rise to the results you have mentioned?—Yes, there is certainly a discolouration.

4407. After it mixes with the water of the navigation?—Undoubtedly; and I have been told by parties who have complained, that there is absolutely a smell and a great nuisance. We have received complaints from the Ware local board of health upon the subject.

4408. (*Chairman.*) The smell would probably come from two causes; first, the heat of the weather, and, secondly, the length of time during which the sewage has stagnated in the sewers before it got into the open air?—No doubt; we then come within 300 or 500 yards of the main sewer of the town of Ware, which is as abominable as it can possibly be; no attempt is made at deodorization, or any process which shall render it innocuous.

4409. It comes down as it is delivered from the town, does it?—Yes.

4410. Have you given them any notice upon the subject?—We have complained, but I may say that there is a little counter irritation in this case. They send us a complaint as to the Hertford sewage, and then we refer them to the nuisance they create.

4411. (*Professor Way.*) I suppose you have no doubt that the measures taken at Hertford to precipitate the sewage place the river in a better position than it is at Ware?—Yes, certainly.

4412. At Hertford the evil is greatly mitigated?—Yes, the work is done there as well as one could think it possible to do it by the process which they adopt.

4413. (*Mr. Harrison.*) Is any bank formed in the navigation below the point where the Ware sewage is discharged?—Yes, I believe there is one accumulated, and we shall have to incur expense in clearing it away.

4414. Is that an obstruction to the navigation?—It will become such.

4415. Cannot you under your Act proceed against the authorities of Ware on that account?—At that point there is a stream which enters the river, and it flows very rapidly there from the Town Mill of Ware, and the rapidity with which the water comes down clears away the bank, or the accumulations which are continually growing there; now and then there must be large accumulations in the river, but they are distributed over a large area.

4416. You would probably find it difficult to bring the matter home to the authorities of Ware?—Yes.

4417. (*Professor Way.*) And perhaps you could not do so until the evil had been the cause of some damage?—No.

(*Mr. Beardmore.*) I may mention that the river also, besides the millstream, has very large floods constantly coming down, and the mud gets washed away into the general stream; there is a very large amount of mud in the river generally, but not at that point.

4418. (*Chairman to the witness.*) Have you looked with any care at the recent Conservancy Act for the Thames?—Not with any very great care, but I have read it through.

4419. I suppose, if a complaint was made before any properly constituted tribunal that the river Thames was polluted by the river Lee, you could not deny it?—Unquestionably not; our great complaint is that pollution does find its way down our channel, but we have not sufficient power to prevent it.

4420. You might say that you do your best to prevent it, but you must at the same time confess you were guilty of passing the foul water into the Thames?—The fact is that our funds are not applicable to the purpose of preventing it. By their prescriptive rights the parties have been empowered to discharge, and from time immemorial discharges have taken place at different points of the river, and the law will not reach them in its present state unless they cause a nuisance.

4421. I suppose you are aware that if any person suffers from a nuisance caused by pollution from sewage, and he can prove that he suffers from it, the person who causes the nuisance can be indicted?—Quite so.

4422. We have been informed that it is by no means a simple process to obtain an injunction to restrain parties from causing a nuisance?—It is a very expensive and tedious proceeding.

4423. And when you have obtained an injunction you are sometimes no better off than before?—That is frequently the case.

4424. You may be suffering in the river Lee from town sewage, and if you obtain an injunction you may be no better off than you were before?—An injunction may be only partial in its operation, for instance, you might proceed against a board, having certain limits to its jurisdiction, and not extending over the whole area of the nuisance, and you would have to multiply your legal proceedings with very doubtful success.

4425. Are you aware that the river Lee Trustees are not alone liable to these almost futile proceedings, but that the authorities of towns and private individuals stand in the same position?—Quite so.

4426. Suits may be multiplied without any beneficial results being attained?—Yes.

4427. Have you considered the question of the future conservancy of the river Lee, and what form it might take in connexion with your trust?—I have thought a good deal about it, but I do not know whether I ought to express an opinion in the presence of the chairman, who is prepared to speak upon that subject.

4428. Will you then, as far as you can, enumerate the nuisances which exist between Ware and the point at which the East London Water Company take their water?—At Ware there are a great number of privies and drains which lie immediately over the river and which are discharged immediately into it; in a space of only about 200 yards there are a great number, about which we have complained, but we

found that the Local Board of Health were not disposed to act in the matter.

4429. If you summoned those parties before the justices I suppose their advocate would say that they had a prescriptive right?—Yes, and that is the difficulty we have to contend with. The next bad nuisance is at Tottenham; I think there is nothing between Ware and Tottenham of any importance. There is a small amount of drainage from the towns and villages.

4430. (*Mr. Harrison.*) Is the sewage of Hoddesdon carried into the river?—Yes, it is partially.

4431. Between Ware and the point from which the East London Water Company take their water are there any streams or tributaries from which any polluted water is passed into the Lee?—Yes, there is the Stort, and I believe the whole of that is turned into the river Lee.

4432. Do you find in the navigation that the water of the Stort brings down much polluted matter?—It is not observable, and it is not in the form of solids; then there is Waltham Abbey.

4433. (*Chairman.*) Have you any legal power over the navigation of the river Stort?—None whatever.

4434. You have no legal authority to pass along that stream to inspect it and see what they are doing?—No, except as one of the public might, not in any official capacity.

4435. That stream is not under your supervision?—No.

4436. The owners have an independent engineer and an independent board, and I believe it is private property?—I believe so. After we leave Waltham Abbey we reach Enfield lock.

4437. Is there any discharge of sewage at Waltham Abbey which is objectionable?—Yes, it is very bad there.

4438. Then you get to Enfield lock?—Yes.

4439. Is the sewage from Waltham Abbey let into the Lee above the point at which the East London Water Company takes its water?—Yes.

4440. So that any foul matter that comes in there necessarily forms part of the water taken by the East London Water Company?—Certainly. The next place is Enfield lock; the outfall works are in that neighbourhood, and the drainage from that district finds its way into the Lee.

4441. Is there any treatment of the sewage matter by filtration before it gets into the river?—I think not, it is all in the natural state.

4442. Is it above or below the point at which the East London Water Company takes its supply?—Above; then we come below the point of the supply to the East London Water Company below Tottenham lock. There we had first an intercepting drain or outfall, and that was constructed by the East London Water Company in pursuance of an Act that was passed in 1852.

4443. To which I believe you assented?—Yes, we were assenting parties, and for this reason: the sewage before that had found its way into the river Lee, through open ditches and several outfalls that there were into the Lee, in a worse form altogether than that in which it presents itself now. Those ditches were intercepted to enable the East London Water Company to take their supply wholly above Tottenham lock as pure as they could get it, and they passed the intercepted sewage down at the tail of Tottenham lock. I might say that it is not so bad as many I have spoken of, as the sewage is conveyed for some miles in an open drain, and absorption, evaporation, and oxidation have been going on, so that when it arrives at the Lee it is not always very polluting in its character. In hot weather it is so certainly.

4444. (*Mr. Harrison.*) The whole drainage of the land adjoining is intercepted as well as the sewage, is it not?—Yes.

4445. So that the sewage is diluted to a considerable extent?—Yes.

4446. I believe there are some tributaries as well?—Yes, at that point there is a considerable silting up of the bed of the navigation by the effluent water and the matters in solution.

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4447. If the sewage matter running down the cut becomes comparatively harmless when it gets to the bottom, what is the effect upon the inhabitants of the district through which it runs?—They complain very much of it. I do not know that there is a very manifest effect produced, but there must be something. Then about a quarter of a mile below the intercepting outfall comes the whole drainage of Tottenham, Wood Green, and West Green.

4448. At Tottenham they profess to disinfect the sewage?—They attempt to do it, but the result, I believe, is utter failure.

4449. Do you think that the process is less effectual than that pursued at Hertford?—Certainly; because the Hertford arrangement is adequate to the volume of the sewage, whereas at Tottenham it is totally inadequate.

4450. You think that they do not take out the amount which they might?—Certainly; not a tenth part of it.

4451. Have you given them any notice that you should interfere with them?—We have filed an information against them in chancery.

4452. There are several places besides the lunatic asylum at Colney Hatch, all of which tend to pollute the Lee at and about Tottenham?—Yes.

4453. I believe that the Tottenham board have either threatened or commenced proceedings against certain parties above them?—Yes, they have attempted to do so. I believe last year they filed a bill against the Hornsey board, but there there is nobody to make amenable; that board is not an enduring body; it is not a corporation.

4454. (*Professor Way.*) The works at Tottenham, I believe, were made 12 years ago?—Yes; rather more.

4455. Has the population of Tottenham increased since that time?—Yes, very largely, but the works have not been increased.

4456. Do you think that that is the cause of their inadequacy?—Yes, I believe that the works have been, although in operation, decreased; that is to say, certain tanks that were in operation originally have been abandoned.

4457. I believe there were certain elevated tanks into which the sewage was lifted, and I think those have been abandoned?—Yes. As I understand the process, it involved the use of those tanks to enable them to deal with a larger volume of sewage than they now deal with.

(*Mr. Beardmore.*) They also had filter-beds in a yard, which have all been filled up.

4458. (*To the witness.*) Was it at the suit of the Trustees of the river Lee that the interim injunction was granted?—Yes; and it was to restrain the authorities of Tottenham from bringing the sewage of Wood Green and West Green into the Lee. The injunction says that they shall not increase the evil until the hearing of the cause.

4459. Was it in consequence of that, that they made cesspools in Wood Green?—I do not know; but I might mention that on the occasion of the last survey of the river, (there is an annual visit paid by the Trustees of the river to inspect the works,) we went to the deodorizing works, and we there saw the pollution passing into the river at Tottenham, below the lock, and the nuisance was then excessive, the sewage was perfectly black and abominable. That was after the institution of our suit.

4460. Have you any control over the drainage of the adjoining lands on either side of the river Lee?—No.

4461. Or any responsibility—for example, if any flooding takes place are you liable for the damage done?—I presume that if damage arose from the want of repairs and the inefficient working of the navigation there probably might be some liability, supposing that the banks were not kept up and made sufficiently strong.

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4462. (*Mr. Harrison.*) Are there any water-marks on your navigation to which you are limited as to the height at which the water is to be kept?—There are marks up to which we are entitled to keep the water for the purposes of the navigation as against other parties, but we are not limited as to any outlay that may be necessary for the preservation of our works; we have proper side weir exits for the water. Then I come to the state of the river from Old Ford to the Thames, which is the tidal portion of the navigation, and that is rendered very pestiferous during hot weather owing to the discharge of impurities from various manufactories and works on the banks of the river there.

4463. Have the Trustees any control over those works either to prevent their establishment or to regulate them when established?—Not unless they interfere with our banks, or they require lay-byes or works and convenience; we have no power if they keep themselves at a distance from our undertaking. We find that they generally come to our banks, and then make application for an agreement for lay-byes or for a supply of water to their engines; then they come under our control in some respects.

4464. Have applications been recently made to you for leave to make wharves for the accommodation of the traffic on the banks of the river in the navigable parts?—Yes, one was made very recently at Ponder's End; large jute works are being erected there.

4465. So that they should be enabled to have their barges come alongside and discharge their loads at the wharves?—Yes, and the agreement is in course of completion. In every case when we enter into an agreement of that kind we invariably insert clauses to restrain parties from casting any pollution into the river; we make that a *sine qua non*, and we will not grant them the facilities they require unless they undertake to exclude all sewage and drainage from the navigation.

4466. Have you made any arrangement with any of the boards of health or other authorities, either of London or any of the adjoining parishes in the tidal portions of the river, to prevent sewage passing in?—No.

4467. Is it not the fact that a considerable amount of sewage has been passed in from the London district to the western side?—Yes.

4468. Have you any sewage passing in from any of the areas on the eastern side; I believe there is no sewer?—I think not. Not in the Limehouse Cut, but there is the West Ham sewage which is discharged beyond the Bow Creek entrance. There are two entrances to the river Lee navigation, one *viâ* Bow Creek to Blackwall, and the other from Bromley to Limehouse, near the church, and up the canal which was constructed under the powers of an Act of Parliament.

4469. That, I think, brings you down to the Thames?—Yes. We then come within the district of the Metropolitan Board at Old Ford, and there are outfalls, what they call storm water outlets. Three or four years ago, I think in 1863, the discharge from those outlets was so enormous that the Trustees were compelled to take proceedings, and they filed an information and bill against the Board and they obtained an injunction and 820*l.* in respect of the damage done to the navigation, and the costs of the suit.

4470. The metropolitan board allowed their sewers to discharge at their overflows as you conceived improperly?—Quite so, and the court justified our view of the question.

4471. I assume that having made overflows at those points they would have power to admit the flood water under certain conditions?—Undoubtedly. The injunction that was obtained is permanent, and since then they have constructed their main outlet works at Barking, so that we do not now anticipate such an influx under any conditions as we had then.

4472. Did the nuisance take place previously to the time when they commenced their outlet works at Barking?—Yes.

4473. They had made a temporary outlet then?—Yes.

4474. (*Professor Way.*) Have they not an overflow at Bow Lane?—I think not.

4475. Does Bow Common drain into the Lee?—No.

4476. You know that there are all sorts of disgusting trades carried on there?—It is a nuisance district.

4477. Does it drain into any stream which drains into the Lee?—I would rather that Mr. Beardmore answered that.

(*Mr. Beardmore.*) It was the ancient Tower Hamlets sewer up to about the 13th of August last. It flowed under the river Lee by a pipe, but there was a storm overflow under Bow Common bridge, which I think is what you refer to; if heavy floods of rain came it flowed over into the Lee, but only on those occasions. On or about the 13th of August the metropolitan board commenced pumping temporarily at Abbey Mills from the low-level sewer, and since that date I believe the bulk of the sewage of that sewer has been turned into the low-level sewer, not because it happened to run into the Lee, where it overreached it, but it ran down into Limekiln Dock, and created an abominable nuisance at Limekiln Dock; that nuisance is very much mitigated.

4478. (*Mr. Harrison.*) When was that abominable nuisance which you speak of?—Up to August it had always prevailed.

4479. You know that of your own knowledge?—Yes. Perhaps I may explain that the nuisance of the Tower Hamlets sewer at Limekiln Dock was very much mitigated when the northern high-level sewer was carried to Barking in the summer of 1863, but the sewage has flowed ever since up to very recently, when it was diverted under the circumstances which I have mentioned, and it is now pumped by temporary engines into the high-level sewer, and so to Barking.

4480. (*Professor Way.*) The Penstock Station was the point which I meant.

(*Witness.*) The storm outlets of which I have been speaking are connected with that Penstock Station, and I may say that the repetition of that nuisance is possible, according to the construction of their works.

4481. Because they have a permanent outfall?—Yes.

4482. It could only, I believe, be possible in a very heavy storm?—I believe that to be so because the gates are set at a very great height.

(*Mr. Beardmore.*) Up to August the low part of the Hackney brook came by gates which are shut down. The arrangements are very complicated; it is hardly possible to explain them or to understand them without a plan and section.

(*Witness.*) We have recently had occasion to complain of what we thought was the inflow of a quantity of sewage from those outlets; there was no diminution in their flow at Barking Creek on the day of which we complained. The outlets are probably a quarter of a mile off, that is to say, the entrance into the Lee is a quarter of a mile from Penstock, and their theory is, that this quarter of a mile must from time to time have accumulated animals and refuse, and that when there was a flood of rain in London it ran over the gates, and simply pushed out the impurities which had flowed up these channels by the action of the wind. If that be the case there must be some preventive means; there must be a grating or something of that kind placed at the mouths to prevent its occurring again. The rust shows that the gates have never been touched for two or three years.

4483. (*Mr. Harrison.*) Is the mill property and the land which the navigation Trustees possess a security for the money which you have borrowed?—Certainly, we consider so.

4484. Are you aware that upon the Thames, the Thames Commissioners had land to the value of about 10,000*l.*, which was not considered security for the bondholders?—I conceive that their bond must have been in a different form. We certainly understand that the whole undertaking is a security for the monies advanced. We have actual power to buy, hold, and dispose of lands.

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4485. In the case of the Thames the Commissioners at any rate actually possessed land valued at about 10,000*l.*, which they said was not available for the payment of the bondholders. Your debentures appear to be terminable at short dates?—At periods of three, five, or seven years.

4486. Is that provided for in your Act of Parliament, or is it an arrangement of your own?—It is an arrangement of our own. We are not limited at all as to time.

4487. You might have the money for an unlimited period of time as the bondholders determined?—Quite so, for a shorter or a longer period as circumstances might admit. I am reminded that we have been a corporate body since 1850, under seal, and as such corporation we are able to hold lands and to dispose of them, but the Commissioners of the Thames were never in that position, so that we are superior to that body in that respect as well as in the other respects which I have mentioned.

4488. The money which is annually paid by the water companies to your Trustees is on account of powers given for the abstraction of the water from the river Lee?—Yes.

4489. Besides that have they not power to call upon you to execute works, they paying for them?—They have, for the better storage of the water.

4490. Have they exercised that power?—In one instance; the New River Company called upon us last year to reconstruct the Hertford lock. The reason was that they drew down the water frequently, as we proved by gaugings, considerably below the navigable head; they did so from time to time. We made complaints to them and threatened them with proceedings because our barges ran aground and did not get over the sill at Hertford lock. Then they said, "Well, in order to prevent your having any cause "for complaint we will ask you to rebuild your lock "and to place the sill at a lower level;" and that has been done, and we have had no further complaint from the traders on the navigation.

4491. You have benefited the navigation and you have improved the construction?—Yes, and they have kept up their water very much better since the lock has been lowered than they did previously.

4492. Shall we obtain from your manager information as to the advantage which the navigation is, not only to Hertford but to the whole district through which it passes, or have you any observations to make upon that head?—My own impression is a very strong one, that the navigation is very essential to the towns through which it passes as a highway. I moreover think that the navigation should be maintained in a sanitary point of view, because the form of a river well maintained and in good repair, the river being full and deep, must be better for the health of the districts than a river neglected and simply running as a channel for the passage of water. Barges passing to and fro causing a change of the water from pond to pond, locking every hour, I fancy, must be more beneficial than a river neglected.

4493. Does the navigation afford greater facilities for manufactories upon its banks than can be given by any railway?—Certainly. There are manufactories on the banks which have no other mode of carriage.

4494. Barges upon a navigation can stop at any point?—Yes.

4495. It is not so easy for the trucks to do so upon a railway?—Just so. There are a number of public wharves upon our navigation, and if they were abandoned it would be a very serious loss to the neighbourhood.

4496. (*Chairman.*) Do you charge a toll for carrying manure?—No.

4497. Then I presume that that is an advantage to the landowners and the farmers?—Quite so. Agricultural manure is not charged for, and that alone must be an immense advantage to the Londoners who purchase an enormous quantity.

4498. (*Mr. Harrison.*) Is artificial manure free?—Yes. If you will allow me to refer to the clause in the Act which exempts those articles you will see what is included. It is the seventh of George III., chapter 51, section 81, "Provided always, that no tonnage "rates or duties shall be due, paid, or demanded for "any boat, barge, lighter, or other vessel carrying "only oil-cakes, malt dust, pigeon dung, or manure "of any kind whatsoever on the said river or the said "new cuts or canals or any of them, or any part "thereof."

4499. So that the agriculturists on each side of the river throughout the whole length of the navigation have a beneficial interest in the maintenance of the navigation?—Unquestionably. There is a very large brickfield at Ware which has no other means of carriage except the road.

4500. (*Chairman.*) What is your present income and what rate of increase has taken place?—That, I think, will be best manifested by the traffic return, which will show it year by year.

4501. Is there anything further which you would wish to name to the Commission?—I think not, except that I will complete my list of Acts.

The witness withdrew.

Appendix No. 1. to Evidence of John Marchant, jun., Esq., Clerk to the River Lee Trust.

Statement (referred to supra, Question 4330) of Matters relating to the River Lee Navigation.

Constitution and Statutory Powers of the River Lee Trust.

Constitution.

The navigation of the river Lee is managed and governed by a public trust, incorporated by the name of "The Trustees of the River Lee."

They derive their powers from various Acts of Parliament, the earliest of which were passed in the reign of Henry VI., one (cap. 5.) in the third year of his reign, (1424); and the other (cap. 9.) in the ninth year of the same reign (1430).

3 Hen. VI., c. 5. (1424.)
3 Hen. VI., c. 9. (1430.)

These two statutes empowered the Chancellor for the time being, to issue commissions for the purpose of clearing, scouring, and amending the river "Ley," which in both of them is stated to be "une des grandes rivers" of England.

The river appears to have been rendered navigable in the reign of Queen Elizabeth, and the constitution of the River Lee Trust, may be said to have been first established in that reign.

13 Eliz., c. 18. (1570.)

In the thirteenth year of Elizabeth (1570), an Act was passed (cap. 18.) "For the bringing of the river of Lee, to the north side of the city of London." By this Act the Lord Mayor, Commonalty and Citizens of London, and their successors, were authorized to bring the said river of Lee from the town of Ware to the north side of the city of London, and by section 4. it was enacted, "That the said "Lord Mayor, Commonalty and Citizens, shall have the "whole jurisdiction, conservice, rule, and government as "well of the said New Cut River and ground of each side, "as also the royalty of the fish and fishing of the same, and "the profits of the said ground, soil, and water to them "and their successors for ever." Power was also given by this Act for the punishment of offenders and persons breaking the rules and orders provided for the preservation and maintenance of the said river.

The Lord Chancellor or Lord Keeper of the Great Seal of England was empowered to appoint and authorize by commission under the Great Seal of England, sixteen Commissioners, (namely four of the city of London, and four of each of the shires of Essex, Middlesex, and Hertford, having lands, tenements, or hereditaments of the clear yearly value of forty marks, and not being London traders,) who should have full power to treat, agree, and compound for the scouring, cleansing, repairing, and keeping of the said river Lee.

The navigation between the towns of Hertford and Ware was at this period under the control of the corporation of Hertford, but certain disputes arose between that body and the inhabitants of Ware and the New River Company as to the jurisdiction of those bodies, and in consequence of these

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disputes an Act was passed in the twelfth year of the reign of George II., cap. 32. (1739.) "For ascertaining, preserving, and improving the navigation of the river Lee from the town of Hertford to the town of Ware in the county of Hertford; and for preserving and improving the said river from the said town of Ware to the New Cut or River made by the Mayor, Commonalty and Citizens of London; and for enabling the governor and company of the New River the better to supply the cities of London and Westminster, and the liberties and suburbs thereof, with good and wholesome water."

12 Geo. II., c. 32. (1739.)

By this Act the course of the river was defined, and certain persons therein named were appointed for the putting in execution the powers and trusts by them reposed by virtue of and in pursuance of that Act for the purposes therein expressed.

7 Geo. III., c. 51. (1766.)

In the seventh year of the reign of George III., cap. 51. (1766) another Act was passed, "For improving the navigation of the river Lee from the town of Hertford to the river Thames; and for extending the said navigation to the flood gates belonging to the town mill in the said town of Hertford."

By this Act the trustees appointed by the 12th George II., cap. 32., together with several other noblemen and gentlemen therein named were appointed, "Trustees for the making, extending, improving, and maintaining the navigation of the said river Lee, from the flood gates belonging to the town mill in the town of Hertford to the river Thames, and for putting this Act in execution;" and they were empowered to cleanse, scour, deepen, enlarge,

7 Geo III., c. 51, sec. 1.

or straighten the channel of the river Lee, and to make and maintain the new cuts therein described, and to build the bridges and works therein mentioned. (Section 1.)

Sec. 69.

By this Act the navigation was declared to be a free navigation for all the King's liege people, subject to the payment of such rates and duties which were thereby authorized to be levied.

Sec. 80.

The main source of revenue of the trust is provided by this Act which defines the tolls to be taken upon the navigation in respect of the commodities conveyed upon it.

9 Geo. III., c. 58. (1778.)

The trustees were authorized by the 19th George III., cap. 58. to raise certain additional tolls therein described.

45 Geo. III., c. 69. (1805.)

Another Act was passed in the 45th year of the reign of George III. (cap. 69), for the better preservation and further improvement of the navigation, defining certain heights of water, and giving power to the trustees to make byelaws for regulating the lading of barges.

Sec. 10.

It was also provided that no craft should carry more than

Sec. 12.

40 tons of freight, but this provision has since been repealed by the Act next to be referred to.

13 & 14 Vic. c. 109. (1850.)

The next Act was passed in the 13th and 14th years of the reign of Queen Victoria (cap. 109), called "The Lee Navigation Improvement Act, 1850." The principal objects of this Act were to enable the trustees further to improve the navigation, and to dispose of the surplus water.

Sec. 3.

The trustees were incorporated by the name of "The Trustees of the River Lee," and were empowered to purchase and hold, and sell, demise, and dispose of lands for the purposes of that and the therein recited Acts.

18 & 19 Vic. c. 196. (1855.)

In 1855 arrangements for the supply of water to the New River and East London Waterworks Company were confirmed by the Act of 18 & 19 Victoria, cap. 196. "The River Lee Water Act, 1855."

Sec. 9.

By this Act the surplus water of the Lee, over and above the quantity required for the purposes of navigation, was vested in "these two companies respectively, subject never-"theless to such rights as might not then belong to the "trustees."

Sec. 11.

The daily quantities of water reserved to the trustees for navigation purposes, and not subject to any control by the companies, are as follows:—

First. They may pass through their locks from the highest point at which the companies or either of them take their supply, down to and including the first lock above Feilde's weir (called "The Upper Reach"), not exceeding in any 24 hours 576,000 cubic feet.

Secondly. They may pass from the first lock above Feilde's weir exclusive down to and including Waltham town lock (called the Middle Reach), not exceeding in any 24 hours 720,000 cubic feet.

Thirdly. They may pass from Waltham town lock exclusive down to and including Old Ford lock (called the Lower Reach), not exceeding in any 24 hours 864,000 cubic feet.

All water below Tottenham mill, not required by the two companies at their drawing stations, is reserved to the trustees for navigation purposes.

Sec. 27.

The two companies are strictly forbidden, without the consent of the trustees, at any time to draw from the river so as to reduce the water in any pond of the naviga- Sec. 30.
tion below the customary head level of that pond.

The priorities of rights to take the water of the river Lee are very clearly defined by this Act, and are as follows:—

First. The right of the trustees to the upper middle and lower daily quantities, and such further quantity as shall be necessary to maintain the water of the navigation on a level with the head levels aforesaid.

Secondly. The right of the New River Company to take 2,500 cubic feet a minute.

Thirdly. The right of the East London Waterworks Company to take 2,500 cubic feet a minute.

Fourthly. The right of each company to take *pari passu* 500 cubic feet a minute.

Fifthly. The right of each company, after notice, to take *pari passu* any additional quantity.

Sixthly. The right of the trustees to surplus water below Tottenham mill.

The body of trustees consists of the following *ex-officio* 12 Geo. II., c. 32, sec. 16.
members, viz.:—

The Lord Mayor, Aldermen, and Recorder of the city of London for the time being; the Knights of the Shire for the county of Middlesex, the Members of Parliament for the city of Westminster, the Knights of the Shire for the counties of Essex and Hertford, the Members of Parliament for the boroughs of Colchester and Hertford; the Mayor of Hertford for the time being; and noblemen and gentlemen from time to time elected from the counties of Hertford, Essex, and Middlesex.

The governor, deputy-governor, and treasurer of the 7 Geo. III., c. 51, sec. 1.
New River Company for the time being are also *ex-officio* members of the trust.

The trustees have, in execution of their powers, made new cuts and straightened the course of the navigation; they have removed locks and other obstructions; they have replaced old wooden locks with new brick and stone structures; and have otherwise expended very large sums in maintaining and improving the navigation between Hertford and London.

By the foregoing Acts the whole jurisdiction, conservice, government, and maintenance of the navigation of the river Lee has been for three centuries and is now vested in the trustees appointed under those statutes.

The trust has been regarded as one of great public importance, having for its sole object the public benefit and advantage.

Nuisances on the Navigation.

Hertford.

Commencing at Hertford there are but few cases of drainage into the river Lee, the town being sewered by the New River Company in order to purify the source of their supply below Hertford lock, the first on the navigation.

The sewers constructed by that company intercept the drainage of the town, and convey it to deodorizing works about a mile down the valley towards Ware. The sewage water after being dealt with at the works is conveyed down an open channel into the river Lee below Ware lock, about two miles south of Hertford, and just above the town of Ware.

The discharge from this channel, called the "Manifold ditch," is not generally offensive, but in the summer months during the prevalence of hot weather it is said to be so.

Communications upon the subject have passed occasionally between the Ware local board of health and the trustees of the river Lee, but the local board have the power in their own hands to deal with the nuisance if it be one.

Ware.

Within 500 yards of the Manifold ditch and discharging into the same pond of water is the outlet of the main sewer of the town of Ware, under the control and management of the local board of health. The sewage flows into the navigation in large volumes, and without any attempt being made to deodorize or purify it. A trap door is fixed at the mouth of the sewer, opening outwards by the action of the sewage.

This Ware sewer is undoubtedly a great nuisance to the navigation, and the neighbourhood of the outfall, and is one which calls for interference.

Another sewer flows into the navigation under Ware bridge, and takes the drainage of Amwell End. There is no attempt to purify the discharge of this drain.

In addition to the above, there are many privies and drains discharging into the river at Ware.

Stanstead.

There is no sewer falling into the river at Stanstead, but there are privies and drains which should be done away with.

Tottenham.

There is no further serious drainage into the navigation below Ware until we reach Tottenham.

The East London Waterworks Company take their supply of water from the river above Tottenham lock.

In about the year 1853, that company constructed an intercepting drain or sewer, to intercept and divert the drainage and sewerage water from Enfield, Ponder's End, and Upper and Lower Edmonton, and part of Tottenham.

Previously this drainage found its way into the navigation through open and circuitous ditches, discharging into the river above Tottenham lock. The intercepting drain was made under the powers of the East London Waterworks Act, 1852, 15 & 16 Vict., cap. 164, (sec. 81).

It has its outfall into the Lee a few yards below Tottenham lock.

When this intercepting drain was constructed the discharge from it was comparatively innocuous, but the increase of population in the districts draining into it has caused a corresponding increase in the volume of discharge which is at times offensive. Large quantities of sewage, mud, and sand are also deposited in the bed of the Lee from the drain.

About a quarter of a mile down the river below the East London drain is an intolerable nuisance, caused by the discharge through an iron pipe into the navigation of the sewage of Tottenham, Wood Green, and West Green by the Tottenham local board of health. In hot weather the water in the neighbourhood of and for some distance below the outfall is black with filth, and the smell is most offensive.

The navigation is also injuriously interfered with by the deposit of mud along its bed.

The trustees of the river Lee have found this nuisance so intolerable that they have been compelled to file an information and bill of complaint in the Court of Chancery. An order has been obtained and is still in force, restraining the Tottenham board from making any further connexions with houses and drains until the hearing of the cause, which will be argued during next term.

Old Ford, Bow, and Limehouse Cut.

The state of the river from Old Ford to the Thames, which is the tidal portion of the navigation, is rendered very pestiferous during hot weather, owing to the discharge of impurities from various manufactories on the banks of the river there.

The Limehouse Cut is at times little better than a reeking ewer.

The trustees have endeavoured to prevent the increase of the nuisances there, but owing to the want of statutory and summary powers have only been very partially successful.

The Metropolitan Board of Works have constructed large storm-water outlets from their works at Old Ford, and in the year 1863, the discharge from these outlets was so enormous that the trustees were compelled to file an information and bill in Chancery, the result of which was a decree by the court, restraining that body from continuing the discharge, and directing the payment by them of 820*l.* in respect of the damage to the navigation by the deposit of the solid sewage in its bed, together with the costs of suit.

The mode of construction of the Metropolitan works is such as to render the repetition of this nuisance possible.

The trustees endeavoured to deal with the cases in the Limehouse Cut, but could get no relief for want of summary powers. On applying to the Thames Conservancy, who have jurisdiction over three miles of the river for nuisance purposes, that body attacked some of the cases, and obtained convictions on the evidence supplied by the officers of the trust.

This part of the river will be relieved of the drainage now discharged into it on the completion of the Metropolitan low-level sewers, which will intercept the drains of that locality.

Financial Position of the Trust.

Revenue.

The trust derives its income from the tolls levied upon commodities carried upon the river; from certain annual payments for water supplied to the New River and East London Water Companies; and from the rentals of mills and other properties belonging to the trustees.

The whole revenue of the trust, from whatever source arising, is vested in the trustees, to be applied in paying the several annual payments directed to be made by the 7th Geo. III., c. 51; in paying interest upon money raised under their borrowing powers; and in improving and maintaining the navigation.

HERTFORD.

Mr. J. Marchant, jun.

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The estimated annual receipts are as follows:—

Tolls	£11,611
Water rents	3,500
Rentals of mills and other property	1,401
Sundries, including ballast	700
	£17,212

The estimated annual payments are as follows:—

Salaries	£1,300
Pensions	430
Lock-keepers' and collectors' wages	1,345
Maintenance and repairs, including materials	3,500
Mills and weirs	800
Land rents	180
Rent and taxes	600
Insurances	15
Printing, stationery, and advertising	165
Office disbursements	160
Sundries	97
Expenditure for maintenance	8,592
Interest on borrowed money, viz.:—	
Debenture loan 7,173	
Other loans 1,250	
	8,423
	£17,015

Capital. 2,630 = 4¾ 4,543 = 5 7,173.

The amount raised on debentures under the borrowing powers of the trust is 149,287*l.*, viz., 58,412*l.* bearing interest at 4½ per cent., and 90,875*l.* at 5 per cent. In addition, the bankers have advanced 23,000*l.*, and the London Life Assurance Association the balance of a loan of 20,000*l.*, 2,000*l.*

The capital raised, therefore, stands thus:—

Debenture loan	£149,287
Loan from bankers	23,000
Ditto London Life Association	2,000
	£174,287

The trustees are empowered to raise the sum of 230,000*l.* upon the credit of the trust, so that their borrowing powers are unexhausted by the sum of 55,713*l.*

Progress of trade.

The progress of the traffic may be understood from the following statement, which shows that the income from tolls has nearly doubled itself within the last 15 years, viz.:—

	£
Tolls received in 1851	5,798
„ 1852	6,266
„ 1853	7,852
„ 1854	7,482
„ 1855	8,010
„ 1856	8,647
„ 1857	8,670
„ 1858	8,104
„ 1859	8,444
„ 1860	8,929
„ 1861	9,202
„ 1862	10,526
„ 1863	10,290
„ 1864	10,057
„ 1865	10,431

APPENDIX No. 2 to EVIDENCE of JOHN MARCHANT, Jun., Esq., Clerk to the River Lee Trust.

Copy of Notice to remove Nuisances given by the direction of the River Lee Trustees.

HERTFORD,
August 1864.

SIR,

At the annual inspection of the river Lee on the 2nd inst., the Trustees observed that considerable nuisance was occasioned to the navigation by the drainage from your into the River.

It is the imperative duty of the Trustees to preserve the river from contamination; I am therefore instructed to request that you will accept this as a notice to remove the cause of complaint from your premises without delay.

The next meeting of the Trustees will be held on Saturday, the 20th instant, by which time they hope to hear from you that you are taking active measures to comply with their requisition.

Your obedient servant,
JNO. MARCHANT,
Clerk to the Trustees.

Mr. J. Marchant, jun.

19 Dec. 1866.

Appendix No. 3 to Evidence of John Marchant, jun., Esq., Clerk to River Lee Trust, (referred to infra, Question 4829).

Abstract of the Receipts and Payments of the Trustees of the River Lee, for the Year ending 31st December 1866.

Receipts.

	Ordinary. £ s. d.	Extraordinary. £ s. d.
Tolls	11,581 5 0	
Water rents	3,441 13 4	
Sundry rents	1,060 11 10	
Loans, namely:—		
Upon debentures — £14,500 0 0		
Less debentures paid off 6,944 11 10	—	7,555 8 2
Sundries	412 2 7	
Ballast sold	298 4 4	
Repayments for sundry works	169 18 0	
Received from the New River Company on account of the reconstruction of Hertford lock	—	1,889 10 1
Purchase of property	—	115 0 0
	16,963 15 1	9,559 18 3
		16,963 15 1
		26,523 13 4
Balance of 1865 account		1,530 18 1
		£28,054 11 5

Payments.

	Ordinary. £ s. d.	Extraordinary. £ s. d.
Interest	8,558 11 11	
Salaries	1,353 15 0	450 0 0
Pensions	423 10 0	
Lock-keepers' and collectors' wages	1,352 13 0	
Maintenance and repairs of locks, weirs, works, plant, and dredging	1,501 4 6	
Materials for ditto	250 2 11	
Reconstruction of Limehouse lock	—	3,115 8 4
Payments on account of ditto, viz.:—		
Materials — £3,294 0 4		
Limehouse board of works — 440 2 2		
Gas — 32 8 5		
Compensation to tenants — 165 10 0		
Watching — 38 7 4		
Munday—Supervision of works 196 5 0		
Rent of warehouse — 52 0 0		
	—	4,218 13 3
Reconstruction of Hertford lock	—	1,889 10 1
Mills and weirs	784 11 8	
Land rents	158 17 7	
Rents, rates, taxes, &c.	639 2 10½	
Insurances	1 1 0	
Printing, stationery, and advertizing	93 2 8	54 2 9
Office disbursements	113 15 0½	
Sundries	82 7 3	
Stamps on debentures	—	17 8 3
Commission on loans	—	122 0 0
Purchase of property	—	94 10 0
Law expenses	—	115 18 2
Parliamentary expenses	—	536 0 9
Engineers' ditto	—	251 7 0
Ballast paid for	78 7 0	
	15,391 2 5	10,864 18 7
		15,391 2 5
Balance of banker's cash, 1866	1,757 8 9	26,256 1 0
Ditto, office cash	41 1 8	1,798 10 5
		£28,054 11 5

At the annual general meeting of the trustees of the River Lee, held at the London Tavern, Bishopsgate Street, in the city of London, on Wednesday, the 6th day of February 1867, the above abstract was submitted to, and settled and passed by, the trustees assembled at such meeting.

(Signed) Gascoyne Salisbury, Chairman.

Statement of Traffic upon the River Lee Navigation during the last 21 Years, from 1846 to 1866.

Year.	Tons.	Tolls. £	Year.	Tons.	Tolls. £
1846	287,327	8,249	1857	274,741	8,670
1847	313,304	8,455	1858	254,269	8,104
1848	287,166	8,349	1859	280,353	8,444
1849	287,520	8,511	1860	275,667	8,929
1850	265,158	7,844	1861	300,900	9,202
1851	212,633	5,798	1862	355,519	10,526
1852	206,213	6,266	1863	320,850	10,290
1853	228,072	7,852	1864	351,038	10,057
1854	216,930	7,482	1865	349,760	10,431
1855	257,886	8,010	1866	393,788	11,581
1856	287,337	8,647			

Comparative Statement of Traffic.

	Tons charged.	Tons. £
Tons carried and tolls collected in the year 1866	393,788	11,581
Average per annum of tons carried and tolls collected in 15 years, 1846 to 1860, inclusive	262,305	7,974
Increase above the average in 1866	131,483	3,607

HERTFORD.

Mr. J. Marchant, jun.

19 Dec. 1866.

Appendix No. 4 to Evidence of John Marchant, jun., Esq., Clerk to the River Lee Trust, referred to infra, Question 4829).

Statement of Balances on "Ordinary" or Revenue Accounts for 10 years, from 1856 to 1865 inclusive, as shown by the foregoing Abstracts:—

	£ s. d.	Surplus. £ s. d.	Deficiency. £ s. d.
1856. Receipts,	11,472 10 2		
„ Payments,	11,640 3 11	—	167 13 9
1857. Receipts,	12,525 4 5		
„ Payments,	11,503 16 10	1,021 7 7	
1858. Receipts,	11,743 12 8		
„ Payments,	11,757 15 2	—	14 2 6
1859. Receipts,	12,934 3 7		
„ Payments,	12,271 9 0	662 14 7	
1860. Receipts,	13,204 0 9		
„ Payments,	13,497 12 10	—	293 12 1
1861. Receipts,	14,362 17 8		
„ Payments,	13,134 2 9	1,228 14 11	
1862. Receipts,	15,289 12 11		
„ Payments,	14,149 15 9	1,139 17 2	
1863. Receipts,	14,568 11 4		
„ Payments,	14,522 18 11	45 12 5	
1864. Receipts,	14,855 17 0		
„ Payments,	15,848 4 6	—	992 7 6
1865. Receipts,	16,064 1 1		
„ Payments,	15,497 4 5	566 16 8	
		£4,665 3 4	1,467 15 10
Surplus upon the operations of 10 years		—	3,197 7 6
			£4,665 3 4

The Marquis of Salisbury examined.

The Marquis of Salisbury.

4502. (*Chairman.*) I believe that your lordship is chairman of the River Lee Trust?—I am.

4503. How many years have you acted as chairman of that trust?—I think about 15.

4504. Will your lordship please to describe the character of the trust; it is I believe an unpaid trust?—Entirely.

4505. You pay your officers?—We pay our officers, but the trustees have no remuneration whatever.

4506. They meet at stated periods?—We generally meet once a month, and at additional times if requisite. We pass our accounts in London once a year, and generally we have the benefit of the attendance of some members of the corporation, and on other occasions they also come, it is principally when we meet in London during the session of Parliament.

4507. What number of trustees is required to make a quorum for business?—I think three, but we cannot sign any cheque without five.

4508. Is there at any time any difficulty in getting a quorum to do the business of the trust?—None. I do not recollect an instance of it.

4509. The gentlemen who are nominated you find quite willing to pay that attention to the duties which is necessary for carrying on the business of the trust?—Quite so.

4510. I presume that your lordship is well acquainted with the character of the district through which the river passes?—I may say that I am entirely acquainted with the river Lee. I do not say that I am well acquainted with all the tributaries, but I am entirely acquainted with the river Lee from Luton down to Bow Creek.

4511. Is the river Lee almost becoming what one might term a necessity to the district?—An absolute necessity.

4512. What amount of traffic in tonnage is now carried on the river Lee?—I have it from 1851 to 1865, for periods of three years at a time. The tonnage from 1851 to 1853 was 215,639 tons; the tolls were 6,638*l.* There has been a regular increase in the tonnage. From 1863 to 1865 it was 340,547 tons, and the tolls were 10,259*l.* The tolls in this year have been increased most prodigiously. I am not quite sure that I can state them correct, as the accounts are not made up; 11,073*l.*, has been received up to the 15th of December, which is more than we received in the previous three years.

His Lordship delivered in the following table:

River Lee Navigation.—Average Statement of Tons carried, and Tolls collected per Annum, taken from Periods of Three Years during the last Fifteen Years.

Years.	Tons.	Tolls.
1851 to 1853	215,639	£6,638
1854 to 1856	254,051	8,046
1857 to 1859	269,784	8,408
1860 to 1862	310,695	9,552
1863 to 1865	340,547	10,259
Tolls received to 15th December 1866		11,073

4513. Any scheme which seriously affected the navigation of the river Lee would, I assume, perhaps in a greater proportion affect the value of property on both its banks?—Most certainly. Very much indeed.

4514. May we consider that the property situated in proximity to the Lee, on both its banks, may be said to exceed the navigation in value and consequently in interest if affected by anything done upon the river?—It would depend upon how far you carried it; but certainly the land is daily rising very much in value all along on both sides.

4515. There are towns situated upon the banks of the Lee and its tributaries?—There are. I am not acquainted with the Stort.

4516. Has the population in the valley of the Lee been increasing of late years?—Very much.

4517. Then, of course, the trade of the district would increase with the population?—Certainly.

4518. I suppose that the navigation upon the Lee is convenient, as it takes the goods more immediately to the premises of persons situate on either bank than any other mode of conveyance yet established can accomplish?—More so certainly, and to a greater extent; but I apprehend also that the carriage of goods on the Lee is very much cheaper than that on the railroads.

4519. We have heard that the river Lee trustees carry the manure without charge. I need scarcely ask the question whether any railway company gives the same facility?—Certainly not.

4520. Then it would be depriving the adjoining landowners of a sort of property into the possession of which they have come, if anything interfered with that arrangement?—I should certainly think so.

4521. Can your lordship give us a statement of the weight of manure which has been carried for any fixed periods?—I can. In 1858 there were 22,000 tons, and in 1863 there were 109,000 tons. In consequence of the cattle plague there was a great falling off in 1864 and 1865, because we ordered no manure to go down the banks. I rather took upon myself to order no manure to go down the banks during the cattle plague.

His lordship delivered in the following tables:—

HERTFORD.

The Marquis of Salisbury.

19 Dec. 1866.

RIVER LEE NAVIGATION.

STATEMENT of TRAFFIC to and from the various Points during Eight Years—1858 to 1865 inclusive.

	1858.		1859.		1860.		1861.		1862.		1863.		1864.		1865.	
	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.
		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.
Limehouse Cut -	60,430½	1,164 17 11	67,808½	1,374 5 10	97,515	1,753 4 2	108,700	1,802 2 8	106,484	1,705 1 1	102,201	1,838 2 6	112,848	2,041 3 8	100,528	1,828 10 2
Duckett's Canal -	1,635½	29 7 4½	4,578½	84 12 10	2,729½	52 19 8	5,301	93 9 4	11,817½	222 11 5	10,988¼	183 12 8½	28,496	449 3 0½	233,46¼	484 1 10
Homerton and Lee Bridge.	9,834½	266 19 3	8,993½	202 13 10	9,375½	201 4 1½	13,550½	293 17 8	13,702	415 1 6½	18,105	487 1 5½	30,794	730 6 5	42,849½	898 12 8
Tottenham and Ponder's End.	12,273¾	342 16 10½	8,671½	241 4 7½	12,344¼	340 18 0½	14,707¼	408 3 4½	56,143½	1,121 11 6½	17,260¼	671 19 7	20,131½	531 8 0	21,499½	553 2 1
Enfield Lock and Waltham.	22,296¼	919 10 7½	22,597½	932 12 6½	24,128½	1,004 8 1½	25,782	1,144 17 0½	23,378	1,204 2 4½	21,181½	1,073 18 5½	19,827	945 3 4½	19,673	907 3 2½
Cheshunt and Hoddesdon.	6,070½	252 11 3	7,013½	260 18 9½	5,678½	205 17 7	6,655½	246 7 5	7,503½	282 2 4½	7,883½	274 2 6½	9,192½	249 10 2½	7,196	241 15 8
River Stort - -	45,407¾	2,037 0 2½	43,499½	1,950 1 3½	40,621	1,838 0 11	40,458½	1,617 12 4½	42,743½	1,937 19 2½	46,489½	2,076 15 7½	44,937	2,038 3 1½	47,361½	2,168 11 9½
Rye and Stanstead -	5,528½	145 3 3	3,185½	130 17 2	4,886½	149 1 8	3,606¾	161 3 0	4,404½	193 18 1	4,475½	203 4 10½	4,023	169 19 8	4,350½	190 5 7
Ware - - -	52,545¾	2,269 9 2½	56,605½	2,449 18 5	5,632½	419 18 10½	65,358½	2,567 3 8½	71,321	2,650 16 9½	73,422½	2,710 8 11½	63,355½	2,179 0 4½	64,333	2,354 10 11½
Hertford - -	16,065½	676 14 8½	18,857½	817 7 1½	21,768	963 16 11½	16,780½	668 0 4½	8,022	733 11 7	18,748¼	770 15 7½	17,494	723 9 11	18,622½	799 13 11½
Total -	232,097½	8,104 10 8	241,808½	8,444 12 5½	275,676½	8,929 10 1½	300,900½	9,202 12 4½	355,619¼	10,526 15 11½	320,850	10,290 2 3½	351,038½	10,057 7 9	349,760½	10,491 7 11½

HERTFORD.

The Marquis of Salisbury.

19 Dec. 1866.

RIVER LEE NAVIGATION.

STATEMENT of TRAFFIC during the last Eight Years.

Year.	Tons charged.	Tons of Manure and Spoil free.	Total Tons.	Tolls.
				£
1858	232,097	22,172	254,269	8,104
1859	241,808	38,545	280,353	8,444
1860	275,676	36,398	312,074	8,929
1861	300,900	40,967	341,867	9,202
1862	355,519	119,111	474,630	10,526
1863	320,850	109,974	430,824	10,290
1864	351,038	36,751	*387,789	10,057
1865	349,760	23,597	*373,357	10,431
Tolls received, 1st Jan. to 15th Dec. 1866 -				11,073

*The falling off in manure in the year 1864-1865 was caused by the prohibitory laws in consequence of the Cattle Plague.

4522. (*Mr. Harrison.*) In the first of those returns can your Lordship separate the weight of artificial manure from the weight of horse manure and London manure?—No.

(*Mr. Glass.*) The artificial manure is a very small proportion; guano and rape cake are the principal things; rape cake has to be certified that it is to be used for manure, and also ashes.

4523. (*Chairman to the Marquis of Salisbury.*) In speaking of carrying the manure free you mean that you permit the farmers or other persons interested, to traverse the navigation free of toll?—Exactly so; we are not carriers.

4524. You are not carriers in any sense; you have no boats of your own?—We have some for the purposes of dredging. I think that there is nothing else; we do not carry for hire but only for our own purposes.

4525. You do not enter into competition with carriers?—Not at all.

4526. You simply maintain the navigation, and levy toll upon persons using the navigation, and you regulate the traffic?—Yes.

4527. (*Mr. Harrison.*) I observe upon the railway a number of trucks between this and London laden with manure?—Yes.

(*Mr. Glass.*) The owners of that manure must pay the railway company for its carriage. When it comes down in small quantities, perhaps the land adjoins the railway and is at a distance from the navigation. Our navigation does not extend beyond Hertford, and perhaps those trucks may be going further down, to Cambridge.

(*Marquis of Salisbury.*) I, myself, have been a large carrier of manure by railway, for my own purposes, and I think that the charge to me was 3*s.* 6*d.* a ton to Hatfield.

4528. What would the charge be upon the navigation for hauling?—That is a question which the traders must look to.

4529. The railway company are haulers as well as owners of the rates, so that it is quite possible that practically they merge any rates in the charge which they make for the carriage?—Probably.

(*Mr. Glass.*) They charge about 2*s.* to 3*s.*, according to the distance. It is generally done by the freighter; he pays for the manure and all; a man goes to the yards in London and gets a barge load of manure.

4530. I presume that your navigation has a beneficial effect as regards the farmers in the neighbourhood?

(*Mr. Glass.*) There is no doubt of it.

4531. (*Professor Way.*) But it is possible that in spite of rates not being levied on manure, if carried by the navigation, the cost might be quite as much or more than the carriage by railway?

(*Mr. Glass.*) It depends upon the barge owners.

4532. (*Professor Way.*) That does not give us any notion how cheaply the manure can be carried?

(*Marquis of Salisbury.*) I think that it is 14*d.* a ton to Hertford, that is the price of the manure altogether.

4533. The rates must be a small proportion of the carriage?—Yes.

(*Mr. Glass.*) It is about 6*d.* a ton?

(*Marquis of Salisbury.*) I used to import manure down to Hertford at 14*d.* for 40 tons, the parties furnishing me with the manure.

4534. (*Chairman.*) I presume that the trustees have had decisions as to parties polluting the water of the navigation?—To a very small extent.

4535. Do you consider that you have sufficient power to deal with the parties causing those pollutions?—I think not.

4536. Do you think that it would be advisable that some additional power should be provided to prevent this state of pollution which is growing up?—I think it very desirable indeed. The cases are rather frightful cases; there is, I think, one case of a man going up to Limehouse Cut, and dying of cholera within 48 hours; he was a bargeman from this part of the country; but there is an universal complaint of it.

4537. Have you arrangements with the two great East of London water companies, namely, the New River Company and the East London Company, for supplying water under certain conditions?—Yes, under an Act of Parliament of 1855.

4538. And you receive a certain rental from them?—We do.

4539. Do you consider that as trustees you have a moral obligation placed upon you to preserve the water pure for the use of the metropolis?—We certainly should think so; we should think it very desirable to do so.

4540. And I presume that you now, as far as your means will carry you, do what you can to prevent the pollution?—We do what we can to the full extent that we think that we have the power, or should be justified in applying the funds.

4541. But you know of your own knowledge, and also by hearsay, that impurities find their way into the river Lee, which forms a source of supply to the eastern portion of the metropolis?—Certainly.

4542. And I daresay that you have heard this autumn that cholera has prevailed very extensively in that eastern portion of London?—I have.

4543. Have you noticed that the Registrar General, whether rightly or wrongly, attributes the outbreak of cholera in some measure to the impure character of the water distributed by the East London Waterworks Company?—I have seen such a report.

4544. I presume that you are aware that that water does receive the sewage of a considerable population situate above the point at which they abstract it?—Certainly.

4545. The town of Luton is, I believe, situate near the head of the main river Lee?—The Lee rises immediately above Luton.

4546. And a large manufacturing population at Luton passes its sewage into the waters of the Lee?—I am not quite aware of what has taken place lately, but Mr. Leigh, when he bought Luton Park, made some arrangement with the town of Luton; there was a lawsuit about it, and the water is supposed to be diverted in his park.

4547. The water at Luton is dealt with in somewhat a similar manner to the mode in which it is dealt with here, the sewage is passed into depositing tanks, and the sediment is intercepted, and the effluent water passes into the Lee and goes on. Any person who calls that a purification of sewage does not understand the chemical character of the water, because it comes in to the tank true sewage, full of a solid deposit, and it simply passes out true sewage freed from the solid deposit?—I am aware that that is the fact. I was not aware what the arrangement was.

4548. We may take it all the way down. We have yet had no evidence that there is any true utilization of sewage by applying it in irrigation to land?—No; I should think that the valley is never wide enough to allow of such utilization, even if it is good.

4549. Would the application of pumping enable

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The Marquis of Salisbury.

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you to put it in another position than that in which it would go by gravity?—I should think it very difficult, the banks are rather steep.

4550. Looking at the constitution of the River Lee Trust, is it the opinion of yourself as chairman that the trustees would take upon themselves the necessary duties, if Parliament granted them the power, to prevent these pollutions through their servants?—Do you mean from Luton?

4551. Taking the whole valley of the Lee, supposing a conservancy board to be formed, would the trustees be willing that they should be constituted a conservancy board, having proper powers and proper authorities to prevent in a practical way these nuisances which now pollute the Lee and its tributaries?—My own opinion is that they would, but they must have means to do it beyond their navigation.

4552. You have now the means of arranging with the two great water companies to receive a rental for the water which they take from you, and to carry out works by arrangement and agreement with them, they paying the costs?—Yes.

4553. Assuming that Parliament thought fit to devise some machinery by which you should be required to give notices to these towns which now pollute the streams, calling upon them to show you through their engineers the way to prevent that pollution, and either to compel them to carry out the work under your supervision, or to enable you to carry it out, and to charge them with the cost, do you think that such a form of conservancy could be made to work?—I think that it could perfectly, and the more so because the members for Hertfordshire, and Essex and Middlesex, and the members for this town, and the mayor of this town, all form a part of the board *ex officio*.

4554. Do you think that the present constitution of the board is such as would justify Parliament in placing such powers as are indicated in their hands?—I think so.

4555. What is the gross number of the trust at present?—67, that is including the *ex officio* members.

4556. What is the mode of election?—The greater portion of the members are *ex officio*.

4557. By reason of their position and holding property?—Yes; and the remainder are elected by our own board, notice being given that such a person will be proposed.

4558. Is there any check upon the acts of the trustees. Supposing that any trader upon the river Lee feels himself aggrieved, is there any superior board of appeal to which he can go for redress?—I think not; we generally have some of the principal traders upon the board.

4559. But is there any board of appeal if any person wishes to appeal?—I am not aware that there is any.

4560. In the event of a conservancy being established do you think that it would be advisable that any board of appeal should exist, such as the Board of Trade, or the Privy Council, or the Home Office?—I apprehend that there could be no objection to it whatever, but if I were to name the board I should say the Board of Trade or the Privy Council.

4561. If Parliament were to authorize powers of conservancy similar to those now exercised by the conservancy board of the river Thames, do you think that it would be advisable that the Government should have the power to nominate one or more members upon the trust as they have to nominate such members upon the conservancy board of the Thames?—I do not think that it would be desirable, because such a member must naturally be immediately the head person of the trust, and give his constant attention to it.

4562. The Government, I think, have power to nominate one or two members upon the conservancy board to act as the other members act?—I do not think that it would answer well. I would give every facility of appeal, but I think that what you suggest would impede the action, because it would be exactly as it is in London, namely, that wherever you have a stipendiary magistrate he takes the thing into his own hands.

4563. I do not anticipate anything of that sort; you would appoint your own engineer and your own clerk, just as you appoint your servants now, and would have power to pay them?—I do not think that the suggestion would answer.

4564. (*Professor Way.*) A member of the Admiralty board has been on the board for years?—He very seldom attends the meeting.

4565. (*Chairman.*) In the case of the Thames such a member attends, the Admiralty being supposed to have a direct interest, but the Admiralty has no direct interest in your navigation?—No; I do not think that is a very desirable thing.

4566. (*Professor Way.*) I presume that the object would be that in case of any point arising in which Government interference would be requisite some member of the board should be in communication with the officers of the Government; you know that at present the new conservancy of the Thames has that element?—I was not aware of that fact; I myself do not think that it would be a desirable mode, because it would be a party matter. Where I have known it to exist it does not seem to me to work satisactforily; it ends in an absence from interference on the part of the other members.

4567. (*Chairman.*) Your lordship is aware that the Local Government Act has been adopted by many of the towns and parishes, and townships upon the banks of the Lee and its tributaries?—I believe that it has.

4568. When the Local Government Act is put in force I suppose your lordship is aware that it sets up a local authority, and that there must be a chairman and members?—Yes.

4569. As they for the most part are the sources of pollution they would be the parties with whom you would have to interfere to prevent pollution. Do you think that it would be advisable that the chairman of those local boards should sit at the conservancy board?—Certainly not.

4570. They are the persons whom you have to keep in order, and they are not to keep you in order?—Just so.

4571. (*Mr. Harrison.*) Would you exclude the mayor of Hertford?—Certainly not; he is an *ex officio* member.

4572. But, I suppose, that he is at the head of the polluting system?—He has the advantage of being approved by a magistrate. I have had put into my hand a letter which shows how little the local boards are inclined to act. This is an answer to our application to the Ware local board on account of the nuisance created by the Ware sewage: "Dear sir,—I "submitted your letter of the 27th instant to the "board at their last meeting, relative to the drains "discharging into the river Lee near the summer-"houses at Ware, and also below Ware bridge, and I "am directed to inform you that the board see no "reason for taking any measures for the diversion "of any drains belonging to them."

4573. (*Chairman.*) With regard to the conservancy which we have been speaking about, in your opinion would this Commission be justified in making a recommendation that the trustees should be consulted by Her Majesty's Government as to the future management of the Lee, going no further than that?—Certainly; I should think it very desirable.

4574. It has not been settled yet which department of the Government shall undertake the duty of bringing in a bill, but when a bill is brought in you think that they should communicate with your lordship and the trustees as to the form which the future conservancy should take?—I think that it would be very desirable, and I am sure that the trustees would give their best attention to it.

4575. May we assume that the trustees would rather not have an entirely new board placed above them, and having jurisdiction over the valley and over the river Lee navigation?—I am quite certain that it could not be done, and that there would altogether cease to be an attendance.

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4576. If any new conservancy board were set up there would have to be paid officers, and they would, in some degree, come into antagonism with you as managers of the river Lee for navigable purposes, but having interests also in keeping the river free from impurities?—Yes.

4577. (*Professor Way.*) I suppose that we may take it to a certain extent, that you would have less difficulty in so modifying, if necessary, your trust as to make a conservancy board than the conservancy of the Thames had, seeing that in that case there were two jurisdictions, one of which had to be abolished?—Certainly.

4578. You have nothing of the kind, you stand without any sort of supervising jurisdiction?—Entirely so.

4579. (*Mr. Harrison.*) Is it quite so; have not the New River Company and the East London Waterworks Company such an interest in the water of the river Lee and in its condition, as to purity, that they would like to be represented upon your board?—By our constitution the governor and deputy-governor of the New River Company are *ex officio* members of the trust.

4580. Is there any representation of the East London Waterworks Company upon your board?—I think not.

4581. Do you think that that would be desirable?—I think that it would be introducing a new element. We have never found that the New River Company have interfered to make the water more pure, and there would be an antagonistic principle introduced between the East London Waterworks Company and the New River Company. The New River Company have never interfered except as to the formation of a storing reservoir; they have never attended a board meeting except during that negotiation.

4582. (*Chairman.*) I suppose that this Commission may understand that the River Lee Trust would decidedly object to any interference with their existing powers in the way of diminishing or crippling those powers, but that they would be willing to be consulted as to any addition to their powers for the prevention of the nuisances which have grown up in the district?—I believe that that is quite correct.

4583. Has there been any system of drainage carried out in the valley with which your lordship is acquainted?—In my own parish, in my own park.

4584. Is there much undrained land on the margin of the Lee as far as you are acquainted with it?—I should think that all the marshes are very low, and in many portions the river is above the marshes.

4585. What is the character of the works which have been carried out in your own park?—They are very rough.

4586. Is the result beneficial?—It has completely stopped the arrival of the sewage into the river. Here is a rough plan (*producing the same*). I began the work in the first instance by sinking wells at different places, but I found that my wells answered the purpose for only two or three years. About 15 years ago I made this work (*pointing to the plan*). These are the holes which I made in the valley to intercept the sewage from the river. I have a statement of the expense, and I have the quantity of sewage; about one-third of that is earth. I have the quantity which we have got out for 1863, 1864, and 1865.

4587. (*Mr. Harrison.*) Is this for the interception of the sewage from your mansion?—It is for the sewage from the town of Hatfield. The first attempt was merely to turn it into a chalk pit, and get rid of it.

4588. (*Professor Way.*) That was happily unsuccessful?—I had reason to be satisfied with it, except that I had to sink a fresh chalk-pit every two or three years, and then I adopted this plan, which does the work perfectly in that way till it gets charged; but it is a work of several years. The solid part of the sewage is stopped by gratings, and by a man who is kept to throw it up and cover it over with mould. The liquid part goes into this chalk pit by having two holes acting as a syphon; the sewage goes down into the chalk with the water, and of course the water rises up on the other side, so that no effluvium can escape so long as the thing works.

4589. (*Chairman.*) Has your lordship's attention been at all directed to the question of utilizing the flood waters of the valley of the Lee, so as to make them available for metropolitan water supply?—There is no difficulty at all about it. An excellent plan was introduced, and it was brought into Parliament, and no doubt would have been carried into effect, but there was a gentleman then at the head of the river Lee board who was frightened at the expense. I will read the notice which was given of that bill in 1850 for the session of 1851.

4590. Was that a notice given by the River Lee Trust?—No, by the New River Company; we were parties who were agreeing with them.

4591. You sanctioned it?—Yes, we were ostensibly the promoters.

His lordship read the notice, as follows:

RIVER LEE TRUST.

Amendment of Acts; Extension of Powers; Enlargement of existing Works; and Construction of new Works.

Notice is hereby given, that application is intended to be made to Parliament in the ensuing session for leave to bring in a bill to enable "the trustees of the river Lee" to effect all or any of the objects hereinafter mentioned, (that is to say) to make, maintain, vary, extend, or enlarge the following works, viz., first, a reservoir on the river Lee, commencing in Hatfield Park at or near Cecil Hill in the parish of Bishop's Hatfield, and terminating by an embankment to be constructed across the valley of the Lee, near Roxford farmhouse, in the parish of Bayford, and which reservoir and embankment will be situate in the parishes, townships, or extra-parochial places of Bishop's Hatfield, Essendon, Bayford, Hertingfordbury, and Brickendon, some or one of them; second, a reservoir adjoining the river Lee, commencing and terminating at or near Ware Mill lock in the parishes, townships, or extra-parochial places of St. John's, Hertford, Ware, Little Amwell, and Great Amwell, some or one of them; third, a reservoir on the river Rib, commencing near Stondon Lordship House, otherwise Standon Lordship House, in the parish of Stondon, otherwise Standon, and terminating by an embankment to be constructed across the valley of the Rib at or near Swangles, in the parish of Thundridge, which embankment and reservoir will be situate in the parishes, townships, or extra-parochial places of Stondon, otherwise Standon, Thundridge, Ware, and Ware-side, some or one of them; fourth, a reservoir on the river Ash, commencing at or near Widford Mill in the parishes of Widford and Ware, or one of them, and terminating by an embankment across the valley of the Ash, at or near Easney Park Wood in the parishes, townships, or extra-parochial places of Widford, Ware-side, Ware, and Stanstead Abbott's, some or one of them; fifth, a tunnel, pipe-track, aqueduct, cut, or channel of communication, from the first-named reservoir near Roxford farmhouse, to the secondly above-named reservoir near the Ware Mill lock, and which said tunnel, pipe-track, aqueduct cut, or channel of communication will pass in, through, or into the parishes, townships, or extra-parochial places of Bayford, Hertingfordbury, Brickendon, Saint Andrew's, Hertford, All Saints, Hertford, St. John's Hertford, Ware, Little Amwell, and Great Amwell, some or one of them; sixth, a tunnel and conduit, cut, or channel of communication from the thirdly above-named reservoir, commencing at or near Timber Hall in the parish of Thundridge, and terminating at the fourthly above-named reservoir, near Hole farm, in the parish of Ware, and which last-mentioned tunnel, conduit, cut, or channel of communication will pass in, through, or into the parishes, townships, or extra-parochial places of Thundridge and Ware, or one of them; seventh, a tunnel, pipe-track, aqueduct, cut, or channel of communication from the fourthly above-named reservoir, at or near Easney Park Wood, to extend across the valley of the river Lee, and terminating in the bed of the New River, near the village of Amwell; and which said last-named tunnel, pipe-track, aqueduct, cut, or channel of communication will pass in, through, or into the parishes, townships, or extra-parochial places of Ware, Stanstead

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Abbott's, Great Amwell, and St. Margaret's, some or one of them; together with all other necessary cuts, sluices, pipe-tracks, channels of communication, aqueducts, embankments, tunnels, and other works for connecting the said reservoirs, tunnels, cuts, channels, and aqueducts with the river Lee and New River, both or either of them; all which said reservoirs, cuts, pipe-tracks, channels, aqueducts, embankments, tunnels, and works, will be made and maintained, and pass from, in, through, or into the several parishes, townships, or extra-parochial places of Bishop's Hatfield, Essendon, Bayford, Hertingfordbury, Brickendon, St. Andrew's, Hertford, All Saints, Hertford, St. John's, Hertford, Little Amwell, Stondon, otherwise Standon, Thundridge, Ware, Widford, Ware-side, Stanstead Abbott's, St. Margaret's, Little Amwell, and Great Amwell, some or one of them. Also to make and maintain all proper and necessary balance engines, gauges, tumbling bays, and other devices and works, on and near the New River and river Lee, at and below Fielde's weir, for correctly ascertaining the flow of water, and to remove all existing balance engines, gauges, tumbling bays, and other devices and works.

And it is also intended by the said bill to take powers to alter and improve certain parts of the course of the New River, and for that purpose to make and maintain the several works herein-after mentioned in the lines and according to the levels defined upon the plans and sections herein-after referred to, that is to say:—the first of such works, consisting of cuts or channels of communication, pipe-tracks, and widenings of the said New River, and commencing at a point about 214 yards above the bridge over the New River (numbered 4) in the parish of St. John, Hertford, and terminating at the bridge over the New River in Theobald's Lane in the parish of Cheshunt. The second of such works, consisting of cuts or channels of communication, pipe-tracks, tunnel, and widenings of the said New River, and commencing at a point about 290 yards above the foot-bridge over the New River in Theobald's Park (numbered 51*a*) in the parish of Cheshunt, and terminating at the north-east end of the reservoirs of the governor and company of the New River brought from Shadwell and Amwell to London in the parish of Stoke Newington, otherwise Newnton; with a branch pipe-track, conduit, or channel of communication, commencing at a point above 213 yards above the bridge over the said New River (numbered 82) and terminating at a point about 100 yards below the bridge over the said New River (numbered 105) in the parish of Edmonton; and also with a branch pipe-track, cut, conduit, or channel of communication commencing at a point about 30 yards above the bridge in the Seven Sister's Road over the New River, and terminating at the eastern end of the Stoke Newington reservoir of the said governor and company in the parish of Stoke Newington, otherwise Newnton. The third of such works, consisting of cuts or channels of communication, pipe-tracks, and widenings of the river, and commencing at the south-west end of the reservoirs of the said governor and company in the parish of Stoke Newington, otherwise Newnton, and terminating at the aqueduct of the said river over the East and West India Docks and Birmingham Junction Railway in the parish of Saint Mary, Islington. Fourth, a reservoir on the New River commencing at or near Clay Hill farmhouse in the parish of Tottenham, and terminating near to the bridge over the said New River in White Hart Lane in the said parish of Tottenham. Fifth, a reservoir on the New River commencing at the bridge in the Green Lane on the New River, near to the Stoke Newington reservoirs of the said governor and company and terminating at or near to the Eel Pie House Tavern, Highbury Vale, in the parish of Hornsey. All which works will be made in or pass through, from, or into, the parishes, townships, or extra-parochial places following, or some of them (that is to say), St. John's, Hertford, Little Amwell, Great Amwell, St. Margaret's, Hoddesdon, Broxbourne, Wormley, Cheshunt, Enfield, Edmonton, Tottenham, Hornsey, Stoke Newington, otherwise Newnton, and St. Mary's, Islington; and also to make and maintain all necessary tunnels, pipe-tracks, sluices, embankments, aqueducts, cuts, or channels of communication for the convenient use and maintenance of such several works, and to remove all such existing works as may interfere therewith; and also for the purpose of improving the drainage, to alter and shorten the course of a certain common sewer on Chase-side in the parish of Enfield, in the manner and direction shown upon the plans herein-after referred to, such alteration being intended to commence at a point in the highway from Chase-side to Enfield Church, near the bridge over the New River (marked No. 69), and to terminate by a junction with the common sewer in Enfield Street where such sewer crosses the highway aforesaid. The whole of such alteration being in the said parish of Enfield.

And it is also intended to apply for powers more effectually to prevent the contamination of the river Lee and New River, or either of them, or any stream, reservoir, aqueduct, or other works connected therewith respectively.

Also to form a roadway, with all necessary bridges, approaches, and works from the bridge across the navigable cut of the river Lee, near the Hertford gas-works, to the public road leading from Bengeo to Ware Park, and which roadway will pass through or into the parishes, townships, or extra-parochial places of St. John's, Hertford, and Bengeo, or one of them.

Also to vary, divert, or stop up and relinquish the Ordnance corn millstream, otherwise Waltham Abbey millstream, and the tail and waste channels leading therefrom, by constructing an embankment across the said corn millstream, at or near the point where it diverges from the old river Lee at Edmondsey Meads in the parish of Waltham Holy Cross. Also to vary, divert, or stop up, and relinquish that branch from the river Lee forming Stewartstone Mill Head and the tail waters and waste channels leading therefrom (which last-mentioned branch diverges from the main channel of the river Lee at or near the sluice at Enfield Lock in the parish of Enfield) and that branch from the river Lee and tail waters and waste channels leading therefrom forming Chingford Mill head and tail (part of which said branch diverges from the river Lee at or near Ponder's End Lock), and also forming that branch of the river Lee called Walthamstow Copper Mill head and tail, and the waste channels leading therefrom, all which streams now terminate in the river Lee at the Copper Mill stream near High Bridge in the parish of Walthamstow, and run from, in, through, or into the parishes, townships, or extra-parochial places of Cheshunt, Waltham, Waltham Holy Cross, Sewardstone, Enfield, Edmonton, Chingford, Walthamstow, and Tottenham, or some or one of them; and also to form a tumbling-bay and cut from the river Lee immediately above the Stone Bridge lock to a point in the same river immediately below such lock, and to make and maintain all such embankments, sluices, and other works as may be necessary for varying, diverting, or stopping up the said streams, channels, and tumbling-bay; and also to construct all such new works as may be necessary for the convenient use and maintenance of such new reservoirs, cuts, aqueducts, and tunnels, and such diverted or improved streams, channels, tumbling bays, and other works, and to remove all such existing works as may interfere therewith; and also to abandon and discontinue using, as the channels of such streams and branches, any portions of the existing courses or lines of the river Lee which may be rendered unnecessary by reason of the execution of the proposed new reservoirs, cuts, channels, or works, and generally to take powers to construct all such new works and remove all such existing works or other obstructions as may be necessary for effecting the objects of the proposed bill. And it is also intended by the said bill to take powers to divert into or cause to flow or proceed through or into the proposed works the waters which flow in or supply the streams, cuts, canals, reservoirs, aqueducts, or navigations herein-after mentioned, that is to say, the river Lee and the several streams, cuts, canals, reservoirs, aqueducts, and navigations connected therewith, videlicet:—The Hertford cut, Parker's cut, Hadsley's cut, Stanstead cut, the cut next below Stanstead bridge, Fielde's Weir cut, Dobb's Weir cut, Hoddesdon or Lins mill-tail, Broxbourne mill-head and tail, Cartha,ena cut, Waitham cut, Cheshunt mill stream, Powder mill stream, Waltham Abbey mill stream, Waltham Common Cut, Enfield Cut, Enfield Mill Stream, Edmonton Cut, Chingford mill stream, Tottenham Mill Stream, and Tottenham New Cut, Walthamstow Mill Stream, the Hackney Cut, Temple Mill Stream, Abbey Mill Stream, West Ham Waterworks Stream, City Mill Stream, Stratford Mill Streams, Pudding Mill Stream, otherwise Hunter's Mill Stream, the Three Mills Stream, the Bow Creek and the Limehouse Cut, the river Mimram, and the several streams, cuts, canals, reservoirs, and aqueducts connected therewith; the river Beane and the several streams, cuts, canals, reservoirs, and aqueducts connected therewith; the river Rib and the several streams, cuts, canals

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reservoirs and aqueducts connected therewith; the New River and the several streams, cuts, canals, reservoirs, and aqueducts connected therewith; the river Ash and the several streams, cuts, canals, reservoirs, and aqueducts connected therewith; the East London Waterworks Company's cuts, canals, reservoirs and aqueducts; Sir George Duckett's Canal, otherwise the Lee Union Canal, and the streams, cuts, canals, reservoirs, aqueducts and navigations connected therewith; the Regent's Canal and the several streams, cuts, canals, reservoirs, aqueducts, and navigations connected therewith and the river Thames.

And it is also intended by the said bill to take powers to make and maintain a sewer or drain, or sewers or drains, and culverts, sluices, and other works connected therewith, for intercepting and diverting the sewage of all sewers and drains from emptying into the rivers Lee, Beane, Mimram, Rib, Ash, and Stort, or any of them, which sewer or drain, or sewers or drains, will commence on the north side of Cowbridge in the parish of St. Andrew, Hertford, and will be made and maintained, or will pass from, in, through, or into the parishes, townships, or extra-parochial places following or some of them (that is to say), St. Andrew's, Hertford, All Saints, Hertford, St. John's, Hertford, Little Amwell, Ware, and Great Amwell, some or one of them, and will terminate at or near Amwell Marsh bridge in the parish of Great Amwell. And also to take power to prohibit and prevent any drain or sewer from flowing into the river Beane below Sele Mill in the parish of St. Andrew, Hertford, or into the river Lee between the Horns Mill in the liberty of Brickendon, andAmwell Marsh lock, or into any part of the New River; all which parishes, townships, or extra-parochial places herein-before mentioned are situate within the counties of Hertford, Essex, or Middlesex, some or one of them.

And it is also intended by the saidbillto take powers to make lateral deviations from the lines of the said intended works to the extent and within the limits defined on the plans to be deposited as herein-after mentioned, and to purchase, lease, and otherwise acquire, compulsorily or by agreement, lands, houses, mills, and other hereditaments, corporeal or incorporeal, and to stop up, alter, or divert roads, railways, rivers. canals, cuts, aqueducts, tunnels, drains, sewers, reservoirs, and streams for the purposes of the said bill, and to extinguish any existing rights and privileges, which may interfere therewith; to provide compensation to the owners and tenants of mills in such manner as may be deemed expedient, and also to take power to raise money for carrying out the objects and provisions of the said bill; to levy tolls, rates, duties, and water rents for or in respect of the several purposes of the said bill; to alter existing tolls, rates, duties, and water rents, and to confer, vary, or extinguish, exemptions from tolls, rates, duties, and water rents; and also to authorize the trustees to appoint committees of their number with such powers as may be deemed expedient, and to confer, vary, or extinguish all such powers, rights, and privileges, as may be necessary for carrying into execution the purposes and provisions of the existing Acts herein-after mentioned and of the said bill.

And notice is also hereby given that duplicate plans and sections, describing the lines or situations and levels of the several intended works before mentioned, and the lands in or through which the same are to be made, maintained, varied, extended, or enlarged, together with a book of reference to such plans, containing the names of the owners or reputed owners, lessees or reputed lessees and occupiers, of all lands and houses in the line of the proposed works or within the limits of deviation as defined upon the said plans, and describing such lands and houses respectively, with a copy of this notice, as published in the "London Gazette," will, on or before the 30th day of November 1850, be deposited at each of the following places, that is to say, with the clerk of the peace for the county of Hertford at his office at St. Albans; with the clerk of the peace for the county of Essex at his office at Chelmsford; and with the clerk of the peace for the county of Middlesex at his office in Clerkenwell Sessions House; and a copy of so much of the plans, sections, and book of reference as relates to each of the several parishes before mentioned, with a copy of this notice, will, on or before the said 30th day of November, be deposited with the parish clerk of each such parish at his place of abode, or, in the case of any extra-parochial place, with the parish clerk of some parish immediately adjoining thereto at his place of abode.

And notice is further given, that it is intended by the said bill to alter or amend, or in whole or in part to repeal, the following Acts, and any Acts therein-mentioned or referred to (that is to say), 13th Elizabeth, chapter 18; 3rd James I., chapter 18; 4th James I., chapter 12; 11th George II., chapter 14; 12th George II., chapter 32; 7th George III., chapter 51; 19th George III., chapter 58; and the Local and Personal Acts, 45th George III., chapter 69; 47th George III., chapter 72; 48th George III., chapter 8; 3rd George IV., chapter 109; 10th George IV., chapter 117; and 13th and 14th Victoria, chapter 109.

Dated this 11th day of November 1850.

JOHN MARCHANT,
Clerk to the Trustees, Ware.

In short, any attempt to divert the sewage without some reservoirs would be almost impossible, because with every diversion of the sewage you would lose a great quantity of water, which must be supplied in some way or other.

4591*a*. Then I may assume that you think that it would be necessary that any legislative powers should arm the trustees with authority to look at all points, and should enable them to devise and carry out the prevention, or assist in preventing the pollution of the river, and in providing for the increased volume of pure water which may be passed on to the metropolis?—I think so; but that I think would be a matter for a special Act of Parliament.

4592. I assume that you have heard that it has been proposed to bring in increased supplies of water to the metropolis, from North Wales by one scheme, and from Cumberland and Westmoreland by another scheme?—I have.

4593. If the river Lee itself and the waters falling into the valley of the Lea were properly dealt with, do you think that such a scheme might be more economical than going to such a distance for water for the metropolis?—530,000*l.* was the estimate given in the case of the bill of which I have read the notice, dated in 1850.

4594. (*Professor Way.*) That was for increasing the available supply of water, and for improving its quality?—Yes.

4595. (*Chairman, to Mr. Beardmore.*) I assume that an estimate was made of the probable income which would be yielded from the works so as to cover the expenditure?—(*Mr. Beardmore.*) I do not know whether that was gone into, because the companies dropped the scheme at an early date. We did not go into evidence before Parliament upon it. With the prospect of a very largely increased supply of water we no doubt reckoned on a large increase of revenue from the water.

4596. (*Mr. Harrison.*) Were the embankments which you proposed to make so as to form these reservoirs to be constructed in any case upon the chalk formation?—(*Marquis of Salisbury.*) I think that in most of these streams the embankments are already made by the millowners, and that they would only require a little raising.

4597. (*Professor Way.*) This proposal was made in 1850?—Yes.

4598. Has anything which you know of occurred in the interval which would cause a serious alteration in this plan, supposing the powers existed to put it into operation?—I should think not.

4599. You think that the plan would be now available?—Yes; of course the expense of the land would be increased.

(*Mr. Beardmore.*) The plan would have to be modified.

4600. That scheme was dropped from the want of means and power to carry it through?—(*Marquis of Salisbury.*) It was dropped, I think, from the want of means; there was no opposition to it.

4601. Supposing that your board of trustees were constituted a conservancy board, would the resuscitation of that plan in any form be possible and desirable?—I think that with certain modifications it would be very desirable. Of course I cannot speak to the details of a plan before Parliament.

4602. (*Chairman.*) I suppose that we may assume that the trust would watch very narrowly any scheme

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of that magnitude and character brought in by what one may term outside persons?—Certainly.

4603. If such a scheme were brought in by any speculators wishing to utilize, as they would term it, the waste waters of the Lee for commercial purposes you would look very earnestly at it before you permitted them to obtain parliamentary powers, if you could prevent their doing so?—I should decidedly think so.

4604. (*Mr. Harrison.*) There was one point which I think your lordship raised just now, and did not give a full explanation of; it was as to the funds which the trustees of the Lee would require in case they were formed into a conservancy board such as you recommend. You said that the funds would be a difficulty. Where do you think that the requisite funds could be obtained from?—I think that the requisite funds might be readily obtained by imposing full costs and penalties wherever a nuisance was supposed to exist.

4605. Do you expect that they would be sufficient to pay for the supervison of the valley of the Lee?—As a board of conservancy has been proposed, it would only require the supervision of the channel of the Lee which we at present perform, but I apprehend that we could not embark in litigation with boards. If we required expensive alterations we should be opposed by local authorities unless we did it at our own cost.

4606. You would require a summary means of punishing those who committed a nuisance, so as not to entail much expense?—Yes; the cost of the litigation with the metropolitan board was upwards of 1,000*l.*; our funds will not allow us to carry on proceedings of that kind.

4607. (*Chairman.*) As a board having public duties, and having no pocket interest in exercising those public duties, supposing that you were placed in a position where it was necessary to raise additional funds to carry out works of great public utility, do you think that you would be in a condition to ask the Government of the day to allow the Chancellor of the Exchequer to issue exchequer bonds at a low rate of interest, you giving the security of the navigation so as to get the money at a less rate of interest than you could get it at in the commercial market?—I rather think that there is always a condition of repayment in the advance of exchequer bonds, and generally I believe it is in 30 years; there would then be the necessity of a sinking fund, which would add very materially to our expense.

4608. If you want anything like half a million the Exchequer Loan Commissioners, without any injury to any person in the State, can lend that money in the present condition of the money market at 3½ per cent.?—Just so.

4609. If you repaid that money in 30 years the annual payment would be about 5*l.* 5*s.* per cent.?—Just so.

4610. I believe that for certain public purposes, and also for private purposes, the Exchequer Loan Commissioners have been authorized by Parliament from time to time to make loans, for instance, for land draining?—Yes.

4611. For carrying on public works in Ireland?—Yes.

4612. And recently for carrying on certain public works in Lancashire, for the relief of the distressed cotton labourers?—I am aware of that.

4613. That money being repayable by annual instalments with interest?—Yes.

4614. It has been considered a very great advantage in many of these places (in Lancashire, for instance, where works have been carried out) for the local authorities to get that money at 3½ per cent., and yet Government will not necessarily lose one farthing in the transaction?—Just so; but I am not quite sure that it would not entail a loss upon the parties who would be supposed to profit by it, because the whole of the country said to be benefited by it would not have anything to do with the supposed relief.

4615. Looking at it in that view you think it better to go on as you have done and to raise any money required in the open market upon such terms as you can raise it?—I think so, and I think that it would rather tend to more economy in the management.

4616. If you have power to borrow and to reborrow it always gives you the power of rectifying your loan by the existing state of the money market?—Exactly so.

4617. If you pay off a debt which you owe to a party, which debt is at 4½ per cent., and you can borrow money at 3½ per cent, you can as a trust relieve yourselves to that extent?—Yes, and we should feel bound to do so; it would be a financial operation, whether it was wise or not wise.

4618. You do not borrow in perpetuity, but you borrow for a limited term?—Yes.

4619. Having the power of repaying the money, or of borrowing to pay off the bonds which you have accepted up to that time?—Yes.

4620. You, I suppose, accept bonds for three, five, seven, and 21 years?—We have never gone beyond seven years.

4621. But those bonds are, I presume, renewable if agreeable to yourselves and to the parties?—If they are allowed to run on beyond the period we put a condition that the debentures shall be realisable at six months' notice.

4622. Are those debentures easily transferable?—Very much so.

4623. Are they taken by trustees?—(*Mr. Marchant.*) They are made available for trustees.

4624. And they can recover their money at short notice?—(*Marquis of Salisbury.*) Yes, in three, five or seven years, and afterwards at six months notice just like the case of any other mortgage.

4625. That makes it an available means of investing money, and one which many persons are very glad to have an opportunity of availing themselves of?—Just so.

4626. And you consider that you have a secure basis for paying the interest?—I can only say that I think so, for I am a very considerable debenture holder, but of course it is a matter of opinion. We have been in great difficulties during the last year and a half; we have had very heavy works to carry on and have had very great difficulty as regards the money, but our bankers have not hesitated to advance us money.

4627. (*Professor Way.*) We have been informed that you have a surplus of profits at this moment?—Yes.

4628. Supposing that you borrowed money from the Government funds at a less interest and paid off the old debt, would not that surplus be available for the gradual liquidation of the debt?—I think not for many years, because we have still considerable improvements to make.

4629. But you would have the means of borrowing a much larger sum at a lower interest?—We might have, but I am not quite sure that we should judge wisely in going too largely into things at once. We should get into a great system of contracts. I certainly should not recommend it; I would rather go on quietly. We are now in very good condition except with reference to two or three locks, and the sills of those locks must be lowered to enable us to make the navigation throughout navigable for boats of 120 tons, which is supposed to be our limit. It was only available for 40 tons. We carried a little more than we were authorized to do, and we now carry commonly 80 or 90 tons.

4630. You are not in the same position as the Commissioners of the Thames, who, besides a large debt, required a large outlay of money to put the river into a proper state?—No. I daresay that we shall spend all the money which we have power to raise in necessary improvements.

4631. (*Mr. Harrison.*) Is there a large area of land in the valley of the Lee liable to be flooded?—I think that a large area of land in the valley of the Lee from Luton to Hertford may be flooded; Hertford is below Luton. From Rye House downwards there is a large tract of land which might be flooded; the valley widens out.

4632. The trustees have made certain cuts, so that in portions of the valley the navigation is in the channel of the river Lee, and in other parts there are new cuts?—Yes.

4633. Have the trustees any control over the river proper, along which the navigation does not pass?—I claim it under grant from the Crown in the old river.

4634. Then the trustees at present have no power over it?—They have abandoned the navigation. It has never come into question except as a fishing right. I pay a fee farm rent to the Crown.

4635. Do you think that it is desirable that the powers of the river Lee trustees should extend to those portions of the river as well as to the navigable parts of it?—No, I do not see that any object would be gained by it; it is not a matter of very great importance.

4636. Do you not think that if the whole river were placed under their jurisdiction they might be a useful body to carry out works to prevent the flooding of the adjoining lands?—I hardly see how it would be possible, because by the alteration of their locks the river in many places is considerably above the level of the land.

(*Mr. Marchant.*) Each reach might be drained into the reach below. There is a fall of 100 feet between this town and London.

(*Marquis of Salisbury.*) That must be by the purchase of land.

4637. Do you think that the land which is liable to be flooded below Waltham Abbey would be increased in value if steps were taken to prevent that flooding?—If it were my own land I should prefer its remaining as it is. I should prefer pasture land. A great deal of it is Lammas land.

4638. Is not a great portion of it in a wretched state, in an agricultural point of view?—No, I think that they are all very valuable meadows.

4639. Might not they be made more valuable if they were properly drained?—That is a question which I must not venture to answer. I am the proprietor of some land in the parish of South Mimms where the Mimms' wash runs through; it is a celebrated place where water runs over two or three times in the course of a week and disappears into chalk-pits, and it makes the most valuable land on the farm.

4640. In the valley of the Stort, and in the valley of the Lee itself, in passing up and down the railway, I see large areas of land covered with rushes?—That may be. I do not deny it at all.

4641. Surely that land could be improved. Is it generally considered that the flooding is an improvement to the land?—We consider so, provided that the flood does not last too long.

4642. (*Professor Way.*) Your lordship would like the benefit of the water, but you would like to have it under control?—Quite so.

4643. It is a compulsory flooding at present?—Yes, but it seldom remains on for a month in the course of a year. I should imagine that 3*l.* an acre is a very common sum, and that is the best test of the value of land.

4644. I suppose that a proper treatment of the district would enable you to keep the floods out, and to use them where you wished to do so?—I do not at all mean to say that the land is not capable of great improvement, but there are a great many proprietors.

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4645. (*Mr. Harrison.*) If it is capable of improvement, do you not think that any improvements which were made should be made as a whole throughout the entire length of the valley?—I should think it very desirable, but then you must obtain the consent of a vast number of owners, because the greater part of the meadows are let in small portions; some are what are called cow leases, and things of that kind. There is no reason why it should not be done, but it is a great undertaking.

4646. It is undoubtedly a great undertaking, but does not your lordship think that if a trust were appointed for the whole of the river Lee it should embrace the carrying out of the works for such an improvement?—I have not the least objection to it, but I think that Parliament would hardly trust any body of men with the power compulsorily to buy up all the cow leases.

4647. I did not intend that, the point I contemplated was to carry out drainage works for the improvement of those lands, so as to prevent the flooding and to drain the whole valley of the Lee?—I am not prepared to say that it would not be very advantageous so to do, but a general drainage is one of those things which we have tried for a good many years, and we have not succeeded yet.

4648. (*Chairman.*) Of course your lordship is aware that this Commission must report to Parliament, and that we must make recommendations?—Yes.

4649. As Chairman of the Commission I only wish to say that I assume that we shall not be considered as travelling out of our way, if we take upon ourselves to recommend that the river Lee trustees be consulted as to any form of legislation for the future management of the water of the river and its navigation, and the water supply to the metropolis, and the prevention of pollution?—Certainly. It cannot be doubted that we as trustees should be very glad that it should be so.

4650. I asked the question because you might have told me that as trustees you would not trouble yourselves with the pollutions beyond indicting the parties who committed them, and would not take upon yourselves the extra amount of duty, seeing that you were an unpaid Commission, and then we should have had to have looked about and to have made some other form of recommendation?—It is the interest of the whole of this part of the country that every possible improvement should be effected, and we as the representatives of the counties and the residents are the persons who would be most interested in carrying out such improvement.

4651. (*Professor Way.*) But your duties would then be much extended; they would not be for the river but for the whole valley?—Those are matters of detail. I do not think that there would be any difficulty in it.

4652. (*Chairman.*) I suppose that before your lordship expressed any further opinion upon this question, you would say, "Let me see what your report and what your recommendations are?"—Exactly so; but I do not think that there would be any difficulty whatever in obtaining the assistance of all my co-trustees.

4653. Is there anything further which your lordship has to offer to the Commission?—I do not know that there is anything.

His lordship withdrew.

Mr. Alfred H. Jarrett (Hertford) examined.

Mr. A. H. Jarrett.

4654. (*Chairman.*) You are inspector of nuisances for the borough of Hertford?—Yes.

4655. How long have you been inspector?—Since the end of 1862.

4656. What are the principal nuisances which are found within the borough?—Nuisances such as are generally found in towns; nothing particular; foul closets and offensive fæcal matter.

4657. How many waterclosets are there in this borough?—I do not know.

4658. How many common privies are there?—I cannot give you that information.

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4659. Are there more common privies than closets?—I think not.

4660. Have you had complaints made to you as to the foul smells from the sewers?—Several during the last three years.

4661. Have you, yourself, observed any foul smells from those sewers?—I have.

4662. Have you had any complaint of foul smells from the outlet works?—None.

4663. Do you occasionally inspect the outlet works?—No.

4664. Have you ever found the water of the river Lee in a foul state at any period of the year?—I have not, only what is occasioned by the atmosphere and rains.

4665. By being muddy?—By being muddy.

4666. Have you anything to do with the water supply?—Yes, I am superintendent of the water.

4667. What volume of water per day is supplied to the borough?—About 150,000 to 160,000 gallons from the new works.

4668. And what from the other works?—We pump up about 51,840 gallons per day from the old works; that makes a total of 2,201,840 gallons.

4669. What is your population here?—6,769

4670. How many persons take water—We have at present about 500 tenants to the works.

4671. How many individuals will that represent, about 2,500?—I make it about 4,955; there are between 500 and 600 persons who steal the water, who do not pay anything for the water but take it from the public taps.

4672. (*Mr. Harrison.*) Are the taps open to any one to take the water from?—No; they are put in public places, and they are paid for by the owners of property adjacent to them, and no one else has a right to take the water.

4673. (*Chairman.*) If you have 4,900 people supplied by your works, have you any idea how much each individual takes per day?—I should say that each individual consumes from 13 to 15 gallons per day.

4674. If you take 4,900 as the number of persons supplied, and 201,840 gallons as the volume supplied, you are giving more than 40 gallons to each person?

(*The Mayor.*) But there is the watering of the roads.

4675. (*Chairman.*) That is a very small quantity.

(*Mr. Jarrett.*) That is the quantity which is pumped, there are 51,840 gallons which are pumped from the old works, and if the consumption is not equal to the supply, a great portion of it returns down the waste pipe.

4676. Then you go on pumping it to let it run away again, you do not mean to say that?—I do, with reference to the old works, but not with reference to the new. We have no control because the old works are by water power, and there are no great means for storing the quantity of water which we pump.

4677. Therefore you let the waterwheel play with the water, pumping it up and letting it go away again?—We have no storage.

4678. Do you know how many waterclosets you supply?—I do not.

4679. Do you know how many houses are drained in the town altogether?—No, I do not know at present, but I can furnish you with the information at a future period.

4680. (*Professor Way.*) You said that 500 houses were supplied with water, and you put down the inhabitants of those houses at 4,000 odd?—Yes.

4681. That would be an average of more than eight people to a house?—Yes.

4682. Do you think that as many as eight persons live in a house here?—Yes, taking in Christ's hospital; I should take the whole of that establishment to be 600; we supply them with water.

4683. What other large establishment have you?—None.

4684. Taking the 600 off, there are seven to a house?—I should think that it would average that.

4685. Then the people live very closely packed together here?—I should say so usually.

4686. (*Mr. Harrison.*) Do you supply any schools with water?—Only Christ's hospital and the grammar school.

4687. How many lads are there at each of those establishments?—They vary according to the period of the year.

4688. Take the average?—I could not give it to you.

4689. (*Professor Way.*) You said 600 just now for Christ's hospital?—I take the number to be that. I should say that the whole of the establishment of Christ's hospital is close upon 600 people.

4690. (*Mr. Harrison.*) Besides Christ's hospital, do you supply any other large establishment?—Yes, the grammar school.

4691. How many lads are there in that establishment?—I cannot answer that question; I should say between 40 and 50.

4692. Are there any other establishments of the same sort which you supply with water?—No.

4693. Do you supply the union?—No, the union is out of the borough.

4694. What is the character of the sewerage works which you have carried out?—Principally in drainage, for draining the houses.

4695. Connecting houses with the main sewers formed by the New River Company?—Yes.

4696. You have not made any new sewers?—We have not done so ourselves.

4697. (*Chairman.*) Have you any further evidence to give?—No.

The witness withdrew.

Mr. WILLIAM WILDS (Hertford) examined.

Mr. W. Wilds.

4698. (*Chairman.*) You are surveyor to the corporation of Hertford?—I am.

4699. How long have you been their surveyor?—About 12 years.

4700. You are also surveyor to the paving and lighting commission?—I am.

4701. Is that distinct from the corporation?—Yes. A part of the members of the corporation are *ex officio* commissioners on the other board.

4702. What do your duties consist of?—I merely take my orders from the mayor, and am chiefly employed upon the buildings belonging to the corporation.

4703. What buildings belong to the corporation?—The Corn Exchange and some other trifling property, and the old waterworks and the new waterworks.

4704. Have you anything to do with the cleansing of the ashpits and middens?—No.

4705. Do you know what number of waterclosets there are in this borough?—No.

4706. Do you know what length of sewerage and drainage has been laid down?—No. The main sewer was laid by the New River Company under their Act, and they were empowered to intercept all old drains, and to cut them off from any connexion with the river.

4707. Do you, as surveyor, devise and execute any house drains?—I am sometimes employed in my private capacity, but not by the corporation.

4708. When any persons want to drain what do they do?—They give notice to the New River Company's agent; they are bound by the Act to give 24 hours notice.

4709. Then are they allowed to break down and to connect with the sewer?—Yes.

4710. Is there any person to see that they make a proper connexion?—Yes, the superintendent at the deodorizing works attends to that matter on the part of the New River Company.

4711. Do you look after the highways and streets?—For the commissioners of paving I survey the foot pavements, but I have nothing to do with the roads.

4712. Who manages the roads?—The stone wardens.

4713. What salary have you?—25*l.* a year from the paving commissioners, and I have no standing salary from the corporation.

4714. How do the corporation pay you?—They pay me the usual fee as an architect and surveyor.

4715. You are an architect in private practice, but you act as their surveyor when they choose to employ you?—Exactly so.

4716. Do you know the outlet works?—I have never been down to them since they were established. I have certainly been on to the ground at the beds, but I never examined the outlet.

4717. (*Mr. Harrison.*) Have any sewers been constructed in Hertford under your directions?—Yes, but very few, and to a very small extent.

4718. Discharging into the main sewers constructed by the New River Company?—Yes.

4719. Have you ventilated those sewers?—Not at all.

4720. Do you know of any others which have been constructed by the parish authorities beyond your district?—Yes, I have known others constructed, but I never knew any instance where private or lateral drains have been ventilated in any way; they have generally been trapped so as to prevent any escape of the effluvia.

4721. So that the only outlet of the gases from the branch sewers, as well as from the main sewers, is through the gully holes of the main sewers?—Exactly so.

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4722. (*Professor Way.*) Are we to understand that the New River Company have not only made a main sewer, but that they regulate the connexion of the district sewers of the town with their main sewer?—The only way in which they interfere is that they require 24 hours notice, and the superintendent generally attends about the time mentioned for connecting the private drain with the main sewer.

4723. After connection, do the drains of the town come under the jurisdiction of the corporation?—No; the street drains are under the management of the stone wardens or parish surveyors.

4724. They are not under the corporation?—No.

4725. After the drains are made and connected, do the New River Company exercise any jurisdiction?—Only with the main sewers, and not with the side drains.

4726. But they require notice of the making of the side drains?—Yes.

4727. And after that their power ceases?—Yes.

4728. (*Chairman.*) Have you anything further to add?—I do not know that I have, except that with regard to the main sewers several complaints were made, and about two years ago I was ordered to devise means of flushing them, which I did, and I reported to the corporation, but it was thought too expensive, and was not carried out.

4729. And therefore they endure the nuisance instead of flushing those sewers?

(*The Mayor.*) There has been flushing with an immense quantity of water.

(*Mr. Wilds.*) They have been flushed from the hydrants, but my proposal was to throw in a large body of water at the end of the main sewers.

The witness withdrew.

Mr. JOHN GLASS (Enfield Lock) examined.

Mr. J. Glass.

4730. (*Chairman.*) What are you?—I am traffic manager for the River Lee Trustees.

4731. How long have you been their traffic manager?—For the last 14 years. I have been connected with the river Lee trust for 27 years.

4732. Is the traffic upon the river a growing one?—It is very much so.

4733. Has it been a growing traffic in spite of railway competition?—It has.

4734. Have the railways at all tended to diminish the traffic on the Lee?—To some extent they have upon some articles, but it has increased upon others.

4735. In what has the traffic diminished?—Principally in coal.

4736. And in what has it increased?—In building materials, and grain and malt; grain of every description.

4737. Is that because you give better accommodation than the railway can give to take the articles nearer to the place where they are wanted, and so nearer to the place where they are to be removed from?—Yes; and because we can do it cheaper in very large quantities.

4738. Have you any written statement which you can put in of the progressive increase of the traffic, and the income from that traffic?—I will put in a statement for the last eight years, showing the amount of tons charged and the amount of tolls collected.

4739. This is a statement of traffic on the river Lee during the last eight years. In 1858 you carried 254,269 tons, including 22,171 tons of manure, and received 8,104*l.*?—Yes.

4740. And the last year, 1865, you carried 373,357 tons, including 23,896 tons of manure, and you received 10,431*l.*?—Yes.

4741. In 1862, which was a maximum year, I find that you carried 474,630 tons, including 119,111 tons of manure, and that you received 10,526*l.*?—Yes.

4742. It would appear that the excess of tonnage there had been in something which did not pay very much, for there is not a difference of 100*l.* between the amount received in that year and the amount received in 1865?—Just so.

(*The Mayor.*) That was manure.

4743. (*To Mr. Glass.*) And the carriage of manure was stopped after the cattle plague set in?—Yes. In the year 1862 large buildings and works were going on in the neighbourhood of Homerton at the East London Waterworks, and that caused a great increase at that point, but this year the amount of tolls received will be considerably more than in 1862.

4744. From what will that arise?—The general increase of traffic; there is no one particular thing; there are building materials of every description and also materials for brick making.

4745. Do you, in the course of your occupation, go much up and down the navigation?—Constantly.

4746. In what state should you say that it is now as regards the banks, and the locks, and the waterway?—Very good.

4747. Have you anything to do with the dredging?—Yes, a great deal; we realize a considerable profit by the dredging.

4748. Have you charge of the dredging operations?—Yes.

4749. Have you had occasion to complain of any pollutions poured into the navigation at any particular points?—That perhaps would be a matter more for the engineer; so long as the water is sufficient to carry the barges up and down I do not interfere much about the quality of it, unless there is any obstruction in the navigation.

4750. You think that dirty water will carry coals as well as clear?—Exactly.

4751. Has the water been at all offensive to you at any time?—Not above Tottenham.

4752. But below Tottenham?—Below Tottenham, very much so.

4753. That is below where the East London Waterworks Company takes its water supply?—Yes.

4754. (*Mr. Harrison.*) As to the traffic upon the

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canal, is that traffic which you have given in distributed throughout the whole length of the canal?—Throughout the whole length of the navigation from London to Hertford, beginning at Limehouse cut, Bromley, Old Ford, part of Homerton, Lee Bridge, Clapton, Tottenham, Edmonton, Ponder's End, Enfield lock, Waltham, Cheshunt, Broxbourne, Hoddesdon, the river Stort navigation, Stanstead, Ware, and Hertford, and at all those places there is an abstract showing the different articles carried, ashes, breeze, chalk, sand for brick making, coals and coke, building materials, cement, stone, iron, and timber, gravel, linseed cake and oil, and linseed for making the cake, barley, and oats. Immense quantities of barley are taken up to be converted into malt. Wheat is taken up to the mills and ground, and sent back again as flour. Flour is carried both up and down; flour is brought from the mills, and foreign flour is carried up in casks. Beans, peas, tares, and every description of grain are carried. Immense quantities of malt are carried, last year there were 26,653 tons of malt carried from Ware only; that multiplied by eight would give you the number of quarters.

4755. (*Professor Way.*) Is that at 1*s.* 3*d.* a ton?—At 1*s.* a ton.

4756. (*Mr. Harrison.*) Besides the traffic to those places which you have mentioned, do you afford accommodation for mills and wharves in between?—Yes. The mills at Hertford keep barges (I am speaking of the flour mills), and they convey the wheat up and grind it, and send the flour again to London in a barge.

4757. Do you know of any railway of the same length with accommodation to such an extent as is afforded throughout the length of the river Lee?—There is nothing like it I should think on any railway in England.

4758. (*Chairman.*) What is the difference between breeze and ashes?—The ashes are the sifted material and the breeze is the coarse material.

4759. Then the breeze is just as you get it from the ashpits in London?—It is the coarse parts sifted from the ashes; the breeze is used for burning the bricks, and the ashes are used for mixing with them, when they make them; the fine part of the ashes is mixed with clay in making the bricks, and the breeze is put into the stack to burn them.

4760. When the dustmen cart the mass from the London dustbins, what would you call it?—The dust.

4761. When you have sifted it the one portion is called breeze and the other is called ashes?—Yes.

4762. The fine portion is called ashes?—Yes.

4763. And the coarse portion is called breeze?—Yes.

4764. (*Mr. Harrison.*) Is the return which you have put in a return for a twelvemonth?—Yes.

4765. (*Professor Way.*) It gives 373,000 tons for the year 1865?—Yes.

4766. That is in both directions, up and down?—Yes.

4767. (*Chairman.*) Can you give us a copy of that return?—I will do so. (*The witness subsequently furnished to the Commissioners a copy of the return, which will be found printed at the end of his evidence.*)

4768. (*Mr. Harrison.*) Do you find that manufactories are being established on the banks of the navigation in consequence of this accommodation which you can give them?—Very much so. In the case of any new factories established in the suburbs of London the parties generally apply to the trustees of the river Lee navigation for land on which to erect the factories.

4769. How far from Bow creek up the navigation does the establishment of factories extend?—To Ponder's End, about nine or ten miles.

4770. Therefore any interference with the navigation would not only injure the property of the navigation but would seriously injure a considerable amount of property on the bank?—Yes; the property established on the banks in old and new factories and warehouses and malthouses is immense; that property is far before the property of the trustees.

4771. When you carried the manure, before the cattle plague broke out, did you find it pretty equally distributed throughout the length of the navigation?—We put all the restrictions which we possibly could upon the manure as far as the law would allow us. We prevented its being landed on the trustees property or across the towing-path, but still a certain amount was carried up which we could not prevent; it was taken up the back rivers. I am speaking of the time during the cattle plague.

4772. Generally speaking, apart from the cattle plague, you do not discourage it?—No.

4773. Is it distributed upon the navigation right and left throughout the whole length?—It generally begins about Ponder's End and goes all the way up to Hertford to different points, Ware and Stanstead, and many parts between the towns, where the agriculturists have land; they bring a barge alongside and carry it at once upon their land; that is the case up the Stort.

4774. Then that is a very great accommodation to the neighbourhood?—Yes; in many places they would not be able otherwise to get it upon the land at all; it is too marshy to cart it.

4775. (*Professor Way.*) I see that last year you carried altogether 349,000 tons of the articles given, and 23,000 tons of manure besides that?—Yes.

4776. These 23,000 tons compared with 349,000 tons of other articles, make about one-sixteenth of the whole, which goes without charge?—Yes. I was going to enumerate the different towns where factories are established on our banks. At Enfield lock there is the large gunmaking establishment, and at Waltham Abbey there is the government powder establishment; they keep barges of their own, locked up barges, in which they send their powder to their stores at Purfleet.

4777. Do they pay you any rate?—Yes, they pay for it, but they could not send their powder except by water; it would be dangerous to the public.

4778. Do they pay you an exceptional rate for it?—They pay the highest rate which we can charge, which is 1*s.* 1*d.*

4779. (*Chairman.*) Is it your duty to make yourself acquainted with the rates charged by the railway company, and to advise your principals of what rates are current in the district for the different kinds of goods?—No, we are not carriers; the railway company are carriers.

4780. Who are the persons generally who carry upon your navigations, are they carrying companies, or proprietors owning their own barges?—Most of them own their own barges; a great many in the lower part of the district are principally lightermen, who have barges of their own, and who work by the job.

4781. Lightermen are persons who may possess from one to a hundred of these lighters or barges?—Exactly so.

4782. And they navigate the Thames as well as the river Lee?—Yes.

4783. And they take up and put down cargo according to their own freightage scale?—Yes.

4784. How do you ascertain the tonnage which they carry?—By gauging; the system is the same as is in operation on all the inland canals, such as the Grand Junction canal, and the Regent's canal.

4785. Do you compel them to have a floating gauge plate, which you can read, on the stem and stern?—No, it is in a different way; we have a gauging rod which we put on the side of the barge, which shows the number of dry inches, that is to say the number of inches from the gunwale of the barge to the water's edge. First of all we have a table made, and according to the number of dry inches and decimal parts, we find the tons by the table.

4786. The boats are registered to carry according to the depth and draught, and you ascertain the draught, and accordingly register them for the tonnage?—Yes.

4787. So far as your knowledge goes, do you think that that is a pretty fair way of ascertaining the tonnage?—It is the most correct mode that can possibly be adopted.

4788. Can you get the tonnage of a 100 ton barge within 5 tons?—Within 5 lbs.

4789. (*Mr. Harrison.*) As each new boat is introduced on to your navigation, do you put it on to a lock or pound, and load it, and see what depth it draws with each additional foot?—We do not take the depth of water, but we take the dry inches, because the depth of water is liable to fraud by putting on pieces at the bottom to make it appear deeper, and it is not always in view. We first of all put on four plates; we measure the extreme length of the barge, and then take the stowage, and divide the stowage into four, and put four plates on, two on each side. We take the dry inches before we put anything into the barge, and according to the size of the barge we have regular weights, 2 cwts. each, which we put in until we have loaded her down to 60 tons, or as deep as is necessary, and then we make a table. A copy of that table is sent to all the collectors on the navigation, and by that means we get at the tonnage as correctly as anything can be got at.

4790. (*Chairman.*) If you measure by tens of tons, the intermediate space for decimals of tons you divide into decimal parts?—Yes.

4791. If it was 4 feet 3 inches and $\frac{1}{10}$th you would know exactly what it meant, although you had not measured the tenth in the arrangement?—If we put in 8 tons we should see what the difference was, and should then divide it by 8. We find that the barges sink from 45 $\frac{1}{100}$ths to about 55 $\frac{1}{100}$ths of an inch to a ton.

4792. (*Mr. Harrison.*) I suppose that you feel the effects of competition through the haulers; if they find that they are losing their traffic by the railway company lowering their rates, they will come to you and let you know, and ask you to reduce your rates?—Yes; it is our interest as much as possible to co-operate with the traders.

4793. (*Chairman.*) Have you anything to do with the maintenance of the banks?—That is more a question for the engineer.

4794. And for the bank manager?—Yes; I have to do with that matter, but it is under the direction of the engineer.

4795. Do you know what is the net income of the trust at present for paying dividend, after paying salaries and maintenance?—No.

4796. (*To Mr. Marchant.*) Do you know whether you have a surplus income, whether you have more than you require, or less than you require?—At the present moment I believe that we have something more of revenue than of expenditure.

4797. (*Professor Way.*) Is that after paying current works out of revenue?—No; we distinguish between ordinary and extraordinary expenditure, that is to say, revenue and capital.

4798. If you have used up your capital, how do you provide for current works except by increasing your debt?—We do not; if we required more money on capital account, we should immediately issue more debentures.

4799. (*Chairman.*) You have not gone to your limit?—We have not.

4800. (*Professor Way.*) You do not use your revenue for new works?—No.

4801. (*Chairman.*) Have you a public audit?—No; we have an auditor appointed, in fact, our deputy chairman, *ex officio* auditor.

4802. Is he appointed by your own board?—Yes.

4803. You have no external authority to which you refer the account?—None.

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4804. Do you not think it advisable if you had additional power, that there should be some independent board to whom you should have to refer your audit?—I can quite conceive that if you were to extend the powers of the trust, and to raise funds by means of rating, or any other means, it would be desirable to have a public audit.

4805. That is to say, that your accounts should be submitted to an independent authority, such as the Board of Trade?—Yes.

4806. And that persons who considered that they were interested, should have the power of making an examination?—I may say, that the accounts are public to this extent, that if any person interested in the navigation desired to have a copy of our accounts, or to look at our books, we should not hesitate for a moment in letting him do so; for copies he would have to pay to the clerk the charge which is mentioned in the Act. The accounts are, therefore, public to that extent.

4807. Then you have a provision in the Act by which any person directly interested in the navigation can ask to have a copy of the accounts?—Yes.

4808. (*Professor Way.*) He could demand it, at all events, he could get an order from the Court of Chancery to see the accounts?—Certainly. We have always an annual meeting in the city of London, at which the accounts are passed, and a statement is placed before the trust.

4809. (*Chairman.*) Your trust is composed of such a variety of interests, that in fact, it amounts to a public audit, because you have so many interests involved in the constitution of the trust?—That is so, the trust is, in fact, essentially a public trust; it is a public commission, the members of that commission being chosen from the localities of the different counties and boroughs through which the river passes.

4810. (*Professor Way.*) There is nothing to prevent us from getting a statement of your receipts and disbursements for the last 10 years?—Certainly not.

4811. (*Chairman.*) Are your annual accounts published, and is a printed copy submitted to each member of the trust?—Not as a rule, but if a member asks me for a copy I gave it to him, they are not sent round as a rule.

4812. You do not necessarily publish and send round the accounts?—No. For instance, there may be *ex-officio* members who have not attended the meetings for a considerable period, and we do not take the trouble to send the accounts to a gentleman who takes so little interest in the affairs of the trust, and the result of our operations; but if any member should happen to write to me for a copy of the accounts, it is sent to him immediately.

4813. (*Professor Way.*) Will you let us have a copy of your receipts and disbursements for the last 10 years?—Certainly.

4814. (*Chairman to Mr. Glass.*) Have you anything to add to your evidence?—Not that I know of, except that I wish to show that the river Lee navigation is a greatly improving navigation, and will be year by year increasing in every direction, and for this reason, namely, that London is spreading out far away, and getting towards the nearest mode of conveyance of heavy materials for building and so on. The trustees have a large quantity of land on the side of the navigation at the marshes at Homerton, in a few years that land will be all built over with large factories, which will be increasing the traffic upon the navigation. Within the last 12 or 14 years the trustees have been improving the navigation and laying out an immense sum of money in widening the locks, so as to admit barges of a larger capacity from the Thames which could not come up before, also barges which travel on the Regent's canal where the locks are wider than

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ours. Barges of any width which traverse the Thames are now enabled to come up to those lower points where these manufactories are likely to be established. I may add that I find that at Ware and Hertford the malting trade is gradually and progressively increasing.

4815. Have you any pleasure boats upon the river in any portion of its course?—Yes, we have a great number of pleasure boats down below Tottenham.

4816. Do they pay any rate to the trustees?—Not unless they come through the lock; some of the owners of these boats pay a small sum per annum for the privilege of keeping their boats over a certain area near the towing-path, so that they should not be interferred with by others.

4817. Have you any idea what number of pleasure boats ply upon the river in the different branches?—I should think that there are 500 or 600 pleasure boats.

4818. Seeing that you have to maintain the river, should you think it any hardship if you had the right of putting a rate of 10*s.* or 1*l.* a year upon the pleasure boats?—We do that to a certain extent in the cuts, and I think that it would be a very excellent thing if we had power to do so on the old river between Tottenham and Lee Bridge, for those boats are a very great nuisance.

4819. You think that a person who could afford to keep a pleasure boat would not object to a moderate payment?—No.

4820. It might be a great advantage to you and might enable you to keep the river in a better condition?—Yes. They always pay for passing through a lock. They do not keep the pleasure boats for their own use, but they keep them for hire.

4821. In that case do you not think that it would be fair and reasonable that you should have the power of levying a rate upon them for a licence, an annual or quarterly payment?—Yes.

4822. If you made them take out a licence at 5*s.* a quarter or 1*l.* a year, you would have a small income from them, and it would do them no very great harm, and it would do you some good?—Yes; we do adopt that principle in the cuts and in some places below where they wish to lay alongside our towing-path, we charge them 10*s.* per boat per annum, and it gives us some little control over the matter.

(*Mr. Beardmore.*) There is no doubt that many of those boats are most dangerous and there ought to be a registration of them.

4823. (*Professor Way to Mr. Glass.*) The pleasure boats are an obstruction to the navigation?—They are a very great obstruction below Tottenham. We keep them within bounds above and have a control over them, but below Tottenham, between there and Lee Bridge, they are a very great obstruction.

4824. (*Chairman.*) Have you power to license persons for fishing?—No, we have nothing to do with the fishing.

4825. Who regulates that?—It is regulated by different parties.

4826. Private owners?—Private owners.

4827. According to arrangements which have been previously entered into?—Yes.

4828. Is there anything further which you wish to add?—There is nothing that I know of.

(*Mr. Beardmore.*) The trustees own two or three fisheries which they let.

4829. (*Professor Way to Mr. Marchant.*) Is there any reason why we should not have a return of your income and expenditure. If we are to make any recommendation we must really know what funds you have at your disposal?—It is necessary for me to have authority to give that return, and the only reason why I say that it is necessary for me to have that authority is, that the Act specifies that those persons who are interested in the navigation should have copies of the accounts; if at our next meeting, which will be on the 14th of January, I can get the authority, it will I presume be sufficient for your purpose. (*Mr. Marchant subsequently furnished to the Commissioners copies of Abstract of Accounts of River Lee Trust from* 1856–66. *The Abstract of Accounts for the year ending Dec.* 31, 1866, *will be found printed as Appendix* 3 *to his evidence.*)

4830. We have authority to call for all papers?—Yes.

The witness withdrew.

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(Signed) JNO. GLASS, Traffic Manager, R.N.T.

APPENDIX I. to the EVIDENCE of JOHN GLASS, Esq., Traffic Manager to the River Lee Trust (referred to supra, Q. 4767).

ABSTRACT of TRADE for the Year ending the 31st December 1865.

	Limehouse Cut.		Bromley, Bow, and Old Ford.		Duckett's Canal.		Homerton, Lee Bridge, and Clapton.		Tottenham, Edmonton, and Ponder's End.		Enfield Lock and Waltham.		Cheshunt, Broxbourne, and Hoddesdon.		River Stort.		Rye and Stanstead.		Ware.		Hertford.		Total.	
	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.	Tons.	Tolls.
		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.
Ashes and breeze	720	1 10 0	18,854	235 13 6	723	17 1 0	—	—	60	1 10 0	202	6 11 0	1,408	25 4 0	312	8 11 0	60	1 10 0	3,220	80 13 0	183	4 11 0	21,843	382 14 0
Coals and coke	702	7 10 6	10,623	133 3 3	8,311½	138 12 6	2,129½	37 4 1	9,217	53 13 4	8,284½	290 10 1	1,180	29 5 8	7,451½	186 7 4½	2,199	109 19 0	4,412	156 7 1	4,893½	110 4 7	51,014	1,091 4 8½
Bricks and tiles	—	—	9,910	124 6 8	620½	7 17 6	8,376½	105 14 7	4,800½	25 0 0	290	3 6 0	880	11 1 6	193	2 8 3	—	—	2,922	110 10 6	73	—	31,474½	398 17 10
Chalk and sand	42	0 14 0	2,102	26 10 8	—	—	13,377	311 14 0	5,987	124 13 6	121	3 0 0	453	11 6 6	64	1 12 0	601	12 10 6	31	1 12 1	—	—	22,108	513 12 8
Cement and lime	19	1 10 0	2,181	41 7 0	45	0 15 0	2,532	62 7 2	—	—	336½	17 14 6½	—	—	0	0 7 0	0	0 7 0	31	4 0 0	64	4 0 0	5,594½	130 11 11½
Slates	—	—	—	—	—	—	493	10 5 8	—	—	42	2 2 0	—	—	281	14 1 0	—	—	197	9 17 0	78	3 18 0	969	32 6 8
Stone	12	0 4 0	480	8 0 0	55	1 1 8	318	0 10 6	1,752	43 11 0	11	0 11 0	1,552	77 2 0	1,393½	69 13 0	50	0 11 0	781	38 11 0	230	11 10 0	3,283½	190 8 11
Timber	963	11 1 0	4,104	68 8 0	293½	4 17 10	983	22 13 10	1,661½	41 14 6	939	23 9 7	473	2 7 0	7,884	12 17 1	160	3 18 0	1,220	30 14 6	30	1 10 0	12,247½	305 16 7
Iron	30	0 3 4	360	1 15 4	54	0 13 6	891	22 5 6	1,018	47 10 0	75	1 17 6	125	3 2 6	414	7 8 0	—	—	7,075	59 12 6	274	13 14 0	9,672	70 18 6
Gravel and road materials	—	—	—	—	444	7 8 0	—	—	—	—	69½	3 4 0	160	10 0	1,393½	69 13 0	—	—	2,212	27 13 6	1,674½	43 14 0	3,163	78 8 0
Linseed cake	240	4 0 0	2,447	40 15 8	593½	0 19 10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7,094½	177 17 11	7,094½	177 17 11
Oil	628	10 9 4	7,062	117 14 0	5	0 1 8	—	—	—	—	—	—	—	—	—	—	—	—	2,988	74 14 0	2,988	74 14 0	14,838½	369 12 6
Barley and oats	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	708	35 8 0	708	35 8 0	10,363	735 3 7½
Wheat	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	4 0	41½	2 1 0	5,016½	158 11 4
Flour and meal	—	—	—	—	82	1 17 10	—	—	—	—	—	—	—	—	—	—	—	—	10	12 3	5,780½	280 6 6	17,214½	517 4 5
Seeds, beans, peas, tares, and rye	330	2 3 4	70,768	169 8 8	—	—	—	—	—	—	100	9 3 8	80	4 0 0	461	23 1 0	—	—	20,053½	1,393 3 6	1,218½	67 8 0	60,253½	2,516 5 6
Malt	—	—	—	—	—	—	—	—	—	—	50	2 10 0	—	—	20,074½	1,003 14 0	2,199	109 19 0	—	0 18 0	—	0 5 0	—	68 3 3
Boats	—	—	—	10 7 0	—	—	—	—	—	—	—	—	—	7 2 0	—	—	—	—	—	80 17 0	—	21 3 0	—	821 0 0
Empty barges	—	6 17 0	—	250 10 0	—	—	—	1 12 0	—	61 10 0	—	—	—	21 18 0	—	51 15 0	—	—	—	—	—	10 12 0	50,927½	69 13 0
Sundries	5,707	17 5 0	23,235	302 5 0	11,087½	177 14 11	13,427	189 13 0	1,615	25 7 6	1,203½	17 14 6½	1,114	1 14 5	1,004	6 10 0½	583	1 0 4½	3 13 1½	170	1,623½	84 14 4	69 13 0½
Saltpetre and gunpowder	—	—	—	—	—	—	—	—	—	—	1,514	84 14 4	—	—	—	—	—	—	—	—	30½	3 4 6½	1,544½	84 14 4
Flints, chalk, gravel, sand, and road materials	—	—	—	—	—	—	—	—	—	—	42	2 2 0	—	—	—	—	—	—	—	—	—	—	42	2 2 0
Wharfage	—	—	—	15 10 1	—	—	—	—	—	4 17 0	11	0 11 0	—	—	—	—	—	—	—	—	—	—	11	0 11 0
Total tons charged	8,544	163 10 4	91,054	1,964 10 10	29,310½	481 1 10	42,810½	898 12 8	21,400½	558 2 1	10,073	290 10 1	6,100	221 15 8	47,801½	2,169 11 0½	4,850½	100 5 7	61,393	2,364 10 11½	18,623½	709 13 11½	349,760½	10,491 7 11½
Manure	568	—	10,523	—	101	—	510	—	2,201	—	803½	—	1,905	—	4,790	—	—	—	2,035	—	473	—	23,550½	—
Total	9,112	—	102,597	—	29,597½	—	43,320½	—	23,702½	—	10,877	—	8,801	—	52,591½	—	4,850½	—	63,428	—	19,096½	—	373,307	—

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Mr. J. Glass.

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Appendix No. 2 to the Evidence of John Glass, Esq., Traffic Manager to the River Lee Trust.

Rates of Tonnage, Table of Distances, and List of Barge Owners.

The River Lee is navigable for craft coming from the lower part of the Thames and the river Medway at Blackwall, through Bow Creek; and from the upper part of the Thames at Limehouse through the Limehouse Cut to Bromley, Stratford, Bow, Old Ford, Homerton, Clapton, Lee Bridge, Walthamstow, Tottenham, Edmonton, Ponder's End, Enfield Lock, Waltham, Cheshunt, Wormley, Hoddesdon, Stanstead, Ware, and Hertford.

The locks are now calculated to admit barges of 90 feet in length to any point, and of the following width, viz.:—

To any point short of Old Ford lock, 20 feet wide.

To any point short of Ponder's End lock, 17 feet wide.

To any point short of Enfield lock, 15 feet wide.

To all points beyond, and the "Stort," 13 feet 3 inches wide.

Junctions with Canals and Railways.

The navigation is connected with the Regent's Canal through the Hertford Union or Duckett's Canal at Old Ford, opening a direct communication with the Grand Junction and all canals and railways north of London.

It also joins the Stort navigation at Hoddesdon, extending to Roydon, Harlow, Sawbridgeworth, and Bishop Stortford.

In the Limehouse Cut there is a coal shoot where craft may load direct from the North London in connexion with the North Western and other lines of Railway. Also at Hertford, a capacious dock and wharf adjoining the Great Northern Railway.

The navigation is open for traffic at all times, night and day, except Sundays, when it is closed from eight o'clock in the morning until 6 in the evening.

River Lee Trust.—Rates of Tonnage.

Goods.	London Trade. To or from the Thames, the Regent's Canal, and the following Points, viz.:—					Local Trade. To or from Hertford, Ware, or the Stort, and		To or from Cheshunt, Waltham, or Enfield Lock, and	
	The Limehouse Cut only.	Junction of the Duckett's Canal, Old Ford, and Homerton.	Lee Bridge, Tottenham, Edmonton, and Ponders End.	Enfield Lock, Waltham, and Cheshunt.	Broxbourne, River Stort, Stanstead, Ware, and Hertford.	Waltham, Cheshunt, or Enfield Lock.	Ponders End, Edmonton, Tottenham, Lee Bridge, or Duckett's Canal.	Ponders End, Edmonton, Tottenham, or Lee Bridge.	Homerton. Duckett's Canal, or Old Ford.
	Per Ton. s. d.	Per Ton. s. d.	Per Ton. s. d.	Per Ton. s. d.	Per Ton. s. d.	Per Ton. s. d.	Per Ton. s. d.	Per Ton. s. d.	Per Ton. s. d.
Tiles, chalk, sand, and gravel and road materials (upwards)	0 4	0 4	0 6	0 6	0 6	0 6	0 6	0 6	0 6
Ashes, breeze, and coke	0 3	0 4	0 6	0 6	0 6	0 6	0 6	0 6	0 6
Coals	0 3	0 4	0 4	0 6	0 6	0 6	0 6	0 6	0 6
Grain, seeds, malt, oil, linseed cake, iron, slates, stone, timber, and flour and meal (upwards	0 4	0 4	0 6	1 0	1 0	0 7	1 0	0 6	1 0
Cement, lime, and sundries	0 4	0 4	0 6	1 1	1 3	0 7	1 3	0 6	1 1
Saltpetre and gunpowder	0 4	0 6	0 6	1 1	1 9	0 7	1 3	0 6	1 1

Bricks or spoil, to or from any point, 3*d.* per ton.

Coals, from Duckett's Canal to any point, or from Hertford to the Thames, not to exceed 4*d.* per ton.

Flour (downwards only), not to exceed 6*d.* per ton.

Rough iron ore, from Hertford to the Thames, 3*d.* per ton.

Empty barges, and barges not having paid toll to that amount, 3*s.* each.

Pleasure boats 1*s.* 3*d.* each, to be paid at the first lock they pass through up or down.

Flints, chalk, gravel, sand, roots, vegetables (downwards only), 2*d.* per ton.

Goods that have not paid tonnage will be charged 1*d.* per ton for wharfage, if landed across the towing path.

Barges not paying toll will be worked through the Bow Tidal Lock at a charge of 1*s.* each way.

Pitch, tar, creosote, and gas products, passing through Old Ford only, 3*d.* per ton.

Wharfage, in Hackney Marsh, for all goods except manure, 3*d.* per ton.

Wharfage, at same place, for manure, 15*s.* per barge.

Ware wharf is open free of toll except for manure, chalk, sand, and gravel, &c., which will be charged 2*d.* per ton, and 1*d.* per ton additional for each week or part of a week that the articles may lay upon the Wharf after the first week.

All articles will be charged by the gauge or actual weight o 20 cwt. to the ton.

The above tolls will be charged until further notice.

By order of the trustees,

J. Marchant, Jun., Clerk.

Hertford, June 1865.

Table of Distances between Hertford and the Thames at Limehouse, in Miles.

	Hertford	Ware	Stanstead	Hoddesdon and Stort	Broxbourne	Cheshunt and Wormley	Waltham	Enfield Lock	Ponder's End	Edmonton	Tottenham and Walthamstow	Lee Bridge and Clapton	Homerton	Old Ford and Duckett's Canal	Stratford, Bromley, and Bow
Hertford	—	3	5	8	11	14	16	18	20	22	24	27	29	30	31
Ware	3	—	2	5	8	11	13	15	17	19	21	24	26	27	28
Stanstead	5	2	—	3	5	8	10	12	14	16	18	21	23	24	25
Hoddesdon and Stort	8	5	3	—	3	6	8	10	12	14	16	19	21	22	23
Broxbourne	11	8	5	3	—	3	5	7	9	11	13	16	18	19	20
Cheshunt and Wormley	14	11	8	6	3	—	2	4	6	8	10	13	15	16	17
Waltham	16	13	10	8	5	2	—	2	4	6	8	11	13	14	15
Enfield Lock	18	15	12	10	7	4	2	—	2	4	6	9	11	12	13
Ponder's End	20	17	14	12	9	6	4	2	—	2	4	7	9	10	11
Edmonton	22	19	16	14	11	8	6	4	2	—	2	5	7	8	9
Tottenham and Walthamstow	24	21	18	16	13	10	8	6	4	2	—	3	5	6	7
Lee Bridge and Clapton	27	24	21	19	16	13	11	9	7	5	3	—	2	3	4
Homerton	29	26	23	21	18	15	13	11	9	7	5	2	—	1	2
Old Ford and Duckett's Canal	30	27	24	22	19	16	14	12	10	8	6	3	1	—	1
Stratford, Bromley, and Bow	31	28	25	23	20	17	15	13	11	9	7	4	2	1	—
Limehouse	32	29	26	24	21	18	16	14	12	10	8	5	3	2	1

The distance from the mouth of Bow Creek at Blackwall is about one mile further than from Limehouse; and the distance on the Stort navigation from its junction with the river Lee at Hoddesdon to Bishop Stortford is 13 miles.

HERTFORD.

Mr. A. Manser.

19 Dec. 1866.

Mr. Alfred Manser (Hoddesdon) examined.

4831. (*Mr. Harrison.*) Where do you live?—At Hoddesdon, on the Lynch, which runs into the Lee.

4832. Do you carry on any occupation there?—I am a miller, a barge owner, and a coal merchant.

4833. Have you more than one mill?—I have two mills, one on the Lynch and the other on the Lee.

4834. Of what power are those mills?—At one mill we have a guaranteed power of 4,000 cubic feet of water per minute.

4835. Which mill is that?—That is the one on the Lee.

4836. What is your fall there?—5 feet.

4837. What is it at the mill on the Lynch?—12 feet.

4838. Does the water originate with you?—It springs on our own premises.

4839. Have you found any difference in the volume of water discharged from that spring of late years?—I have not measured it.

4840. You have not found any sensible diminution in the power of your waterwheel?—No, I cannot say that I have.

4841. It was mentioned to us at Bishop Stortford that in many cases the water power had considerably diminished. Your mills are flour mills?—Yes.

4842. Do you use the navigation for carrying your corn and flour?—Yes, almost entirely.

4843. Do you find it a convenience?—A very great convenience; the rail would be very inconvenient to me, I could not work with it.

4844. So that any interference with the navigation would be a decided disadvantage to you?—It would make the mills comparatively worthless; at one mill I should be three miles from the railway station.

4845. How far are you below Ware?—We call it four miles. Charlton mill is the first mill below where the Stort enters.

4846. Do you find any nuisance arising from the waters of the Stort, or of the Lee?—No; our foreman at the Charlton mill cottage always uses the Lee water for drinking and cooking, and so they do at the "Fish and Eels" public-house.

4847. Without filtration?—Without filtration. I do not think that our foreman has a filter. I drink the water myself, occasionally.

4848. Do you see much difference between the water now, and in former years, as to its purity?—I do not think that it is quite so pure as it was; that is speaking of above me as far as it comes down to me; below it certainly is not so clear.

4849. The benefit of the navigation to yourselves would be equally felt by millers situated upon the river, and other persons, throughout its length?—Yes, maltsters and millers, seed crushers, and every one. I consider it of very great value; in fact, it is that which makes Hertford, and Ware, and Waltham Abbey what they are.

4850. You think that the railway will not do for those towns what the navigation does?—No, certainly not. In my own case I can get a sack of flour conveyed by the navigation for 3*d.*, if I send it to the rail I must pay 6*d.*, and I must first get it to the rail.

4851. Have you any steam power?—No, there is a steam engine put up by the New River Company to make up the quantity of water which they have to supply in dry seasons; they have to supply us with a certain quantity of water, or to forfeit 10*l.* a day. We have to give them notice.

4852. When was that engine erected?—I think in 1855, just after the last Act.

4853. In how many instances have you had occasion to call upon them to use it?—That has been the case most years; it was so in last year, and the year before. I should think that it has been at work eight years out of ten.

4854. In 1864 for what length of time was it used?—I think that it was at work about two or three months.

4855. And in 1865?—About the same time. In 1864 I think that it was at work three months, and in 1865 two months.

4856. Of what horse power is it?—They call it, I believe, 40-horse nominal power. The engine pumps the water. They have centrifugal pumps; we would not allow them to put it up at the mill. The New River Company were to provide a certain quantity of water by pumping or otherwise, and we said, "Provide it by pumping."

4857. You would rather have a regular steady action of the waterwheel than steam power?—Yes, decidedly.

4858. (*Chairman.*) They pay 1*s.* every time they pump for nine pennyworth of power?—I believe that if that engine was worked up to 45-horse power it would only do about 8-horse power of work; they lose 10*d.* out of the 1*s.*

4859. Or more than that?—Yes.

4860. (*Professor Way.*) Would it not seem the most reasonable way for you to take some compensation?—We fought it out rather hard and we died hard.

4861. (*Mr. Harrison.*) What is your opinion as to the value of the navigation for the powder works, and the small-arms factory?—I do not think that the powder works could be carried on without it. The way in which they manage is to work small boats upon the cuts, and they take the charges to the various magazines, so that it is not necessary to use a cart or a truck; there is no friction and no danger, and as soon as they have 500 barrels of powder it is sent away to Purfleet.

4862. (*Chairman.*) They can isolate themselves?—Yes.

4863. (*Professor Way.*) They were put there for the very purpose of that being the mode of transit to the depôts?—Yes.

4864. (*Mr. Harrison.*) How do you think that the present river Lee trust works for the benefit of the public?—I think that it worked better when there were a greater number of men of business upon it.

4865. (*Chairman.*) Is there anything to prevent your being a member of the trust?—No, if I choose to qualify; you must have a certain amount of income derived from freehold property.

4866. (*Mr. Harrison.*) Is there any exclusion of millers from the trust?—No, I should have qualified, but I do not quite like the way in which they manage things.

4867. Would not the best thing for you to do be to get on the board and induce them to manage better?—I very much doubt that. I am the secretary of an association which has been formed, to endeavour as much as we can to keep them in their places.

4868. (*Mr. Harrison.*) How does that association act upon them?—I think that, for instance, in the case of the Regent's Canal Bill, which was brought forward two years ago, it acted beneficially; it stirred them up, and pushed them forward to do their duty.

4869. How is it that the men of business are not upon the board now?—Some years ago there was a great change in the management of things. A vice-chairman and a great number of county gentlemen were introduced, and it did not appear that there was that amount of attention paid to the wishes of men of business which there had been, and consequently I think that in most cases they declined to attend and others declined to become fresh members. We have no court of appeal; for instance, if I went to-morrow and said, "So-and-so is wrong," it is possible that I might be heard, and in all probability I should be heard, but in the event of my not getting any redress there would be nowhere for me to go.

4870. (*Chairman.*) Then do you think that there should be some superior board to whom you could appeal?—Yes, I think that if there were two or three commissioners before whom we could lay any case of complaint, in case we could not obtain redress from the board, it would act extremely well.

4871. Do you think that if the trust was to be

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extended in its operations into a conservancy board, the Government in granting that power should place some sort of check or control, or should establish a court of appeal to which persons thinking themselves in anyway aggrieved could have recourse?—Yes, I think that there should be a superior board.

4872. (*Professor Way.*) But I take it that you would not like the present trust in any form unless it was considerably modified by the admission of a large business element?—I think so.

4873. (*Mr. Harrison.*) Is the Regent's Canal Company much interested in the Lee navigation?—As a navigation I do not think that it is now, because the communication was cut off two years ago, that is to say, the communication between the Regent's canal basin and the Limehouse cut; it was cut off at the Coffer dam in consequence of their losing their bill, and having to give up property which they had held for many years, they held it for 12 years, and we got it away again.

(*Mr. Beardmore.*) A very large traffic is carried on from the Regent's canal through Duckett's canal.

4874. (*Chairman to Mr. Manser.*) Have you ever preferred a complaint which the trust has not dealt with?—I have.

4875. What was that complaint, and when?—It is now a good many years ago; it was with regard to the reconstruction of a weir, and its water-marks.

4876. Has it not been reconstructed to this day?—It was reconstructed, but I did not get what I wanted. I had no appeal; the matter was not fairly gone into to say whether I was right or wrong; the thing remained in *statu quo.*

4877. The trustees had power to deal with it in their own way, and you think that they did not consult your interests?—Yes, but I do not make a charge against them, that is not my object.

4878. (*Mr. Harrison.*) Do you admit the general statements which we have had given in evidence to-day, namely, that under the present management and since the passing of the Act in 1855, the canal has been much improved, and the locks have been made good, and the canal has been deepened so as to take barges of nearly 100 tons instead of 40, and that accommodation is given so as to encourage an increase of the traffic to a very considerable extent upon the navigation?—I believe so in every respect. I am perfectly satisfied with it, so far as regards the actual improvement of the navigation.

4879. Therefore so far as the substantial interests of the public are concerned, the present trust appears to be working well?—Yes, so far as the public are concerned.

4880. Would your complaint be an individual one?—I think that if they paid more attention to economy and exercised more care, and if instead of borrowing a large amount of money and raising these debentures, they endeavoured to be careful to improve the river out of income, which they might very properly do, it would be very much better.

4881. Do you think that if they had confined their attention to doing works of that kind, you would have had the benefit of the present improved navigation?—We perhaps might not have had it quite so quickly, but still it is progressive.

4882. (*Chairman.*) Within the last two years, did not a memorial proceed from the association, of which you are the acting secretary, and was it not sent to the river Lee trustees, begging them to reconstruct the Limehouse entrance, it involving an outlay of something like 15,000*l.*?—Yes, but I do not think that it was necessary that they should borrow the money, because I think that if greater economy had been practised for 10 or 12 years previously, that money would have been saved, and need not have been borrowed.

(*Mr. Marchant.*) We are not enabled to create a surplus capital fund. If we had a large fund in hand applicable to such a purpose, as the memorialists requested of us, we should have to reduce our tolls. We must improve the river from year to year; we cannot make a fund for 20 years, which shall repay a possible expenditure 20 years hence. If any extraordinary work, such as that of the Limehouse entrance, is forced upon us by an association, or by extensions of business, we must borrow the money by the powers of the Act.

4883. I presume that the association in their application to the Lee trust, represented what the trade required, or the trust would not have been coerced into making that outlay?—There was no coercion. When the trade represent such a matter to us we carry it out if it is needed. This memorial was a recommendation; it was not antagonistic to us at all.

4884. (*Mr. Harrison to Mr. Manser.*) Do you know the condition of the land in the valley of the Lee, below the point where your mill is?—Yes.

4885. Is it liable to be flooded much?—Yes.

4886. Is it injured or benefited by the floods?—I should think that it is not injured. I think that the water down below in the lower part of the river is so very foul, that it manures that land rather than otherwise.

4887. Does it lie for sometime upon the land?—Generally a day or two.

4888. It lies for so short a time that it does not injure the land from the water becoming stagnant?—No; the weirs for passing off the water are better than they used to be, so that the water is passed off more quickly. Those weirs I think are all under the control of the trustees. Mr. Beardmore has introduced an iron weir in place of a wooden one, so that his posts are perhaps 6 or 7 inches instead of 14, and that increases the difference in waterway.

4889. Then that is a benefit to the neighbourhood which must be carried to the credit of the trustees of the navigation?—Yes, I will give them full credit there.

(*Mr. Beardmore.*) The improved getting off of the water is due as much to the dredging as to the other works.

4890. You have deepened the reaches?—Yes.

4891. (*Chairman.*) You have increased the sectional area through which the water can pass?—Yes.

(*Mr. Manser.*) And they have raised the banks a little.

(*Mr. Beardmore.*) The sectional area in shoal places is now at least double.

4892. That would give more than double the volume of water in the same time?—Yes; the hydraulic effect as you are aware is very much larger. I should think that it is pretty nearly eight times.

4893. (*To Mr. Manser.*) Is there anything further which you wish to bring before the Commission?—Nothing, I think, except that I do hope that any recommendation which you may make may lead to some higher power being appointed to control the acts of the trustees, and to give us justice when we seek for it.

The witness withdrew.

Mr. F. Haggar.

Mr. Franklin Haggar (Hertford) examined.

4894. (*Chairman.*) What are you?—A seed crusher and flour miller.

4895. Are you a trader having goods carried upon this river?—Yes.

4896. (*Mr. Harrison.*) Where are your mills situated?—One at the north end of the town of Hertford and the other at the west end.

4897. What power do you use for crushing?—Steam and water at one mill and only water at the other.

4898. Is your water power regulated in the same way as Mr. Manser's is?—No.

4899. Have you the control of the whole of the water of the Lee?—We have the control of the whole of the water which passes down the Lee and the Beane. One mill is on the Lee and the other is on the Beane.

4900. Have you experienced any diminution in your power on the Beane?—Previously to this year we had a considerable diminution, consequent, I imagine, upon the small quantity of rainfall in the eastern counties generally; but this year we have had an abundant supply of water.

4901. Situated as you are at Hertford, with two railways working competitively, and the navigation, do you find that the navigation of the river Lee is a benefit to you?—I am quite certain that we should be very much worse off without the navigation; it is most desirable that it should be maintained in its present efficient state.

4902. Do you convey your goods much by the navigation?—I do not convey a great deal by the navigation because I have railway communication into one mill.

4903. Have you equal accommodation to the canal?—Yes; I can carry goods either to the river or to the railway.

4904. Were you in business here before the construction of the railways?—Yes.

4905. Do you find that you have your goods carried now at a cheaper rate than you had before the railways were constructed?—I find that I have the goods carried cheaper by railway than I had by the river.

4906. And cheaper than the river would carry them now?—Yes.

4907. Do you use much coal?—I use a large quantity of coal at the seed-crushing mill.

4908. By what conveyance do you get it?—We get it direct from the north by railway into the mill. Neither of my mills is on the navigation. I have similar accommodation, inasmuch as I can carry either to the rail or to the Lee river by land.

4909. But you have not the navigation coming close up to your mill?—I have not.

4910. You get your coal direct now from the north?—Yes.

4911. Do you get it at a lower price now than you did years ago?—I had not the mills before the railway was made, at least I had not the steam power; I had the mills but not the steam power.

4912. Is either of your mills situated below the point of discharge from the works for the purification of the sewage?—They are situated above the point of discharge.

4913. Do you find that there is any silting up in the river below your mill?—Very considerable indeed.

4914. Is it more than it used to be in former years?—I do not think that it is more than it used to be, but it is very considerable; it is getting into a very bad state indeed now.

4915. Is that below your tail race or within the navigation?—It interferes with our tail water.

4916. Is a bank formed in the tail race or in the navigation?—Not in the navigation but in the tail race, before it joins the Lee.

4917. Whose duty has it been to remove that obstruction?—I and my father before me removed it for many years, and we have commenced to remove it this year; we have taken out a large quantity, when the question has arisen as to who is entitled to the accumulations taken out of the river and thrown on to the bank; that is the question in dispute at the present time.

4918. Is it of value?—Yes.

4919. That which is an obstruction to your mill by damming up the water is really a benefit and worth taking out of the river?—Yes; but it is not worth more than the expense of taking it out. What we have to pay to take it out is about the value of it.

4920. Who disputes with you the right of taking it out?—It is not the right of taking it out.

(*The Mayor.*) We dispute your right to excavate the bed of the river.

(*The witness.*) I concede that the corporation have a right to the bed of the river, but I claim a right to take out the accumulations of soil.

(*The Mayor.*) You have done more than that.

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4921. (*Professor Way to the witness.*) Supposing there is an impediment and it is removed for the purpose of obtaining power, when it is got out it may be of some value, although not equal to the cost of getting it out, then a dispute may arise as to who is to have it when it is got out?—Yes, that is the question.

4922. The dispute does not arise before it is got out?—(*The Mayor.*) Yes, we dispute it; but it appears to me that it is not a question for us to decide now, the right of Mr. Haggard to do what he has done. The fact is that he has excavated down to too great a depth; he might clear away the accumulations, but not the bed of the river.

4923. (*Mr. Harrison to the witness.*) It appears that your right to remove an obstruction is not disputed, but that your right to dredge for gravel is disputed. How many years have you known the river Lee?—All my life.

4924. What is its condition now as compared with what it was formerly?—The navigable river Lee is very much improved as a navigation certainly.

4925. What is its condition as to purity?—As to its purity it must be more pure of course as the sewage of the town of Hertford does not pass into it.

4926. Do you frequently find that dead animals are passed down the river?—Yes, dogs and cats are to be seen passing down the river.

4927. What do you do with them when they are stopped at your mill?—We pass them on.

4928. That appears to be the general practice?—We could not undertake to take them out. They come down to us and we pass them on. The river Lee above Hertford is getting into a very bad state; it is being silted up very much, and I am satisfied that the river in places is quite a foot higher than it used to be above the town of Hertford.

4929. Is the river above the point where the navigation commences under any control?—None whatever, I believe.

4930. To whom does it belong, the owners of the adjoining property?—Yes; the owners of the adjoining land have the right of fishing, and I daresay they would not let anyone come to clean it out.

4931. Are there any mills above you?—Yes, but between my mill and the mill above there is a fall, an ordinary fall in the bed of the river, which is not appropriated.

4932. The bed of the river, you think, has risen a foot within your recollection?—Quite so.

4933. Has the effect of that rising of the bed been to flood the land more than it used to be?—I have no doubt of it.

4934. Is the land in fact flooded more than it used to be in your recollection?—I should say so certainly.

4935. How far up the river does the flooding extend?—I should say for three or four miles.

4936. How far up the river is the next mill above Hertford?—The next mill above Hertford is about four and a half miles.

4937. Above that point does the miller take steps to keep the channel deep?—I do not think he does, as there is this natural waterfall that I speak of, and he is not affected.

4938. Has not the raising of the bed of the river affected the water at his mill-tail?—I think not, because of this fall, which is below his mill-tail, and it is not affected by it.

4939. What is the condition of the land adjoining the Lee above Hertford?—It is principally meadow land in the valley of the Lee.

4940. Is it in good condition?—I should say that it is generally very wet. There is land adjoining the town, or within a mile, that it is not possible to walk over; there are some acres together.

4941. Do you not think there ought to be some control over the river above Hertford to prevent the silting up of the land?—Yes, certainly.

4942. (*Professor Way.*) You are a seed crusher, are you not?—Yes.

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4943. Is it linseed principally that you crush?—Linseed, rape, and cotton.

4944. The crushing of cotton seed has only taken place, I believe, of late years?—Within the last two or three years to any extent.

4945. Do you decorticate the cotton seed?—No.

4946. You crush the whole of the seed?—Yes.

4947. In the case of the linseed, do you steam that in the first instance?—Yes, after it has been ground.

4948. You steam it and put it into presses?—Yes.

4949. What runs out besides the oil from the presses?—Nothing.

4950. What remains in the presses is the linseed cake?—Yes; there is no refuse.

4951. Is there any from the cotton seed?—None whatever.

4952. Or from the rape seed?—None whatever.

4953. If you discharge anything into the river it is only the condensed water of the engine?—Yes.

4954. How many men do you employ?—From 60 to 80.

4955. Have you any privy accommodation on your premises for your hands?—Yes.

4956. Do they drain into sewers?—No.

4957. Does the refuse pass into the river?—Yes.

4958. Except that, no other refuse is produced on your premises?—None whatever.

4959. Would it be difficult for you to get the sewage from the privies conveyed into the sewers, so as to prevent that direct pollution of the river?—They do not come within a quarter of a mile of our place.

4960. Have you heard of what is called the earth-closet?—I have heard a description of it, but I have not seen it.

4961. Do you know upon what principle it is made?—I believe it is by using sifted earth for the refuse to fall on and to be covered over by it. I think the difficulty would be to get the quantity of sifted earth that was required.

4962. (*Chairman.*) Do you use any engine power?—Yes.

4963. What do you do with the ashes?—We burn everything up to the clinkers.

4964. You have no refuse ashes?—No.

4965. (*Professor Way.*) If you are not near to a sewer the probability is that you are near some land, and would it be impossible for you to sift the earth that might be necessary for the earth-closets requisite for 30 or 60 persons?—Not impossible, but it would be expensive.

4966. (*Chairman.*) Could not you so arrange the privies that an iron cart should receive the refuse, and then let the farmers take it away as the manufacturers do in the valley of the Aire and Calder, perhaps from 700 or 800 people?—Such an arrangement is quite possible.

4967. Would not the farmers pay for it?—I really do not know, but I am afraid they would not pay anything for it.

4968. If you were put under compulsion, and you were forbidden any longer to pass refuse into the river, would you not be obliged to do something with it?—Yes, we should be under the obligation then of asking the farmers to come and fetch it away, and therefore they would not pay anything for it.

4969. If the manufacturers in the north can get their refuse taken away into the country with profit to themselves, would there be anything unjust in saying that you should do the same thing?—Perhaps land is more valuable there, and manure perhaps is of more value than in an agricultural district like this.

The witness withdrew.

Mr. Thomas W. Grindle (Hertford) examined.

Mr. T. W. Grindle.

4970. (*Chairman.*) Do you manage the outlet works here?—Yes.

4971. How long have you managed them?—For nearly nine years, since they commenced.

4972. What weight of solid material do you get out in a week?—Not more than about 4 tons, perhaps 4 tons 10 cwt.

4973. Do you sell it?—Yes, we get 2*s.* 6*d.* a ton for a farmer's ton, about 25 cwt.

4974. Do the same farmers take it more than once?—Yes.

4975. They find that it is worth the price they give for it?—Yes; one of them has spoken for a lot after having taken it for four or five years before.

4976. Do you take it out and let it get dry?—We merely cast it out and let it drain.

4977. Does it smell in hot weather?—It does if there is any rain when the warm weather comes.

4978. Do you use lime to cause it to deposit?—Yes; lime to deposit and chloride of lime to disinfect.

4979. What weight of lime do you use in a week?—About 7 cwt. a day.

4980. How do you mix it, by hand?—It is mixed by a small waterwheel, there is a fall of about 3 feet.

4981. How much chloride of lime do you use?—About 64 lbs. such a day as this; I vary it according to what state I should fancy the sewage is in when coming down. If we have not had wet weather for a long time, I should use more, because I should know that the sewage would be in a worse state than if the sewers had been freshly cleansed out.

4982. How long have you used chloride of lime?—I should say for 3½ years.

4983. Did you begin before the cholera made its appearance?—Yes; long before that.

4984. Did you begin when complaints were made as to the foul state of the outlet?—Yes, as the people of Ware complained.

4985. You used the chloride to disinfect the sewage to a larger extent?—Yes, I found that it destroyed that nasty spongy weed that you find in a ditch, to a certain extent.

4986. What is the value of the material that you use each week for disinfecting purposes?—I should say it was nearly 1*l.* a day.

4987. What amount do you pay for wages?—About 17*l.* 10*s.* a fortnight, or 8*l.* 15*s.* a week.

4988. Do you pay 450*l.* a year for wages?—Yes.

4989. And 365*l.* for material?—I would put it at 350*l.*, it is a very little less than 1*l.* a day.

4990. Then it is about 800*l.* a year that the works cost altogether?—It is over 700*l.* a year I know.

4991. Who finds that money?—The New River Company.

4992. On the other side, what amount of income is obtained?—25*l.*, but it is not a question of taking the manure from it.

4993. It is a question of purifying, or rather of clarifying the water?—Yes.

4994. Have you had that water analysed?—Yes, several times.

4995. After it comes from the works?—Both as it enters the works and on leaving them.

4996. Have you any copy of that analysis?—It may be obtained from the engineer, Mr. Muir.

4997. Do you remember what the purport of the analysis is?—I have never seen it.

4998. Have you seen a scum rising to the surface of the river after the water from your outlet has passed in from the deodorizing works?—Yes.

4999. Does that take place more in hot weather than in cold weather?—It takes place more in hot weather, but on the purest river a scum will rise, but not that peculiar scum.

5000. Do you know anything of the sewers in the town?—I have seen connexions made with them.

5001. Have any complaints been made about the want of ventilation in them?—I have been frequently spoken to about it.

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5002. Is there not a foul smell from the sewers?—There is more from the gullies than from the ventilators.

5003. It is from the gullies?—When I say the gullies, it is the grating that receives the washwater in the gutters, they are trapped.

5004. Would not that lead you to infer that the sewers require to be fully ventilated?—It is not so much from the sewers as from the cesspools or gullies.

5005. The gullies hold the sediment until it is cleared away?—No; at the time when these complaints were made it was a very dry season, there was very little or no water running along the streets, and there was a cesspool with a lot of stagnant water in it, and water will absorb any gas.

5006. The fact is, that a gully is a large cesspit to receive any sediment or deposit before it is passed into the sewer?—Yes.

5007. And the water becomes putrid?—Yes, unless it is changed; all gullies are upon the same principle, even in London. These are 16 or 18 inches, just large enough to put a scoop in. It was merely on account of the dry weather that the first complaint was made, and they did not keep a continual supply of water in those gullies.

5008. It was not gas coming back from the drain—No, there is too much water in those drains for there to be any great smell.

5009. (*Mr. Harrison.*) How are the sewers ventilated?—With an iron ventilator in the middle of the road.

5010. (*Chairman.*) Have you seen the method by which ventilators can be constructed so as to compel the gases to pass through a certain quantity of charcoal?—Yes; we have not tried that. We do not consider that we are bound to take away the smell.

5011. (*Professor Way.*) May I ask whether this is a case of divided authority?

(*The Mayor.*) The matter has been under the consideration of the corporation. The opinion of counsel has been obtained, and we are now in communication with the New River Company upon the subject.

5011*a*. (*To the witness.*) Who has charge of the drains?—The New River Company.

5012. Then the corporation have not charge of their own drains?—No.

(*The Surveyor.*) I may mention that the old drains, before the introduction of sewers by the New River Company, were made in each separate parish by the surveyor. There was no regular system about it. The fall was very little in the upper part of the town, and of course the old system was very bad. The New River Company were not bound to interfere with those old drains, but to intercept them, cut off their connexion with the river, and turn them into their sewers. In consequence of this there has never been any perfect system of drainage or sewerage, and the corporation has nothing to do with them beyond seeing that they are kept clean.

5013. You do not owe any allegiance to the corporation?—Not the slightest.

5014. You have the control of the drains?—The control of the sewers, not the drains.

5015. (*Chairman.*) When was the defect in the ventilation of the sewers first complained of?—It was first spoken about to me the year before last.

5016. That was a very hot year?—Yes, and a dry year. I may say that it was only a year before that that I had charge of the sewers.

5017. (*To the witness.*) Your sewers are ventilated in the same manner as the great majority of the metropolitan sewers by a shaft through which the gases escape in the centre of the street?—Yes.

(*Mr. Beardmore.*) Might I be allowed to explain that, when the New River Company laid down their new sewer through Hertford all the old drains had a fall to the river, and they bricked up the mouths of the sewers going to the river and made a thorough good stoppage of it, but the sewers still lie with the fall reversed; then the old gullies were also left, so that there are many things in the town which have not been altered, that the New River Company did not alter.

(*The Surveyor.*) I do not think there were any of the old drains left; they were intercepted and reversed some of them.

The witness withdrew.

Mr. William Pollard (Hertford) examined.

Mr. W. Pollard.

5018. (*Chairman.*) You wish to put in some papers, I believe?—Yes. This (*handing in the same*) is the original memorial from the corporation when they applied for 3,000*l.* to make new waterworks, and this is the counter memorial (*handing in the same*) which was agreed to and signed by a majority of the ratepayers of Hertford, and there is also the second rejoinder that we issued to the reply of the corporation.

5019. Are there any other documents that you wish to put in?—I have observed that you mentioned Mr. Ranger's visit to Hertford, and I have brought you a copy of the "Herts Guardian" (*handing in the same*), containing a report of Mr. Ranger's inquiry relative to the permission of the Lords of the Treasury to raise this money for the work to be done here. Mr. Armstrong was then acting on behalf of the ratepayers of Hertford in opposition to the corporation, but he was unable to attend at the meeting which took place when Mr. Ranger came down, and the bulk of the thing fell upon myself. That will account for Mr. Armstrong's name not being mentioned in that report, but he was acting officially for us. I have also a paper containing Dr. Taylor's report, but I have brought you a copy of it in print (*handing in the same*).

5020. Are these all you wish to put in?—Yes, the evidence is closed, and therefore I do not think I ought to take up your time, but I may perhaps say that the analysis made by Dr. Taylor resulted from some remarks that I made. You will remember that in August last the Privy Council recommended that all water should be boiled and filtered before it was used. The surveyor general to the Post Office sent a similar recommendation, and there was one also published in the Lancet. I had stated that I did not consider it advisable that the water which the public received from the new waterworks should be used without being boiled and filtered, and I believe it was in consequence of those remarks that an application was made to Dr. Taylor, and he made his analysis of the water; but it has always seemed to me that there was something very inexplicable in that report. Dr. Taylor gives a very favourable analysis. I do not say this with any idea of casting any imputation upon Dr. Taylor, but you know that the opinion of counsel sometimes varies according to the instructions that are given, and the questions that are asked. Dr. Taylor stated in his analysis that the water was pure, and I took the liberty to ask him by letter what he meant by those terms, whether he meant that the Hertford water was exceptional water, to which the recommendation sent all over the country that it should be boiled and filtered did not apply, or whether he meant that it should be filtered for making tea, or drinking cold. We have here many excellent springs of very pure water. I believe that no town is better supplied than Hertford is, and to those who drink water at their meals, it is of great consequence that we should have the best water we can get. To those who drink beer it is another consideration, because that water has been boiled. I asked Dr. Taylor with regard to what he meant by "Fit for drinking," and he said, "The words fit for drinking, "mean simply that the water is fit and proper to drink "cold. With respect to filtering, I think it proper,

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" under present circumstances, that all water for " drinking should be filtered if drunk cold." He furnished me with plans of the filters that he used in his own house, and after we have paid him 48*l.* 5*s.* for saying that this water is fit for drinking, he says that it is right and proper it should be filtered before it is drunk. I think I ought to add that we have some rather extraordinary evidence connected with the question of this water; it seems to me that the water from the river Lee is at times in a much purer state than at others. I fancy that the water that was furnished to Dr. Taylor for analysis was taken at a time when the river was in a purer state, and it is certain, from evidence which has been given voluntarily to me by tradesmen in the town [two of them being bakers], that the water at times is in an extremely offensive and disagreeable state. I inspected it at the request of a gentleman at the police office; it came, I believe, from the new works, and it was full of *animalculæ*. The inspector thought that the glass was not clean, and we took it a second time, and it was then full of animalculæ. Two days later I called at the house of Mr. Twaddle, who, a few days previously, had sent some water to the police office; some of it was drawn for me in a glass, it smelt disagreeably, and it had certainly anything but a pleasant taste.

5021. When do you consider the river Lee is in its purest condition; when it has the clearest water in it, or the muddiest?—I can hardly say, but I think when it is muddiest it is in the purer condition. I think I ought to say one word as to the commercial interests of the neighbourhood. I am always in direct communication with the principal merchants and millers of this locality, and I can assure you that they would regard with great jealousy any attempt to remove any further quantity of water from the river Lee for the purposes of the large London consuming companies. I believe their opinion is that your suggested reservoirs would be a very excellent scheme, if it could be carried out, in order to secure the flood water and bring it into the river at proper times, and not to admit any sewage water into the Lee at all if you can get rid of it by any other means. I have seen a good deal of Dr. Gilbert, the right hand man of Mr. Lawes, the manure manufacturer, and at his house I have met Mr. Campbell, who has been conducting sewage operations. Mr. Lawes and Mr. Campbell have both been conducting experiments at Rugby as to the town sewage, and I know that the opinion which Dr. Gilbert, who is Mr. Lawes' right hand man, and Mr. Campbell, have expressed is this, that you do not get rid of the poisonous matter of the sewage by the deodorizing process; that the refuse matter which is carted away by the farmers is comparatively innoxious compared with the water; and that the water which goes down from these works contains the quintessence of the poisonous matter. They seem to consider that you should prevent any water of that kind from going into the rivers from which water was afterwards to be supplied for drinking purposes. Personally I have had but little to do with Mr. Lawes, it has been principally with Dr. Gilbert, but I know their opinion is, that the water that comes from the deodorizing works is so poisonous that it ought not to be mixed with water from which towns afterwards draw their supply.

The witness withdrew.

Adjourned to Wednesday, 16th January 1867, at Ware.

Ware, Wednesday, 16th January 1867.

PRESENT:

ROBERT RAWLINSON, Esq., C.B., IN THE CHAIR.

JOHN THORNHILL HARRISON, Esq. | Professor JOHN THOMAS WAY.

Mr. NATHANIEL COBHAM (Ware) examined.

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5022. (*Chairman.*) You are a solicitor?—I am.

5023. Are you clerk to the local board of health for the district of Ware?—Yes, and I have been since its formation in 1849.

5024. What is the population of Ware?—Nearly 6,000.

5025. Do you know what it was in 1849 when you adopted the Public Health Act?—Not exactly, but there has not been a very great increase.

5026. Is there any official report that was made in 1849?—No.

5027. How were you able to put the Act in force—was it done without a report being made?—We went through the necessary forms to enable us to put it in force, and we adopted it in 1849.

5028. Was any inspector sent down?—Yes, Mr. Ranger came down, and he reported upon the state of the town, and as to the desirability of having a board of health here.

5029. Have you a copy of that report?—No.

5030. How long have you known the town of Ware?—For 45 years.

5031. Is the town situate on the river Lee?—Yes.

5032. Is the river navigable up to Ware?—Yes, and to Hertford, which is two miles further.

5033. What is the principal business carried on in Ware?—Malting, and there are large brickfields besides, but malting is the principal trade.

5034. Is there much manure brought either up the navigation or taken down?—There is a great deal of manure brought up from London.

5035. Is that discharged on to the towing-path or banks of the canal and river?—Yes.

5036. Is there any system of sewerage in the town?—Yes, the town is under-drained from the commencement of it to the end of it.

5037. Who laid out the sewerage?—There was some sewerage before the board of health was established, and some has also been made since under the direction of the surveyor.

5038. Where do the sewers empty themselves?—We have five sewers that empty themselves into the river Lee.

5039. Are there any disinfecting or depositing tanks of any kind at the outlets?—No, none are required as far as smell is concerned.

5040. Does the sewage go directly into the waters of the Lee?—I wish to say that the sewer that Mr. John Marchant spoke of at Hertford as the main sewer is not at all the main sewer of the town—he was mistaken in what he said—there is a sewer of about 4 feet in diameter, that was made some 45 years ago for the purpose of taking down the flood waters from the town, since that time all the under-drains in that part of the town have been drained into this sewer, but the sewer itself was made entirely to carry off the flood waters. I should tell you that in the upper part of the town originally, and as long as I can remember, there was a sort of open ditch which was washed down by the water from the Lee twice a week, of course all the filth and manure of the town were washed down the street and went down just where this large sewer is that Mr. Marchant spoke of; it went down there where the sewer is now; it used to go down the surface of the street, all the flood water that came down discharged itself into an open sewer

2 or 3 feet deep. In order to get rid of that the trustees of the Cheshunt trust made this large sewer to bring down the flood water, they took it through private property; they did not adopt the plan that they had. Under a blacksmith's shop nearly opposite to where it goes down, by Mr. Gosling's, that is a covered sewer.

5041. You take down now in a covered sewer what formerly went down in a surface channel?—Yes.

5042. Are there many waterclosets constructed in Ware?—The surveyor will give you the exact number. I think there are altogether 260.

5043. Do you know what number of butchers there are in the town?—Seven or eight.

5044. Have they private slaughter-houses attached to their premises?—No, they are not attached to their premises.

5045. Whatever killing takes place is done in private slaughter-houses?—Yes.

5046. Where does the drainage from those slaughter-houses go?—They are not drained into the river at all, the refuse is taken away in carts.

5047. Are they drained into cesspools?—Yes; one is drained into the river.

5048. Is the blood always carried away?—Yes. I have said that one is drained into the river, but the blood is not drained in, the washings of course go.

5049. If there is any drainage from any of the slaughter-houses it will go the way of the other drainage?—Yes, for that one which I have mentioned, the others drain into cesspools, but they do not allow them to overflow.

5050. Is there an inspector of nuisances for the town?—Yes, he will be here to be examined.

5051. Are there any markets or fairs held in the town?—There is a market every Tuesday, and two fairs which are held in April and September.

5052. What is sold in the market that you have every week?—It is for the sale of corn and cattle.

5053. Where do the washings from the streets and the dirt caused by the cattle go?—We have not a sufficient number of cattle here to have any washings.

5054. The cattle brought to market are not numerous?—No.

5055. What is the chief trade of the district?—Malting; it is the largest malting business in the kingdom, we have returned upwards of 200,000 qrs. of malt.

5056. What value in money do that quantity represent?—I have a return here from the collector in the district, and the figures are 256,224 qrs.

5057. What would the average price be?—78*s.*

5058. Is barley grown in the district?—There is very little barley grown in proportion here, it is brought from all the surrounding counties, Norfolk, Essex, and Cambridge.

5059. Is it brought to Ware by railway partly and by the river?—The barley is chiefly brought by the railway.

5060. Does it go away as malt by the river or by the railway?—Chiefly by river—by far the greater proportion after it is made into malt—they could not take it all away by the railway.

5061. Will any practical maltsters be here to give evidence?—Yes; the information that I have obtained was from the collector.

5062. Is there any public water supply in Ware?—No.

5063. How do the inhabitants obtain their water?—They get it from pumps on their own premises.

5064. What is the subsoil?—Gravel overlying chalk in all this part of the town, lower down beyond the bridge the subsoil is boggy.

5065. Do they obtain an abundant supply of water by sinking wells?—Yes.

5066. If there are only 250 waterclosets in use, I assume that by the rest of the population cesspools are used?—Yes.

5067. Are they sunk into the same gravel that you get the water from?—Yes.

5068. You have a system of wells for water supply, and cesspools or cesspits for storing the refuse?—Yes.

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5069. Are those cesspits or cesspools emptied by the individuals who own them, or is that operation considered to be a part of the duty of the board?—They are emptied at the expense of the individuals.

5070. When they choose, I suppose, to give you notice?—No, it is the duty of the inspector to take care that proper notice is given to the parties when the cesspools get full.

5071. Are they served with a notice?—Yes, if they require it, and they are liable to a penalty if the cesspools are found to be full without any notice under the byelaws of the board.

5072. Are any regulations laid down as to the time when they are to be emptied, or are they emptied indiscriminately, or at any time?—No, the parties are bound to have them emptied between 12 o'clock and 4 in the morning in properly covered carts, and the sewage has to be conveyed out of the district.

5073. Has there been any complaint of a nuisance being caused during the time when those places were being emptied at night?—It is the business of the inspector to take care that there should be no cause for complaint, and that they should use ime.

5074. Have you a cesspool at your house?—No, a watercloset.

5075. Have you ever passed by at night when the cesspools were being emptied?—Yes, I have smelt them offensively, on coming home at night from a party.

5076. You would say I suppose that generally where the matter has become putrid it is offensive, and its offensiveness would be in proportion to the kind of weather when the emptying takes place?—No doubt of it.

5077. In hot or damp weather it would be more offensive than in dry weather?—Yes.

5078. As a local board have you any public debt?—Yes.

5079. For what purpose was it incurred?—We incurred a debt for paving purposes.

5080. To what extent?—1,500*l.*

5081. Have you repaid any part of that debt?—Yes, we are paying it off at the rate of 150*l.* a year and the interest; we borrowed 1,500*l.*

5082. Have you ever discussed at the board the desirability or otherwise of having a public water supply?—We have discussed that question several times.

5083. Where do the maltsters get their water?—From wells of their own.

5084. Is it pumped up by engine power?—No, it is pumped up by hand except in one instance.

5085. Is there little or no engine power used in Ware?—None; except that the New River Company have an engine.

5086. What do coals cost you for domestic purposes in Ware?—About 26*s.* a ton, sometimes less, never so low as 20*s.*, I mean delivered at 26*s.*

5087. Is any part of the town or the neighbouring district liable to be flooded in times of excessive floods from rain?—We have had immense floods, but the town of late years has not been flooded.

5088. What part of the district is generally flooded?—The meadows are flooded constantly, but the town itself is not. Years ago, and until means were applied for the better getting off the water by the trustees of the Lee, I have known Amwell End to be so flooded as to be impassable.

5089. Have you heard complaints made with regard to that flooding, as to its causing disease, or fever, or making the place unhealthy?—None; I believe that Ware is an extremely healthy place, owing to the subsoil being gravel.

5090. To whom does the land which is flooded belong?—To different owners.

5091. Not to any large landed proprietors?—No.

5092. Have you any large landed proprietors in the neighbourhood?—No, not adjoining the river.

5093. There are no large landowners owning pro-

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perty in the town?—No, there are some large proprietors of land lying outside the town, but not adjoining the river.

5094. There is nothing that impedes the growth of the town?—No.

5095. By whom is the house property owned—by separate private owners?—There are a great many owners; we have no noblemen who have any control over the property, it is a great deal dispersed; the maltsters hold property of their own.

5096. Is the land generally held on leasehold or freehold tenure?—Freehold.

5097. What does land sell at in the town per square yard?—The price varies very much. When we laid out a new street, the land fetched from 50*s.* to 3*l.* for building purposes. Land is dear in the neighbourhood, from 80*l.* to 90*l.* an acre.

5098. May we take it that Ware is at the present time a thriving place?—Yes, I think so. There was more malt made in Ware last year than had ever been known to be made before. The town was very much depressed a few years ago in consequence of the failure of a bank, but since that it has recovered itself.

5099. Do you remember what number of applications have been made to the local board of health, or were made last year, for new buildings?—No.

5100. I suppose that all persons are required before hand to deposit plans and to give you notice of their intention to build houses?—Yes, they are required to deposit plans and to show what drainage is intended, and I may state that there was an instance the other day in which a London builder did not furnish any plans, and he was summoned before the magistrates and fined, but only nominally—there was no desire to press upon him because it had been evidently done without knowing what the laws of the town were.

5101. You have had considerable experience of the working of the Public Health Act, and the Local Government Act?—Yes.

5102. Have you found them of any advantage to the town?—I consider that they have been a very great advantage, the town is in a very different state now, indeed I think it would hardly be known by persons who knew what it was 20 years ago.

5103. Has there been any unpleasant interference with your affairs by the central board?—No, they have never interfered with us in any way.

5104. Have you ever had occasion to ask advice of the central board as to what it would be best to do under certain circumstances?—Never; the board here have always conducted their own affairs, quite independently.

5105. You would say then generally that in your transactions with the central board in London you have never been obstructed or improperly interfered with?—Never.

5106. Upon the whole you believe that you are better off on account of having adopted the Local Government Act?—Yes, I am quite sure that we are very much better off.

5107. What number of members do you elect on the board?—We elect three members annually; the whole board consists of nine.

5108. You have a clerk, surveyor, and inspector of nuisances?—Yes, and an officer of health.

5109. Is it unfair to ask you what the salary of the clerk is?—No, I receive 100*l.* a year, which includes all the law expenses, whatever they may be, except cash out of pocket.

5110. For that remuneration you attend the board and keep their minutes either by yourself or by one of your clerks?—Yes, I conduct all the correspondence.

5111. You transact the whole of the law business?—Yes, free of expense, except money out of pocket.

5012. What does the surveyor receive?—30*l.* a year.

5113. What do you pay the inspector of nuisances?—25*s.* a week, and he collects the rates for the board.

5114. He is both rate collector and inspector of nuisances?—Yes, for the board.

5115. What does the medical officer receive?—10*l.* a year.

5116. How often does the officer of health report to the board?—Every board day; once a fortnight.

5117. Are those reports verbal or made in writing?—In writing.

5118. If it was required, could you give us an abstract of them?—They are here to-day.

5119. Have you any suggestions to offer relative to the special purpose of our inquiry?—I may say that I do not see that it would be possible to divert the drainage of this town in any way, as the water from the maltings alone passing through our sewers in the malting season amounts to 37,000,000 of gallons, that is during six or seven months, and it all passes back into the river.

5120. What do you infer from that fact?—That I hardly know how it would be possible to take our flood water and 37,000,000 of gallons from the maltings into any place for drainage.

5121. Have you any idea what sized sewer would be required to pass off 37,000,000 of gallons in the months you have mentioned?—It is not the passing it off only, it is the stowing of it away.

5122. You are supposing that it should be dealt with and not allowed to pass into the river?—Yes.

5123. Do you know whether there is anything in that water that would make it desirable for irrigating purposes; what does it contain?—I do not know, that is rather a chemical question, but the water when it comes from the cistern is not disagreeable in itself. If it is allowed to become stagnant it vegetates, and then becomes very offensive.

6124. Is there any other difficulty that you can point out that presents itself with regard to your sewerage?—Yes, the fall through the maltings is all to the river, and I cannot conceive how you could get it away unless you made drains for the purpose.

5125. Do you see any difficulty in dealing with the sewage proper?—I see the same difficulty, because all the malting water is drained into the sewer and mixed with the sewage and the flood water.

5126. If the Legislature were to forbid you to pass foul water of any kind into the river, do you suppose that that would impose upon you a serious difficulty?—Yes, I do. I conceive that it would be one of the most unjust things that ever happened to any town. I look upon the navigation to be one of the great highways of the country, and into it this town has always drained.

5127. Are you aware what number of people are supplied from the Lee with drinking water in London?—Not at all.

5128. Will you be surprised if I tell you that something like one million of persons are dependent upon the river Lee for their supply of water for domestic purposes?—No, I should not be surprised at it at all.

5129. If health is the first requisite in the world, and if, to preserve it, it is necessary to supply the people with wholesome and pure water, is there anything you can put in the opposite scale when 1,000,000 of persons are concerned?—With regard to the schemes which have been suggested for the purpose of taking pure water to London, I do not think, as far as the river is concerned, that you can have a supply of pure water in London from any open river like the Lee.

5130. You probably think that it would be better to bring in, as has been proposed, pure water from the lakes of Cumberland, or elsewhere, and leave the Lee to be used for the purposes of navigation?—Yes, decidedly; because if you shut up the river Lee, and this town is not to have the use of it for navigation, you might as well shut up the town altogether; you would seriously injure or do away with the malting trade altogether.

5131. You are of opinion that for the interests, not only of this town, but of the district, you must preserve the river Lee as a navigation?—No doubt of it.

5132. According to your views you are to make use of the river Lee as the medium of draining the country?—No, I do not go quite so far as to say that you

are to allow all kinds of drainage from manufactories, or to let all kinds of poisonous matter pass into the stream; but as to any drainage that passes as it does from this town into the Lee, that is, malting drainage, and the drainage of the town going in as it does at so many different places, I say that there is no smell from it at any part of the town. As I stated before, the main drain, that was so spoken of by Mr. Marchant, is not the main drain, and as the drainage passes off there is no smell from it whatever.

5133. Looking at the question in a common sense point of view, if you had only the soluble portions of the sewage from one watercloset, whether it smelt or not, to deal with, do you think you could divest your imagination of the thought that it was poisonous if it was to be drunk?—I do not believe that when once the poison is in you can get it out.

5134. If poisonous matter passes into the river Lee and the water is afterwards to be drunk, do you think that ought to be so?—I say that I think it ought not to be so.

5135. That is to say, you would prevent people from drinking the water of the Lee?—Yes.

5136. You would not attempt to purify it?—I would not have the river Lee made a cesspool of, but I think that all matters that did not cause a nuisance ought to go in. I may mention that the New River Company, when they applied to Parliament for a bill some years ago, had a clause inserted in the bill to prevent the sewage of Ware going into the Lee. The board of health instructed me to oppose that clause, and I think I attended the committee of the House of Commons for 23 days for that purpose. The committee struck out that clause, and introduced a clause preserving the right of the board of health to drain into the Lee; that was in 1851.

5137. Have you seen the new Act which has been obtained by the Conservators of the river Thames?—I have not read it.

5138. I should recommend you to look at it carefully and see what Parliament has done in that case?—I will do so. The great thing that we have to contend against is the sewage from Hertford, which creates the greatest possible nuisance in this place; their sewage is brought down all together, while ours passes in at a variety of places. The board were advised with reference to the Hertford sewage to take the opinion of counsel, and the opinion of counsel was that the New River Company ought to be indicted.

5139. (*Mr. Harrison.*) They take steps at Hertford to disinfect their sewage do they not?—Yes.

5140. Notwithstanding that, you say that a nuisance is caused to the inhabitants of Ware by the sewage of Hertford?—Yes, and so much so that people cannot sit in their own summer-houses or be on the water at certain times. I have communicated with the trustees of the navigation upon this subject several times.

5141. Is there a deposit caused in the river?—The sewage creates a sort of fungus on the top of the water. The drainage of Hertford comes into a piece of still water, and when the barges pass through a lock the water that comes down is most offensive.

5142. How far below Hertford is the first lock?—At a distance of about a quarter of a mile.

5143. What fall is there to that lock?—About 8 feet.

5144. How far is it from that lock to the next?—Two miles along the watercourse.

5145. How much fall is there between the two?—I am told that there is a fall of 11 feet in the two miles. The Hertford sewage comes down what is called the Manifold ditch into a still piece of water; it passes only through one lock before it comes here.

5146. Is there any land on the side of the Lee that you think might be obtained on to which the sewage might be passed for irrigating purposes?—The New River Company had a clause introduced into their bill by which they proposed then to take the Hertford sewage right away below Ware along the river Lee, but the New River Company were not to carry that part of the bill out unless they liked, but they bought land of a gentleman who is present, for the purpose of taking the sewage of Hertford below the town of Ware.

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5147. Is there any land below Ware upon which the sewage of Hertford might be applied in the way of irrigation?—Yes, no doubt there is.

5148. Do you think you could obtain that land without any difficulty?—I do not think any land could be obtained anywhere near here without difficulty.

5149. Are you aware that sewage when applied to land in that way is found to be most fertilizing and profitable?—I think it is so, but not so much after it has been deodorized; when it is taken directly on to the land I have no doubt it is as you say, but if it is first deodorized my opinion is that the virtue is taken out of it.

5150. In this case you appear to have a fall of 11 feet within a distance of two miles of the town, that is abundant fall to enable you to apply the sewage of Ware to the land?—The fall of 11 feet is above Ware, and I believe there is about the same fall between Ware and Stansfield.

5151. There is abundance of fall from Ware downwards, is there not, to enable you to apply the sewage of the town to the land without any pumping?—No doubt of it.

5152. You say that you know it is profitable, and if the sewage could be applied to land without any pumping there would seem to be no hardship in calling upon the inhabitants of Ware to apply it to the land?—I do not know where you are to go; as to the sewage from the maltings, according to the fall that there is now, you could not get that back into the town.

5153. (*Professor Way.*) I think you stated that it would not do to shut up the navigation?—The question has been asked, I think.

5154. Do you think it would be impossible, while the navigation was preserved, to improve the condition of the water?—No doubt the purity of the water would be improved if you were to shut out the drainage.

5155. Do you know of any reason why that should not be done in Ware as in other towns?—It would be attended with enormous expense to the town unless it were done at the expense of Government or at the expense of the large water companies.

5156. What should you consider an enormous expense?—I hardly know, but I hear that it would be an enormous expense to the town.

5157. You have stated that 37,000,000 of gallons of water were discharged from the maltings in six or seven months, which is something like 200,000 gallons a day?—I mentioned that quantity as being something like what you would have to deal with if you had to stow it away in any place; I mean a place to receive the sewage of the town.

5158. (*Chairman.*) I wish you to dismiss from your mind the idea of stowing away; this Commission will never recommend the stowing away of that which would grow more corrupt every day?—I am glad to hear you say so.

5159. (*Professor Way.*) There is that certain quantity to be dealt with every day, 200,000 gallons, which are only one-fifth of a million, and 1,000,000 gallons of water are dealt with every day at Croydon at this moment without any trouble?—Then you must take the large sewer that comes down the town, which is a 4-feet sewer, and that is full of water in flood times, full to the brim.

5160. (*Chairman.*) Does that sewer also convey the town sewage?—Yes, that is the one Mr. Marchant spoke about as being the main sewer of the town; it takes away the flood water and a portion of the sewage of the town only.

5161. (*Mr. Harrison.*) Does the water from the maltings pass into a part of the river that is stagnant?—It passes into a variety of places.

5162. Is the navigation stagnant?—No part of it.

5163. Is it always on the move?—Yes; Ware mill

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is situated above the town, and the water in that part of the river is always passing downwards.

5164. (*Professor Way.*) There is no reason, is there, why the same thing should not be done here that is found to be advantageous when done in other towns?—No, all things being equal.

5165. Mr. Harrison has elicited from you that there is a fall by which the sewage of the town might be passed away?—No doubt there is.

5166. You have also stated that there is a larger malting trade carried on in this town than in any other town in the kingdom?—Yes.

5167. I suppose you know that in the act of converting barley into malt a certain quantity of the substance of the barley is taken away in the water in which it is steeped?—Yes.

5168. Do you think that that is likely to be injurious to land?—No.

5169. Does not it follow that the sewage of this town, plus the water from the maltings, would be better than ordinary sewage?—Yes.

5170. Does not that lead to this, that there could be no serious difficulty in dealing with the sewage of this town and possibly a great advantage?—I think there is a serious difficulty in getting rid of the drainage from the maltings and from the town.

5171. (*Chairman.*) Are you of opinion that the water from the maltings would be a benefit to the land rather than an injury if applied economically?—Yes, I think it would be.

5172. Would it not take back to the land that which would be beneficial to it?—Yes.

5173. Are there any water meadows in this neighbourhood where irrigation is practised?—None that I know of.

5174. Did you ever see waters meadows so treated?—No.

5175. You know, I presume, that there are places where irrigation is carried on by spring water?—I do not know that.

5176. I suppose you would think, that if something was put into that water to add value to it as manure, it would be more advantageous to use it?—No doubt of it.

5177. If town sewage is passed into a certain volume of water, and the refuse from the steeping of malt, which contains solid ingredients that would be beneficial to land, is also passed in, I suppose you would consider it so much better than spring water?—No doubt of it.

5178. And the only other question to be considered would be the cost of the apparatus, the labour required for putting it on the land, and management?—Yes, no doubt of it.

5179. You have never witnessed the irrigation which is carried on at Croydon, Worthing, and Norwood?—I have not.

5180. Have you never read anything about it?—Very little.

5181. Do you know what weight of hay is usually taken off a rich meadow?—I took five loads off $2\frac{1}{2}$ acres the year before last.

5182. What might that represent in weight?—It was above 36 cwt. per acre; but it was an exceedingly good crop that year, for there was hardly any grown.

5183. Are you aware that your meadow might be made to yield 10 times that weight?—I should be very glad if it could; I think it might be made to produce a great deal more by passing sewage matter on to it.

5184. (*Professor Way.*) You have no reason to believe that your town is worse situated than any other town you know of for the disposing of the sewage as has been suggested on the land?—No, if there is sufficient fall, certainly not.

The witness withdrew.

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HENRY BUTCHER, Esq., (Licentiate of the Royal College of Physicians, Edinburgh,) examined.

5185. (*Chairman.*) You are medical officer of Ware?—I am.

5186. How long have you known the town of Ware?—Nearly 30 years.

5187. How long have you practised as a surgeon?—Altogether since 1828.

5188. We may assume, I suppose, that you have had very considerable experience in this district?—Yes.

5189. Are there any special types of disease connected with the district that you can name to us?—No, I think not.

5190. Do the inhabitants never suffer from ague?—Never.

5191. Or from any low type of fever of any kind?—Very seldom; not as a rule.

5192. Do the people suffer from gastric fever at all?—Very seldom.

5193. Do you meet with typhoid fever?—Hardly ever.

5194. Or typhus fever?—Yes, at times.

5195. Have you ever had cholera here?—Yes, once since I have been here.

5196. In what parts of the town have you had to to treat cases of typhus, in what class of houses, and what class of people?—The worst cases of typhoid fever have occurred up at Musley in the new cottages that have been built there. I have had one serious case lately to treat, but that may be said to have been brought from London. The patient whom I was called in to attend had been to London to visit her father; I will with your permission read an extract from the entries contained in this book; this is a report of mine, "I beg to call the attention of the board "to the extremely dirty condition of some cottages in "Musley, particularly to one which I have already "named to the inspector of nuisances. I have met "with none so filthy for a long time, it consists of "three small sleeping rooms, and up to within a few "days they have been occupied by the lodger, his "wife and three children; the tenant of the house, "his wife and two children. The wife of the lodger "is dangerously ill with typhus fever, caught proba-"bly whilst on a visit to her father in London who "died from fever about five weeks ago; a sister died "from the same cause about three weeks before, and "the mother on Friday last. I called the attention of "the relieving officer to the case on Tuesday last; "he refused to interfere, and up to this evening has "made no personal inspection, and I shall not be at "all surprised if the fever becomes of serious conse-"quence to the immediate neighbourhood."

5197. After you had made that report to the local board, did they cause the house to be purified?—I believe it has not been done yet. This was on the 10th of December, and there has been fever ever since in that house.

5198. Do not you think that in that case the board would only do their duty by taking possession, legally or illegally of that house for a short time, for the purpose of cleansing and purifying it?—Yes, and I called the attention of the relieving officer to the matter on Tuesday last being also a guardian of the union, but as I said before he refused to interfere, and up to the evening of the day when I made the report had made no personal inspection. I should explain that the relieving officer refused to interfere because the husband was said to be earning 5*s.* a day; he did not even go to inspect the house, and when the case came before the guardians, before whom I brought it a day or two afterwards, they decided that he ought to have gone to inspect the case and have given relief. If the party had been in a condition to have paid afterwards it ought to have been done in the way of a loan.

5199. Might you not compare the existence of fever in one small spot to a large farm building which had caught fire and had just begun slowly to burn, and which a few buckets of water would at once extinguish, whereas if no attempt was made to arrest the progress of the fire the whole place might be burned down?—Yes.

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5200. And so if that particular house had been dealt with in the case you have mentioned, the spread of typhoid fever might have been prevented throughout the district?—I believe that a great deal might have been done, and that was my object in bringing the matter before both boards as I did.

(*Mr. Cobham.*) May I be allowed to say with respect to that report of Mr. Butcher's, that the inspector of nuisances received orders to visit the house immediately, to use disinfectants, and to see that the parties did everything that was required to be done. Disinfecting fluid was entirely at his service. I should, perhaps, add that this happened at a time when the board had adjourned for a month in consequence of the Christmas holidays.

(*Witness.*) The disease has not yet disappeared from that house, and the occupier, a woman, is still suffering.

5201. (*Professor Way.*) How long has that woman been ill?—I think I was called in about the 7th or 8th of December.

5202. And fever exists there now?—Yes.

5203. (*Mr. Harrison.*) Were you called in as medical officer of the board of health?—No, I was called in as a private practitioner.

5204. Were the parties in distress and in want of relief?—Yes, so far that there was not proper nursing provided; the woman was occupying a room with three children, and although the man was said to be earning 5*s.* or 7*s.* a day when employed, he had been ill himself some time ago with diarrhœa; some months back after coming from London at the time the cholera was prevalent.

5205. Was he at the time receiving 5*s.* a day?—Yes, and that was the relieving officer's excuse for not going. (*The witness subsequently informed the Commissioners that the illness of the above-mentioned female patient had terminated fatally.*)

5206. (*Chairman.*) Have you at any time had occasion to suspect the purity of the water that the people were drinking in places where fever and disease of any kind has been prevailing?—Yes, I have; there were three or four cases which I noticed in my reports, and in one place the water used to be very pure in one of the wells, but there has been a privy erected near it and that has polluted the water, so that it cannot be used for domestic purposes.

5207. (*Mr. Cobham through the Chairman.*) Are you aware that that well was stopped up and a new well sunk after you made your report?—Yes; I believe it has been done since.

5208. (*Chairman.*) Have you found in your experience that the use of impure water produces disease in this town?—No, I think the case I have mentioned is quite an exceptional one. The water in the wells of Ware is very good indeed. My attention has been called to the river Lee occasionally, and I have reported upon it. On the 12th of December 1864, I reported in these terms, "Last week on crossing "Ware bridge I observed the river Lee covered "with a black oily scum, which on close examination "I found was in a state of fermentation, and giving "out bubbles innumerable of gas. A large quantity "of seething and putrid mud was deposited by the "edge of the river. Whence it came I could not "satisfactorily ascertain, for on proceeding with the "local inspector to the outlet of the Hertford drain-"age all was clear and limpid." I was told by the relieving officer that the stench was very great indeed. "Still the matter, which I have no doubt, on analysis, "would be found to be of a poisonous character, might "and did most probably float from thence, that part of "the river having had time to clear itself before we "visited it." I thought, as the water there comes, as it were, upon a dead level, that it had remained there until it got agitated by barges going backwards and forwards, and that that in a great measure caused the stench. Opposite to this place there are houses, and the gentlemen occupying them have summer-houses, which they used to occupy very much. One gentleman made use of his summer-house as a study, others used to take their meals in their summer-houses, particularly their tea, but all of them, I have understood, have been obliged to give up this practice on account of the stench. I have further been told that gudgeon cannot now be found, that they have quite disappeared from that part of the river. That is all I have to say as to the condition of the drainage.

5209. You are a guardian of the poor?—Yes.

5210. How long have you acted as guardian?—I should think 15 or 16 years.

5211. Can you put in a tabulated return of the rates of mortality compared with the population?—I have gone through the reports for the last two years made by the sub-registrar of the deaths, and I find that the deaths between January 1865 and January 1867 were 231, taking the population of Ware—the population of St. Mary's being 3,400 in 1858 and of Christchurch 1,200—but the register contains also those who have died in the neighbouring parish of Thundridge. I might point to the lamentable amount of deaths among the children under two years of age, no fewer than 63 out of 231; there were 15 deaths above the age of two and under 21, 52 above 21 and under 60, 101 above 60 and up to 100; the average age of these put together is 73 and 4 months, so that Ware does not appear to be a very unhealthy town.

5212. Are the children of the town employed in any kind of occupation?—Not any.

5213. (*Professor Way.*) Are any young children brought into the town to be nursed?—No; I find that the diseases are principally catarrh and of a bronchial and rheumatic character. There is some diarrhœa in the autumn, but not excessive, and fever is generally of an endemic character; it appears in Musley and also at a place in Amwell End, where there are a number of new houses, and I never could understand why it was not included within the jurisdiction of the board of health; it is a small place which is just left out.

5214. (*Chairman.*) Judging from your past experience, do you think that if people could be induced to be cleanly in their persons, to be temperate in their lives, and could protect themselves from cold and wet when out of doors, and their dwellings were properly ventilated, you would have very little fever?—I think we should have less fever than we have; still, I have never known any real epidemic here. Scarlet fever one year was very bad, and also cholera once, but it was not so bad as it was elsewhere.

5215. When were you troubled with cholera?—I think 10 or 12 years ago.

5216. Was it in 1849 or 1850?—I believe it was about that time.

5217. Are there any common lodging-houses in the town?—Yes.

5218. Are they regulated under the Common Lodging Houses Act?—I believe so; they are visited by the inspector of nuisances.

5219. What is their condition at the present time compared with what it was before the Common Lodging Houses Act was passed?—The houses are very much cleaner; the worst one was pulled down and a very excellent house was built on its site; it is not much occupied.

5220. There has been great improvement in that respect?—Yes.

5221. Has there been in consequence a diminution of sickness?—I think there has been a general improvement in the town; we have never had anything very serious, only a few isolated cases of fever. The town has certainly been improved since the Local Government Act came into operation; the pavement of the town is better, but still the surface drainage is not what it ought to be. In Amwell End in some of the courts I have understood that the fall is not sufficient to do what is necessary. I have reported frequently upon the state of the drainage, and that has been generally the answer I have received, that the fall is not sufficient.

5222. Have you ever been called in to attend poor persons in fever-stricken and overcrowded places, at night, for instance?—Yes; in the course of my prac-

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tice I have been called up at night to go and visit them, but I do not know anything special about it.

5223. What kind of atmosphere have you generally found in those dwellings?—Very close indeed. I remember some years ago in a place called Caroline Court, which is now much improved, I had some severe cases to treat, but they were quite endemic cases; they were confined to that spot.

5224. (*Mr. Harrison.*) Can you call to mind any other cases, besides the one you have mentioned, of the water being polluted?—I cannot call to mind any others just at this moment, but there were one or two pumps, I believe, which were not situated very conveniently for the traffic, and which were closed; but the people finding it inconvenient to have them closed, I believe the board of health had them reopened.

5225. Knowing of these cases, and knowing also that the town of Ware is situated upon a substratum of gravel with a number of cesspools in the town, do you not think that the water is liable to be contaminated in the way you have mentioned?—I do not think it is.

5226. Why not?—Because I think that the pump which I have alluded to got contaminated from a privy that had been erected. I have never heard of any other pump or well being rendered offensive by any drainage.

5227. Have you had the water analysed?—No, I have not. With regard to the Hertford drainage I may state that nothing can look better; it is most inviting in appearance.

5228. May not that be the case in your town as well?—I have never heard any complaints made; on the contrary, everybody has praised the water and thought it most beautiful.

5229. (*Professor Way.*) You have been asked generally whether you have as a matter of fact traced any connexion between bad water and disease, and you said, "No"?—Yes, I say that personally I have not.

5230. Do you not believe that that is possible?—Yes; but I have not in my experience found any disease arise from bad water in this town; that is to say, I could not trace it.

5231. Do you believe or not that bad water will produce disease?—I believe it will.

5232. (*Chairman.*) Do you believe also that you may have bright sparkling water that shall not be wholesome?—Yes, I believe it is so; that it may contain any amount of poison, and yet be bright to look at; there may be oxalic acid in it.

5233. Would you be surprised to learn that into the river Lee there are tons of oxalic acid poured every year?—I was not aware of that.

5234. At Luton there is a population of 20,000; and in bleaching the straw plait and dyeing it they use oxalic acid, and tons of it in the course of a year pass into the Lee?—I have understood that some went in. We might also say that the surface drainage here would tend to pollute the river Lee, because there are barge loads of manure that are brought in and put upon the soil, and of course the first shower of rain may wash that into the river.

5235. Would not that tend to pollute it?—Yes, and it does.

5236. You probably know, from your own experience, that out of 1,000 people there may be perhaps only one who is affected by a particular medicine in a particular way?—Yes.

5237. So that an infinitesimal dose of that medicine will affect that person?—Yes.

5238. And so with well poisoning, there may be a great number of people with robust constitutions who will not be affected by it?—Yes.

5239. Have you anything further to add?—No.

The witness withdrew.

Mr. GEORGE HITCH (Ware) examined.

Mr. G. Hitch.

5240. (*Chairman.*) You are surveyor to the local board?—Yes.

5241. How long have you held that appointment?—Nine years.

5242. Do you do anything else but attend to the business of the board as surveyor?—Yes.

5243. What other occupation do you follow?—I am a barge builder.

5244. You are a kind of honorary surveyor to the local board, for which you receive 30*l.* a year?—Yes.

5245. What duties do they expect to be performed by you?—I superintend all the drainage, and I have to examine all the plans that are laid before the board.

5246. For new buildings?—Yes.

5247. You examine them to see whether the parties comply with the requirements of the Act or not?—Yes.

5248. Do the board meet fortnightly?—Yes.

5249. Have you devised and carried out any sewers yourself in the town?—I have carried out some of the branches, but not the mains.

5250. If persons wish to drain their houses into the sewers, are they obliged to give notice to the board, and deposit a plan of the proposed drains?—Yes.

5251. Do you see the connexion made?—Yes, I do, or I employ a man to do it; the board expect me to do it.

5252. Do you think that the sewerage and drainage of this town are at all as complete as they ought to be?—Not in all parts.

5253. Whereabouts are the sewers discharged; have you any plan?—I have no plan.

5254. How many outlets are there?—Five altogether; four into the navigation, and one into the old river Lee.

5255. Four of them pass their contents into the navigation, and one into the old river?—Yes.

5256. Do you know how many waterclosets there are in the town?—220.

5257. In what class of houses are they principally to be found?—Principally in the best houses.

5258. Are there any waterclosets in any of the cottages?—In some instances, but they are not supplied with water, they have pans.

5259. They cleanse them by throwing down buckets of water I suppose?—Yes, there are 60 of those out of the 220.

5260. In your experience how have you found them to answer?—They answer very well if they are properly attended to.

5261. Do you consider that they are an improvement upon the cesspit?—Yes.

5262. Is it your duty to examine and report as to the position of a cesspit or cesspool and well when a new house is about to be built?—Not as to the position of the well.

5263. Take any private house that you know, and suppose that you have within the area of this room a well in one place and a cesspool in another, how far apart would they be?—I have allowed them to put a cesspit within 30 feet of the well.

5264. Are the cesspits absorbent; do they drain away or filter away the water?—No, all the new ones have been cemented and made tight.

5265. Do you think the old ones are tight?—I do not know.

5266. Have any complaints been made to you that the water of a well has after some time become disagreeable?—Yes, in one or two cases.

5267. What do you suppose the complaint has arisen from?—In the case that Mr. Butcher referred to, it arose from a privy that had been erected some years ago close to the well.

5268. The privy was contaminating the well?—Yes, I expect so.

5269. When these watertight cesspits are made in new houses, do you make overflows to take the surplus water away into the drains?—No.

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5270. Then when they get full, what do you do with the contents?—They are emptied, and the contents are taken away in a cart provided by the board of health.

5271. When they are being emptied, is there much foul smell?—I do not know, I have nothing to do with them then.

5272. Are your sewers ventilated upon any principle?—Not at all.

5273. Do you think that that is a state of things that ought to continue?—No; I think that they ought to be ventilated, but that has never been done; I have never heard any complaints about it.

5274. Do you know that there is occasionally fever in the town?—Yes.

5275. Do you know whether fever has occurred in the houses that are drained, or in the houses that are not drained?—The special case that has been brought before your notice by Mr. Butcher was in a house that has no drainage at all.

5276. Have you known a fever to occur in houses where there were drains?—I cannot call to mind any cases at this moment.

5277. (*Mr. Harrison.*) Do you remember when the main drains in the town were constructed?—No.

5278. Do you think that much spring water gets into the drains?—Yes, in the lower parts of the town.

5279. You think they discharge a good deal into them besides what passes in from the houses?—Yes.

5280. Are most of the back premises and cottages connected with the drains?—Yes, most of them.

5281. All the slops I suppose pass into the drains?—Yes, all that goes in. There is a part of the town called Musley where there have been some new houses built; there are at least 10 or 12 houses which are not drained at all.

5282. What becomes of the slops from those houses?—They are thrown out on to the surface.

5283. (*Chairman.*) Do you know that your Act gives you power to give those parties notice and to compel them to drain, or you may drain for them if you have a sewer within 100 feet of the houses?—Yes.

(*Mr. Cobham.*) I may mention that the board once served notices upon all the owners in that part of the town to make a drain to join the other drains, but it was not carried out I believe on account of poverty.

5284. (*Mr Harrison to the witness.*) You are, I understand, a barge builder on the navigation?—Yes.

5285. Do you find that any nuisance arises from the river?—Never; and I live in the lower part of the town.

5286. Below the mill?—Yes; my yard adjoins the tumbling bay as it is called, and I never smell anything.

5287. (*Mr. Cobham through the Chairman.*) Have you ever known any nuisance arise from the sewer since you trapped it?—Not the least.

5288. (*Mr. Harrison to the witness.*) Have you ever had your attention drawn to the state of the river where the sewage of Hertford comes into it?—Yes, I have several times, and I cannot say that I have experienced a nuisance from it. There is a lot of scum that arises which I have noticed at different times, and that is very offensive.

5289. Have you observed any similar notice in the river at the points where the sewage of Ware is discharged into it?—I have never noticed it.

5290. (*Professor Way.*) Do you think the quantity of the subsoil water which flows through the gravel and gets into the drains is very large?—Yes, it is in places; there is a great quantity in our sewer.

5291. In fact that sewer acts as a subsoil drain?—Yes it does, as far as it goes.

5292. If that is so, I suppose, so far as one can judge, such a quantity of water would alter the appearance of the sewage and filth?—I think it would.

5293. It does not prove that the sewage does not pass down because the water is comparative bright and clear?—No.

5294. Is it the case generally throughout the district that there is a large quantity of subsoil water which passes underneath the houses?—It is so in the sewers in the lower part of the town, but not in the upper part of the town.

5295. With regard to the cesspools, do you think they drain away rapidly?—Most of the new ones are cemented and made watertight.

5296. Do you mean that the water neither gets in nor gets out?—No, it gets in, but it is taken out by the night carts; as to any of the old ones, I do not know how it is.

5297. How often are they emptied?—That is according to the size of them. I do not know about that; they never apply to me; they apply to the inspector of nuisances.

5298. Do they often require to be emptied, or do the contents drain away into the gravel?—That I cannot say, but I suppose on the average they would require to be emptied once or twice a year.

5299. What was the object of cementing some of them?—To prevent anything from the soil draining through.

5300. I suppose it is understood that the connexion of a well with a cesspit is not a desirable thing?—Yes.

5301. And yet you say there are many cases in the town where wells and cesspits are near together, and the cesspits are not cemented?—I have no doubt that many of the old ones are not cemented.

5302. (*Mr. Harrison.*) You have stated that the sewers in the lower part of the town take in a large quantity of spring water, but that those in the upper part take none?—I did not say a large quantity, but there is always a slight drainage.

5303. Are you ever called upon to clean out the sewers in the upper parts of the town?—Never.

5304. In opening the ground to make connexions have you ever found any difficulty in those parts of the sewers?—No, they are all clean, and I attribute that principally to the quantity of cistern water that runs through them from the maltings.

5305. (*Chairman.*) The river Lee flows through Ware?—Yes.

5306. Is the town built upon both banks of the of the river?—No, only on one side; the other side of the town is Amwell End.

5307. Are there any houses or other properties situate on the margin of the river?—Only the malting trade premises, besides Ware mill.

5308. Are there any privies on the banks of the river?—Yes.

5309. Does the refuse fall direct into the river?—Yes, in some instances it does; in a few of them.

5310. In how many instances do you think?—I should say from 12 to 15.

5311. Can you name the places where they are, or upon whose property they are?—There is one on what is called the back ditch belonging to Mr. Wilkins, and there is one belonging to Mr. Lawrence.

5312. Do you think there would be any difficulty in altering the arrangement so as to prevent the refuse going into the river?—Only by making a cesspool, or by draining those places into a sewer.

5313. Have you not power to give the proprietors notice to prevent that drainage passing direct into the river?—I do not know whether we have.

5314. Is there any portion of the town where the streets are paved?—Yes, the main street is all paved.

5315. What is it paved with; sets or boulders?—Berk Hill paving.

5316. What does that cost per square yard?—We get it down at about 9*d.* a square foot, but the greater part of it was done by contract; what I have done since cost about 8*d.* or 9*d.* or 10*d.* a foot.

5317. Was that the actual cost of the stone?—Yes.

5318. What does it cost to lay it down?—The board keep a man constantly employed to do their works, and he does it for them.

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5319. What does it cost per square yard to lay it down?—About threepence.

5320. Are the footpaths flagged?—Yes, I mean them.

5321. I was speaking just now of the cart road?—There is no cart road that is paved.

5322. That is all macadamized is it?—Yes.

5323. What do you make it with—flint?—In the main street it is all granite.

5324. Where do you get the granite from?—From London.

5325. At how much a ton?—I cannot say exactly, perhaps 15*s.*

5326. Do you know how many square yards of road a ton will make?—No, I have nothing to do with the roads.

5327. What do bricks cost per 1,000 here?—About 35*s.*, at this time they are rather more, they are 1*s.* more now per 1,000.

5328. Are they dearer now than they used to be 20 years ago?—Yes.

5329. Do you think that bricks are cheaper because the duty has been taken off?—No, I know that we pay quite as much.

The witness withdrew.

Mr. THOMAS GARRATT further examined.

Mr. T. Garratt.

5330. (*Chairman.*) You were examined at Bishop Stortford, and you live at Hunsdon Mills?—Yes.

5331. I understand you wish to make some corrections in your former evidence?—Yes.

5332. Upon what points do you wish now to speak?—The evidence that I gave before was upon the pollution of the Stort, but I was asked whether I had any evidence to give upon the sources of the Lee and the Mimram. I described to you then the state of the Stort, and the evidence that I omitted to give then was that which I will now supply, viz., that a great deal of sheep washing is carried on in the spring of the year, and from that cause I have known the fish to die.

5333. In which river, or at what point is this sheep washing carried on?—I think there is scarcely a single place on any stream near Hertford where sheep washing is not carried on; it is carried on at nearly every point.

5334. In what months does the sheep washing take place?—In May and June.

5335. When the sheep are washed in the streams is there something that comes from the wool that is poisonous to the fish?—Yes, on the river Mimram some years ago there used to be at a place called Kimpton Mill, about 7,000 sheep washed, and in one year we had a great many trout in the river, and I can remember that after the washing there were 13 or 14 trout picked up dead. I believe nearly every farmer dips his sheep in the autumn, and in doing that, for every score of sheep it is necessary to use from 4 lbs. to 6 lbs. of dippings with a great deal of brimstone and arsenic.

5336. What is the object of the dipping, what does it do for the wool?—It kills the ticks and poisons the insects. The sheep get lousy in the summer time, and the dipping kills the fly, and prevents the scab, or the maggot; then that is retained in the wool until the spring comes when the sheep are washed before shearing; it improves the growth of the wool but it is certainly then washed off. On the Stort I washed some sheep this last spring, and after that I saw the gudgeons and small fish quite sickly on the top of the water.

5337. Are there any other points that you wish to speak to?—I told you I think that at Welwyn and Whitwell there is scarcely a house where the privies and waterclosets are not drained into the river.

5338. And the sewage goes down with the water?—Yes, the Mimram is the clearest stream that runs into London if it is not polluted. I have lived upon it for 20 years, and I never yet saw it overflow its banks; it rises through veins of chalk, and it would be one of the finest trout streams were it not for the pollution from a tan yard at Whitwell that used to run in; the lime used to kill some of the trout.

5339. What number of barges pass Hunsdon Mill down the Stort, or what number did pass during the years 1862, 1863, 1864 and 1865?—I receive a toll for every barge that goes down the river Stort. The proprietors of the barges send me a toll of 1*s.* for the journey of every barge, less 2*d.* for collection, which makes it 10*d.* In 1862 there were 720; in 1863, 732; in 1864, 745; and in 1865, 757 that went the journey up and down. I believe there were about 10 or 12 more that came up from the Lee as far as Roydon, or Roydon station.

5340. What is the size of the lock above your mill?—It is 92 ft. long, the width at the bottom is 14 ft. 6, at the top 36 feet. I have always complained that there was a great waste of water on the river from there being no Commissioners; every dispute between the millers and the proprietors should be settled by the Commissioners, but some years ago the Commissioners died; they allowed them to die off, and no fresh ones were appointed, it was under the 32nd Clause of their Act that the disputes between the millers and the proprietors were to be settled by the Commissioners. I have complained several times to the Stort proprietors about the great waste of the water, for I consider that each lock takes much more water than it ought to do.

5341. Have the locks any side walls?—The Roydon Mill has, but the Hunsdon Mill is made wide at the top and tapering down. Under the Act of Parliament they are bound to compensate me for the full loss of my water. I mean through the Commissioners, but as they have allowed the Commissioners to die off, I have no resource, no claim, unless they appoint Commissioners. It was stated by one of the witnesses at Bishop Stortford that the millers were under a penalty of 20*s.* for refusing to comply with the navigation orders, but it is 40*s.* through the Commissioners as provided in the 6th George 3rd, Chapter 78, Clause 8. This is a private navigation and has nothing to do with the Lee.

5342. Have you anything further to state?—No.

The witness withdrew.

WILLIAM PARKER, Esq. (Ware), examined.

W. Parker, Esq.

5343. (*Chairman.*) Where do you reside?—At Ware Park in this parish.

5344. How long have you known Ware?—For 35 years; I have lived here for 25 years.

5345. Do you know the condition of the river Lee?—Yes.

5346. Are you officially interested in the Lee?—Yes, I am a trustee.

5347. Do you attend the meetings of the Trust?—Yes.

5348. The river Lee I assume is managed principally as a navigable river by the trustees?—Exactly so.

5349. Is it any part of your duty to preserve the water of the Lee pure for domestic purposes in London?—In a very recent Act of Parliament there is a clause to prevent draining into the Lee, but it has been found very difficult to carry out that power.

5350. Do you know that drainage is still passed into the river?—Yes.

5351. Is it not desirable that that should be mitigated or prevented?—For the navigation I do not think that the drainage into it is objectionable.

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5352. Do the trustees receive any beneficial income for the water supplied from the Lee to the metropolis?—The water of the Lee in its present state has been sold to the New River Company and to the East London Waterworks Company.

5353. Is there a sort of rental paid for it?—Yes, for certain given quantities.

5354. Taking that as a precedent, and assuming that it is necessary further to purify that water for consumption in the metropolis, might there be an equitable arrangement come to, if Parliament empowered the trustees to effect certain improvements, the expense of which the water companies of London were willing to meet, and would the trustees undertake to discharge the necessary duties?—I have no doubt of it.

5355. You are an unpaid body of trustees?—Yes.

5356. Your servants are paid?—Yes, and that is all; it is very much like the old system of turnpike roads, we are an unpaid body, and we meet in order to see that the navigation is kept in repair.

5357. (*Mr. Harrison.*) I presume you look upon the navigation as a benefit to the whole country?—Yes.

5358. (*Chairman.*) Do you consider that it confers a money value upon the estates which lie adjacent to it in the different districts through which it passes?—Yes.

5359. And that it confers a benefit upon the property situate in this town?—Certainly.

5360. Then the whole property of the town has a value, a portion of which is represented by the accommodation afforded by the river Lee?—Very largely so, and I believe that the town would be destroyed if the Lee was annihilated.

5361. As a navigable river?—Yes.

5362. Are you aware nevertheless that this town deriving such large benefits from the Lee pollutes the river by draining its sewage into it?—The river Lee is a natural drain or sewer.

5363. It is a natural watercourse to which all the waters of the district flow down?—Yes, on both sides.

5364. Cannot you imagine an arrangement by which an interception might take place, and the sewage of a town like this might be prevented from flowing into the Lee?—I think it is very desirable that it should be done, and I think it might be done by having intercepting sewers on each side of the river.

5365. If the trustees of the Lee had adequate powers given to them by Parliament, and an equitable arrangement was made by which the necessary funds were furnished, do you think there would be any difficulty?—I do not think so.

5366. You could preserve the navigation, and you could vastly improve the town without doing injury to any person?—I believe that the town would not be improved unless there was a better water supply.

5367. Is not that question rather for the inhabitants of the town?—It is a question of cost. When this district was put under the control of the Board of Health I was chairman of that board, and the question, of course, came before us in every aspect, not forgetting, of course, the expense, and we employed an eminent engineer to survey the district with a view to a water supply and drainage, but the cost appeared to be so great that it was really thought it would ruin the town.

5368. A good water supply, I presume, you will admit, is essential for the health and comfort of the inhabitants?—Yes.

5369. Do you not think, if it could be proved that the inhabitants might be supplied with water, say, at 10*s.* per annum, to be delivered by high pressure and constant service into any room of a house, that the well and the pump would be an extravagant mode of doing it, compared with a supply within the house at 10*s.* per annum?—I think it would be desirable to obtain such a supply, and to get rid of the well.

5370. If it can be shown that waterworks might be established in this town, and that water might be delivered within the four walls of a dwelling at the price I have named, would it not be most desirable to obtain it?—Yes.

5371. Every gallon of water weighs 10 lbs., which involves extra labour for servants, and we know that a pump and a well are liable to contamination from many sources?—Yes, there are in this town many distinct wells; it is a poor town, and there is a large number of the labouring population in it; the cost of supplying them with water is nothing at all; it is more the cost of shoe leather.

5372. If you could furnish to the inhabitants of those cottages an abundant supply of water at 1*s.* a quarter, less 25 per cent. if paid by the landlord, the well and the pump would become a nuisance?—Yes, but I have no doubt there would be great difficulty in raising the necessary capital for the works. No doubt it would be beneficial, if the money was forthcoming, to raise 15,000*l.* or 20,000*l.* for this town; but if that were attempted to be done, you would drive many of the inhabitants out of it. We should have to levy 1*s.* or 1*s.* 6*d.* in addition to 3*s.* or 4*s.* for poor rate.

5373. You probably heard it stated this morning that fever is prevailing in several parts of the town, that typhus fever, typhoid fever, measles, and scarlet fever have occasionally prevailed, and that there is a large infantile mortality?—Yes.

5374. I believe you are deputy-chairman of the quarter sessions?—Yes.

5375. Does that bring you into collision with cases of pollution or of nuisances caused in the county?—No, nothing except what has occurred under the late cattle plague arrangements. We have had occasion to prohibit the passing of manure.

5376. While you acted as chairman of the local board in Ware what were your practical difficulties in carrying out sanitary works; had you to discuss at the board what you must or not do in order to avoid getting into a dilemma, as the Hitchin people did?—Yes, I think our great difficulty was a want of funds and a proper outfall. We had the district surveyed, and I was very anxious that a reasonable sum should be raised in order properly to supply the town with water, but the sum that it was found would be requisite was so great that the board generally objected to it, and the inhabitants particularly. I do not believe they would have returned any member to the board who would have been favourable to carrying out that scheme.

5377. At what rate of interest did you borrow the money that was laid out in sewerage?—5 per cent.

5378. That, with a sinking fund, I suppose, would bring it up to nearly 7 per cent.?—Not quite so much.

5379. If Government could be induced to lend money for sanitary purposes at 3½ per cent., and take it back by annual instalments, extended over a period of years, would that be a relief to you?—Yes, no doubt of it.

5380. We know that ratepayers are sometimes alarmed about rates, because they do not see the advantage to result from money being advantageously laid out?—Quite so, but really my opinion is this, that those who get a better commodity should pay something more for it—that is to say, if the river Lee trustees have sold the water of the Lee to the London water companies, and in future should get by arrangement a better supply of water, they should pay something more for it. I think that that would be fair and equitable.

5381. (*Professor Way.*) Provided there is no right on the part of any person to foul the water?—I hope we shall not get into law, but I do not think this district will give up their legal right.

5382. The question is, whether the people have a legal right to foul the water of the river?—They have a prescriptive right to use the river, that is what

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I understand. Then again a concentrated drain is far worse than drains which enter at different points; we see that exemplified in this district by the drainage of the New River Company coming in and poisoning the water most terribly with what I may call the concentrated essence of the sewage from Hertford.

5383. A number of outfalls merely have the effect of distributing the nuisance so far as the people residing near are concerned, but what do you say as to the people who reside many miles below; would the number of outfalls here make any difference to them?—Yes, a great deal more water comes in with the foul matter.

5384. If a certain quantity of sewage is poured into the river 20 miles above, does it matter whether it comes in through five pipes or 20?—That is the question.

5385. It appears to me to be a distinction without a difference?—I think there is a difference.

5386. Do you think that you have a prescriptive right to throw what dirt you like into the river Lee?—No, but I think I have a right to use a drain as it has been used from time immemorial.

5387. You think that you have not only a legal right, but a moral right?—If I thought it was injurious so to use it, I think I should not have a moral right.

5388. (*Mr. Harrison.*) I believe the law is that no length of time can legalize a nuisance?—Yes, I think it is so.

5389. Therefore you can never gain a prescriptive right to commit a nuisance?—Yes, but the question is, what is a nuisance?

5390. (*Chairman.*) I believe you are the proprietor of large brick-fields in this district?—Yes.

5391. Do you employ the river largely for carrying purposes?—My tenant does.

5392. Do you bring the materials up from London, the breeze, and so forth?—Yes.

5393. And are your bricks taken down?—Yes, in very large quantities.

5394. What do you get per 1,000 for them?—There is such a variety of makes; the price varies according to the kind of bricks.

5395. Do you know the character of the land in the neighbourhood?—Yes.

5396. Do you remember any plans being prepared for storage reservoirs in this district?—Yes, very elaborate plans were got up by Mr. Rendel.

5397. Did you form any opinion as to the advisability of constructing those storage reservoirs?—I thought it most desirable that reservoirs should be constructed.

5398. If the water companies could construct them, I assume that they might have comparatively pure water for the supply of London?—Yes.

5399. Instead of taking the water of the Lee?—Certainly.

5400. Do you know the sites upon which those reservoirs were proposed to be made?—Yes, I know two or three of them. I think one was in Hatfield park, the intention being to stop the water of the Lee.

5401. Would the Marquis of Salisbury allow that to be done?—I think it would be a question with all of us, a question of compensation, and whether the reservoirs were made ornamental or not, and so as not to be left entirely dry at times, and so on.

5402. It would be a question whether the embankments were so constructed, and in such a position, as to be safe?—Certainly.

(*Mr. Marchant.*) The Marquis of Salisbury was a strong promoter of the scheme.

(*The witness.*) I may mention that I am chairman of the Regent's Canal Company, which is a very large navigation in point of tonnage, and the whole of the water which is supplied to that navigation, except what comes from the Grand Junction Canal and in very dry seasons from waterworks companies, is storage water; there is one reservoir covering 220 acres, and capable of storing 70,012,000 cubic feet of water.

5403. Could you obtain from your engineer a return as to the tonnage which is passed along that canal, and as to the volume of storage water?—Yes, without any difficulty. I could give you the revenue now, but I will furnish you in writing with the length of the navigation, its tonnage, the area covered by the reservoirs, the cubical capacity of the reservoirs, the annual volume of water used, and the area of the gathering grounds. The valley of the Lee from which all these rivers come is like a sponge; it contains a vast quantity of water, of excellent quality, and if the river was deepened, and the storage water used for the navigation, I think, then, that the spring water might be taken to London, and the navigation be entirely supplied from the reservoirs.

5404. You think that the spring water should be preserved for the supply of the metropolis, and the navigation proper should be supplied from the catchment reservoirs?—Yes.

5405. All you want is water in the navigation to work the lockage?—Yes.

5406. (*Mr. Harrison.*) Still, I presume, you would not approve of the towns discharging their sewage and other refuse into the navigation?—No; but, as I have said before, you must consider the money question. We are very poor in this district.

(*Mr. Mylne.*) The trustees' scheme of 1851 contemplated storage reservoirs of 994,000,000 cubic feet. The reservoirs were to be on the Ash and the Rib—one in Amwell marsh, two on the Lee, one above the other, on Roxford farm, and the other above Hatfield park, and a small one near Ware mill lock, which is not included in the 994,000,000 of cubic feet. The Ash and the Rib were to hold 500,000,000 cubic feet.

5407. Would those reservoirs receive chiefly spring water which would be almost entirely free from pollution?—They were to be catchment basins for a certain drainage area, taking in the surface water and spring water.

5408. Do those areas contain a very sparse population as compared with other districts?—I do not refer to the Lee Proper. There is Luton and Dunstable.

5409. Was it part of the scheme to divert the sewage of Luton?—I do not recollect the details of that scheme.

(*Chairman.*) To what amount of tonnage do you restrict your tenant?

(*Mr. Rydon.*) It would come to about 25,000 or 28,000 tons that I am to pass up and down annually.

(*The witness.*) I have made a private cut of my own for other purposes, which would perhaps bring 10,000 tons out of the river Lee into my own ground at my own expense.

5410. Upon that cut you would probably convey something like 10,000 tons per annum?—Yes.

5411. Making about 35,000 tons in all?—Yes.

5412. (*Mr. Harrison.*) You probably know that there are at the present time upwards of 40,000,000 of gallons of water taken in from the Lee to London daily for drinking purposes by different water companies?—Yes; this may be so.

5413. That forms a very large proportion of the whole supply given to London. From the Thames they take only 48,000,000 of gallons?—Yes; this may be so.

5414. Therefore the Lee is one of the most important sources of supply to London?—Yes.

5415. Do you think that the formation of reservoirs such as you have mentioned, which would hold 994,000,000 of gallons, or about 25 days supply, would be the best means of providing a supply at present for London?—No. I think that the river ought to be deepened. I believe that the whole valley is like a sponge, and that the water does not get away.

5416. What steps do you think it would be advisable to take to put the river Lee under good management, so that it might be made in the highest degree beneficial to the public, both for the navigation, and for a supply of water?—I think there should be a good engineer to manage it, that the navigation should be deepened, and the locks enlarged, in short, that Mr. Rendel's plan should be, to a great extent, carried out. I would lessen the number of the locks, lower the bed of the river, and save the water that would otherwise go away by evaporation and in other ways.

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5417. Under what kind of management would you place the whole valley of the Lee in order to attain those ends?—It is a difficult thing to say what it would be best to do.

5418. Are you at present one of the trustees of the river Lee navigation?—Yes.

5419. Do you think that the river Lee trust would be able, with extended powers and adequate authority, to carry out a system of the kind?—I should say that there ought to be a joint management. I think this, that those who have an interest in affairs of this kind, generally manage them better than those who have not. Some of the members of the New River Company are *ex-officio* trustees of the river Lee trust.

5420. Do you think that the whole valley of the Lea is in an unsatisfactory state?—Yes, I think it is.

5421. Would you be inclined to carry out a system of drainage throughout the valley as it exists?—Yes, and get rid of many of the mills. Many of them in Hertfordshire are extremely detrimental, not only to land, but to the value of property where the water is headed up.

5422. Is it at times the fact that water so headed up by mills injures a larger amount of property by flooding, there being a want of drainage, and does more damage than the mill itself is worth?—That is a question I cannot answer, for it is very difficult to ascertain the injury that is done to land by these heads.

5423. (*Chairman.*) Do you know that there are certain mills which do inflict injury upon the adjoining land, and do impede the drainage of the valley?—I should say that every mill in the county more or less does so. I do not know of one that heads up the water and does not injure the land adjoining.

5424. Are you not of opinion that we have glided into an age when steam may fairly be said to have superseded water power?—Yes, I think so.

5425. And probably it would be much better to sweep away the mills and substitute another form of power, water mills being now out of date and things of the past?—Certainly; and it is very much the fact of railroads passing nearer to modern mills which has made the older mills valueless, cartage to any station being too far.

5426. In the primitive state of the country, when there were few roads, and land had a very small value, and when people had comparatively no knowledge of artificial power, mills were a necessity?—Yes.

5427. They were put up to grind corn and make flour for the people of that period, but now machinery and the means of rapid communication by railways enable you to bring flour from distant parts, and the necessity for a mill no longer exists?—That is very much so.

5428. A mill now blocks the drainage and injures the adjoining land, to what extent you cannot say?—No.

5429. You can say that it blocks the drainage and injures the adjoining land?—Certainly.

5430. (*Mr. Harrison.*) Do you think that the river Lee trust might be re-constituted, and a board be formed that should at once improve the whole value of the Lee by carrying out drainage works, maintaining the navigation, and provide at certain points, to be carried away by water companies, a large supply of pure water for London?—I think there is quite material enough to carry that out.

5431. How should you say that funds might be raised to carry out those several objects?—Funds would be raised by showing that the scheme would be a profitable one.

5432. If you were to carry out drainage works, it would be necessary to have taxation in some form or other?—Yes.

5433. Upon whom would you levy the tax?—I think it should be divided in portions—for instance, I should say, if a town was drained, a third of the amount should be contributed by the town drained, and two-thirds by the London water companies who would get a better supply of water, and so divide it into small sums. Again, if you could show that the land was benefited, I would place a small tax upon the land.

5434. (*Professor Way.*) Your point seems to be, to exact from the metropolis some contribution towards purifying that water which you have made impure, and the more impure it was the more they must pay?—No, I do not mean that.

5435. You seem to argue that you have a right to make the Lee impure?—It is impure; and let me mention, that there was a negociation of a business-like character carried on between the East London Water Company and the New River Company, and they made a bargain, and surely if the bargain had been, you must first purify your water, we should have said, very well, let this arrangement stand over for a time, and we will ascertain what the expense will be, and when we have done that, we will make you pay for it accordingly.

5436. The question is whether anybody has a right so to use the water as to abuse it and pollute it. If you say that you have a right so to use the water, there is an end to the question?—But we do not do it.

5437 I presume that none of the people here would wish to represent through this Commission that they consider they have a right to make the Lee impure?—Yes, they do. I maintain that we have a right to drain into the river Lee.

5438. And a right to make it impure?—No, I do not say that.

5439. The opinion which you have expressed you would probably not apply to another river in which you had no interest?—I think it would be a question for the House of Commons as to what sort of Bill should be passed to deal with those matters.

5440. It is not a question of principle with you, it is a question of pounds, shillings, and pence?—We must consider the expense.

5441. (*Mr. Harrison.*) With regard to the constitution of the river Lee trust, do you think that that trust represents local interests as fully and as sufficiently as you would wish?—Yes.

5442. (*Chairman.*) If you had such important duties entrusted to a board as those connected with the conservancy of the river Lee and its tributaries, do you think it would be advisable that its numbers should be unlimited, or that its jurisdiction should not be clearly defined?—I think the question is whether these gentlemen are competent to carry out an Act of Parliament.

5443. If there is power to elect 500 people to qualify, the question is whether the Board would be as well managed by 500 persons who could so come in as it would be by 50 who came in by right, and could not be interfered with by any greater number?—I think the question is, is it advisable to limit the Board in its arrangements; we appoint committees and sub-committees.

5444. Are you a county magistrate?—Yes, and I am deputy-chairman of Quarter Sessions.

5445. Do you ever appoint any public officers?—Yes.

5446. Do you as deputy-chairman of Quarter Sessions attend pretty closely to your duties?—Yes.

5447. At the sessions or at any other meetings, how many magistrates on the average attend?—For the county business I should think probably 30 or 40.

5448. How many magistrates are there in the county?—I really do not know.

5449. 300?—Probably 150.

5450. Have you sometimes appointments to make in the county?—Yes.

5451. When you have an important appointment to make, how many magistrates usually attend to vote?—The post of Chief Constable I believe is the most

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popular thing in the county, and I believe all the magistrates muster then.

5452. You mean I suppose that those magistrates who transact the ordinary business of the county are not left to make appointments themselves, for those who seldom or ever come near at other times assemble numerously upon those occasions?—Yes, the Chief Constable is the constable for the whole county, A great deal of the county business is done at the Petty Sessions.

5453. Is the fact that the men who from their constant attendance transact the business of the county are over-ruled in the appointment of so important an officer as Chief Constable by gentlemen who never attend except on that occasion?—No.

5454. (*Mr. Harrison.*) Does not this matter require a little qualification, that although there may be only 30 or 40 magistrates who attend the Quarter Sessions usually, you will find five or six magistrates probably attending each of the Petty Sessions where they have to some extent the local management of the police?—Yes, of course that is so.

5455. Therefore the magistrates who attend each of the Petty Sessions are interested very materially in the appointment of Chief Constable?—Yes, and if there is any business connected with any part of the county—the county bridges for instance are an important question—then the Quarter Sessions are attended by every magistrate in that locality, and it is of great use and advantage for those gentlemen to give us their opinions, we are very glad to hear the opinion of the gentlemen living in the locality in which the business is required to be done.

5456. (*Chairman.*) Do you not find any practical inconvenience from having so large a Board in the transaction of business?—No, the only difficulty is this, that at times we do not get the same number of magistrates in attendance as we should like.

5457. (*Professor Way.*) Is not that a practical difficulty?—That is one. The chairman makes a point of attending and also the vice-chairman, and some others do the same.

5458. You have been asked by Mr. Harrison whether in the case of some conservancy body being formed for the valley of the Lee, the existing body of trustees would be fit and proper persons to perform the duties of such a Board?—Yes.

5459. Is it a fact that the Lee trustees at present consist of 60 or 70 members?—Yes.

5460. Are some 23 or 24 of them aldermen of the city of London?—Yes, all the aldermen of the city of London are *ex-officio* members.

5461. Are the other *ex-officio* members principally members of Parliament?—All the other *ex-officio* members are members of Parliament.

5462. How many members of the River Lee Trust altogether are interested in the land and property of this district, are the aldermen of the city of London so interested?—No.

5463. Are the county members interested in the land and property of the district?—The borough members are.

5464. Supposing that 24 members of the trust are aldermen of the city of London, and some 30 more consist of the members of Parliament for this district, some who are not members for this district, and others, what interest do you think preponderates?—The river Lee Navigation commences at Hertford, and we have the Marquis of Salisbury, the Mayor of Hertford, and we have two or three traders and the Ex-Mayor of Hertford. Mr. Squires is a trustee having a very large mill on the stream or two I believe. I come next to Mr. Baker who lives higher up above the navigation; he is a trustee, and his son also is a trustee.

5465. How many aldermen of the city of London have any interest in the matter?—I do not know that any of them have, but they come down sometimes.

5466. Have they any right to interfere in the business of the trust?—Only as *ex-officio* trustees.

5467. They form rather a large element in the trust?—Yes, then adjoining me Mr. Gosselin, a landowner, was a trustee. Mr. Puller is a trustee, and his son also; Mr. Page, the largest maltster in England, is a trustee, and in fact I do not know of anybody who is not a trustee, if he is thought to be a desirable man. The last trustee appointed was Mr. Baxendale, who lives about two miles from the river.

5468. Is it a fact that 30 members of Parliament are *ex-officio* trustees?—(*Mr. Marchant.*) I think you may take the number of members of Parliament at 10, they are only the members of the counties through which the river passes, and they are parties who live in the counties through which the river passes.

5469. (*Chairman to the witness.*) Do you think that the business of the trust would be worse managed if the number of the trustees was reduced to about 15, if the present trustees were made simply an elective body, and not an executive body, and that the first requisite for an acting trustee should be qualification by property, or interest in the district, or the navigation up to a certain sum; and above all things that he should be resident?—I think that that would be an improvement.

5470. So that the present body should elect the representatives who were to be the executive?—Yes, I dare say it would be better done then.

5471. (*Professor Way.*) Supposing a new arrangement was about to be made for the control and management of the river Lee, would there be any possible reason why 24 out of 60 or 70 members should be aldermen of the city of London and *ex-officio* members?—I should not think that necessary at all.

5472. (*Chairman.*) If Parliament should think fit to create an acting body of trustees, limiting their number, and putting more duties upon their shoulders, do you not think it would be just that Parliament should provide that at all events the members of the body should be repaid all expenses out of pocket like the Thames Conservators, for example that 1,000 or 2,000*l.* a year should be divided amongst the executive body who did the actual work of the conservancy, and not as a payment for services rendered?—You know better than I do, that if it comes a question of payment, you do not get the best working men from the men who are paid, on a trust of this sort.

5473. I do not mean men who are paid, but you are aware that in railway companies and other large companies an annual sum is voted to defray the expenses of the working directors?—Yes.

5474. Why should you be called upon to give up the whole of your time for the public of London to furnish a water supply, to look after the navigation, and the interests of the landholders above and below you, as well as your own small portion of it for no equivalent. How could the public expect you would do so heartily if you had to put your hand into your own pocket every time you attended a meeting?—It is part of the system of England that there should be a number of gentlemen so engaged, and I should be very sorry to see the duties of the magistrates of England put into the hands of those whom we paid for attending to them.

5475. (*Professor Way.*) The object of my questions was to ascertain whether your Trust was really a body which represented the interests connected with the river Lee, and whether, if any legislation should take place, we as commissioners would be justified in saying, we believe that the trustees would be the proper persons to carry out that legislation. For my own part I cannot see why 24 aldermen of the city of London out of a body of 70 should have any right to vote?—I may state that they do not attain that position without being men of very sound sense and having good heads upon their shoulders; and such men are extremely valuable.

5476. I presume it would be your object that the members of such a body should really represent the interests connected with the river Lee?—Yes, with regard to payment that is another question, or whether

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there might not be a paid chairman, you would have to throw a great responsibility upon somebody, and if you could throw a great responsibility upon any individual, I think perhaps you might pay him.

5477. In the case of the river Thames, Parliament takes the conservancy as it exists, and makes its arrangements for the future treatment of that river, and if Parliament is to deal with the river Lee it may turn its eyes upon the present trustees as a fit and proper body to manage the river Lee. We are simply asking you whether you think, without considerable modifications, they are an eligible body for the purpose?—In my opinion they are quite capable of doing it, and as capable as anybody that can possibly be found.

5478. (*Chairman.*) One great question is, the question of numbers?—Yes.

5479. And when we are looking forward to the future, and we see that certain additional duties will have to be put upon some board for the preservation of the navigation and to maintain the purity of the water, the question is who is to constitute that board?—I have given you my opinion with regard to the present trust.

5480. You are chairman of the Regent's Canal Company?—Yes.

5481. Are the gentlemen who serve on the board and conduct the business of the Regent's Canal paid?—Yes; we receive 1,000*l.* a year among 15.

5482. (*Mr. Harrison.*) There are two questions here, first, whether you think the present trustees represent fully the local interests connected with the Lee, and secondly whether the same trustees would be a proper constituency to whom should be entrusted the power of electing a good working board say, of 15 or 20 members, and in order that they should not be out of pocket, whether a sum like 1,000*l.* a year to cover their expenses, might not be allowed?—I think that the body from which they are elected cannot be improved.

5483. (*Professor Way.*) For the present purpose, or for any future purpose?—For any purpose; for the navigation of the river Lee, or for any other purpose that might be entrusted to them. I think I stated before that there are some of the directors of the New River Company who are *ex-officio* members of the trust, the governor, the deputy governor, and the treasurer, they do not attend.

5484. Do you think that there is enough water in the valley of the Lee, not only to supply the navigation, but if properly managed to distribute a much purer supply of water to the inhabitants of London?—I think so.

5485. (*Chairman.*) Is there anything further you would wish to add?—Nothing else occurs to me at present.

The witness withdrew.

Mr. A. Bond.

Mr. Albany Bond (Ware) examined.

5486. (*Chairman.*) Are you inspector of nuisances in this town?—Yes.

5487. How long have you held that appointment?—About 3½ years.

5488. What duties have you to perform as inspector of nuisances?—I have to go round and find out any nuisances that may exist upon any premises, or within the district, and report them to the next meeting of the board.

5489. What power have you to interfere and to cause a nuisance to be abated, supposing that you find a nuisance very offensive?—Then I order it to be removed at once.

5490. Do the Board furnish you with funds to purchase disinfectants?—I have had them from Mr. Cobham, the clerk. We have them by order of the board.

5491. Do you obtain as much as you want?—Yes, as much as is required.

5492. With regard to the cesspits and cesspools, if you find them to be the cause of nuisance, what course do you take?—I call upon the parties to have them emptied.

5493. How are they to do that?—We provide them with a soil cart for the use of which they pay 2*s.*

5494. Where is the refuse taken to?—It is taken towards Ware Park and towards a brickfield; that is, it is removed out of the district.

5495. Do you sell it to farmers for manure?—No; there is a hole at the place I am speaking of, and a man covers it over with lime.

5495. But is it not useful as manure?—I should say so, but nobody cares about it here.

5497. Supposing you find there is fever in a house, what course do you take?—I generally take some of the disinfectants or chloride of lime, and have the rooms whitewashed after the patient gets better.

5498. Have you any other duties to perform besides those you have mentioned as inspector of nuisances?—Yes, I collect the rates.

5499. What do the rates amount to in the pound?—The present rate is 1*s.* in the pound.

5500. Do you mean 1*s.* in the pound for the half year?—Yes.

5501. Will the rate be 2*s.* in the pound for the whole year?—The present rate is 1*s.* in the pound, but I do not know what the next rate would be.

5502. How much does the 1*s.* rate produce?—About 800*l.*

5503. And the 2*s.* for the year would produce 1,600*l.*—Yes.

5504. Will you be good enough to explain for what purposes the rate is collected and applied?—(*Mr. Cobham.*) It is for the repairs of roads, and paying off the borrowed money, which is a very heavy item; also for the lighting of the town, to pay the salaries of the officers of the board, for any drainage that may require to be done, and also for paving.

5505. Does the 2*s.* in the pound cover all the local rates that are collected?—(*Mr. Cobham.*) It does, and it would do more than that; but the fact is that we were about to make some drainage works, and we were going to have 500*l.* borrowed by the board, but these works appeared to require such extensive plans that we thought proper to abandon the idea, and the rate was increased in place of borrowing the 500*l.* When I say the board, I mean the board in London. We increased the rate one penny in the pound by three rates, and by that means we avoided the repayment of the money we intended to borrow; therefore a 2*s.* rate is really more than the board want under ordinary circumstances. I think Mr. Bond has been rather misleading you as to the removal of the night soil; the truth is that the board charge 2*s.* for the use of the cart, and for the cart alone, but those who have the use of the cart may employ what men they like, with the exception of one man; they must pay one of the men, but they have a perfect control over him. They take the soil away, but we say they must take it out of the district, and when they have done that, they may do what they like with it. I believe that they sell it occasionally. I happen to know that when they can find a customer they do sell it.

5506. Is there anything further that you wish to add?—No.

5507. (*Mr. Harrison to the witness.*) What kind of place is it into which the night soil is tipped?—It is a gravel pit; the gravel has been taken out and it is filled up with soil, and then covered with lime.

5508. Is the soil ever removed from the pit again?—No, not generally.

5509. What is the size of the pit?—There is a hole here and a hole there just as they can get it in.

5510. Are these holes which have been made for the purpose of taking away the gravel?—Yes.

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5511. And in this way you fill up the gravel-pits?—Yes, with the soil.

5512. Do you find that you can go on tipping into one of these holes a large quantity of night soil for a considerable time?—Yes, perhaps it has been there for 12 months, and has subsided, and then they go again and fill it up again.

5513. Where are these holes situate with reference to the town?—They lie towards the Park.

5514. They are at a higher level, are they not, than the town of Ware?—Yes.

5515. Does the gravel bed into which you throw the night soil extend downwards, and join the gravel bed on which the town is built?—Yes, it does join it; it is on the borders of the road near the cottagers' gardens.

5516. As inspector of nuisances to the town do you consider that the operation you have described may become a nuisance to the town by the sewage draining towards the town through the gravel?—I should not think it would; time may perhaps produce an effect.

5517. You say that this has been done until the pit gets nearly full; then in the course of a year it will sink down, and the pit is ready to receive another supply?—Yes; and so they go round.

5518. The rains of summer, and the water that percolates through the gravel will have taken all that night soil somewhere or other?—Yes.

5519. Is it not quite possible that it may have been brought down again to the town of Ware?—It might have been so; but I am not sufficiently versed in such matters to be able to say.

(*Mr. Cobham.*) I feel perfectly certain that it does not do so. It goes away from the town nearly in a solid state in the first instance, and the next thing is that there happens to be a field of clay adjoining the gravel between the point where it is put into the pits and the town.

5520. In which direction would the gravel pit drain?—There seems to be a bed of gravel for some length, a very great bed of gravel. Mr. Parker's pits are on the one side, and the sewage is put in in such small quantities that I believe there is nothing to apprehend.

5521. (*Professor Way to the witness.*) Are there any vegetables grown near the town for the London market?—No, I think not; not to my knowledge.

5522. Is any manure brought from London to Ware?—Yes, occasionally by the river we have some.

5523. Can you at all account for the night soil being considered so valueless here that you have to throw it into a pit to get rid of it?—No; but no one will have it.

5524. Can you account for its being considered so valueless?—I cannot; if it was allowed by the board, I think that some of the farmers in the district would be very happy to have it on their land.

5525. But the fact remains that this quantity of sewage is thrown into pits just to get rid of it?—Yes.

5526. We have been often told in the course of our inquiries that the liquid part of manure is of no value, and that it is only that portion which remains in a solid state which is useful?—I believe that they are both of value in a certain sense.

5527. Is it not a curious fact that the stuff conveyed to these pits should not be considered worth buying for manure?—Yes, I have thought so.

5528. Do you think it probable that in consequence of these cesspits, whether they be cemented or not, being open to the water, the sewage gets so washed and diluted that it becomes of no value?—I do not fancy that that is the case.

5529. (*Mr. Harrison.*) The surveyor stated that the new cesspits which are formed are cemented, but that a great number of the old ones are not in that state?—Yes.

5530. Have you occasion frequently to call upon the persons owning the old cesspits, to clean them out?—Yes.

5531. Do they fill them up to the top?—Yes.

5532. How often are they emptied?—Some of them once in 12 months, some once in two years, and some according to the state in which they are; it is according to the height it is up to.

5533. Do you know that any of them into which refuse is thrown constantly are never cleaned out?—No, I cannot say that.

5534. How long have you known one of them to be used without being cleaned out?—Three or four years.

5535. (*Professor Way.*) Supposing that this sewage is not worth a farmer's purchase or even his acceptance upon any terms, and it has therefore to be thrown into the pits to be got rid of, does not that seem to indicate that something must have happened to diminish its value?—I am not able to answer that question.

5536. If it has been so impoverished as to be valueless, is it not plain that its value has gone somewhere else, for instance, into the sub-strata?—I suppose it may have done so.

(*Mr. Cobham.*) I may mention that the farmers used to bring a waggon and take it away when they where under no restrictions; or when a privy was emptied the contents were carried into the river Lee. When however they had to come under restrictions, and the night soil had to be removed between the hours of 12 and 4, that seemed to do away with the practice entirely; the farmer wanted a longer time to do it.

The witness withdrew.

Mr. ALFRED BROWN (Ware) examined.

Mr. A. Brown.

5537. (*Chairman.*) You are a miller I believe?—Yes.

5538. Where is your mill situate?—In the town of Ware, close to the railway station.

5539. What water power do you employ?—I have a steam-engine, and I draw water from the Lee for the purpose of the engine.

5540. What power do you use?—16-horse.

5541. What weight of coals do you use in a week?—I burn a variety of coals; sometimes I have sea coals and sometimes I use Midland coals.

5542. What weight of coals do you consume in a week?—I do not know exactly.

5543. Do you know how many hundred-weight you burn in an hour?—At a guess I should say that I consume perhaps eight tons a week.

5544. How many hours do you work?—Night and day at times.

5545. Is your's a high-pressure engine?—Yes, a high-pressure condensing engine of 16-horse power.

5546. How old is it?—It has been erected about 16 years.

5547. What did it cost you originally?—It is not my own, and I do not know exactly what the cost was, but I think the engine and machinery cost something like 1,600*l.* or 1,700*l.*

5548. How many pairs of stones do you work?—Five pairs.

5549. How many dressing machines?—Only one.

5550. What do you do with the ashes?—We make none, the coal is all burned down to clinkers.

5551. What amount of traffic in weight passes over the river Lee to and from your mill?—The Lee is very useful to me; it acts as a check against the railway company, and it is likewise useful to me as it enables me to get wheat from vessels lying in the Thames. The barges go alongside the vessels, and it is loaded from the vessels into the barges.

5552. You get the wheat up in that way, grind it, and return it in the shape of flour?—Yes, at times we have foreign wheat for the purpose of mixing with the country wheat from the neighbourhood.

5553. Do you suffer from the foul state of the river Lee at any time?—No, I have never done so. I draw water from the Lee for the engine; I have a well close by the engine, but that is so silted that I cannot use it; it cuts up the buckets and pumps, and I therefore draw water from the Lee on purpose.

5554. Are there any fish in the Lee opposite to your mill?—A great quantity of small fish; you may see thousands of them all round the place where the condensed water flows into the Lee; these are small fish, the large fish come up there after them.

5555. Are there any special points that you wish to mention to the Commission?—None that I know of.

The witness withdrew.

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Mr. HENRY BENINGFIELD (Ware) examined.

Mr. H. Beningfield.

5556. (*Chairman.*) Are you a resident in Ware?—Yes.

5557. Do you carry on any business here?—Yes; I am a surveyor and auctioneer.

5558. Upon what particular points do you wish to give evidence?—Relative to the report which I have seen respecting the flooding of the Rye Meads at Stanstead. I noticed it in reading the evidence of one of the witnesses who was examined at Stortford. It was stated that the Rye Meads were now about to be enclosed, and that arrangements were made for their drainage. The question was specially put, and being somewhat concerned in the enclosure, I thought it would be advisable for you to know that such arrangements had not been made, that the valuer acting under the enclosure has received no instructions whatever to drain the Rye Meads, but simply to apportion them out to various parties. No arrangement whatever has been made for the drainage of the Rye Meads.

5559. Then, I suppose, if they are to be drained, that must result from some subsequent arrangement?—Quite so.

5560. Are there any other points that you wish to mention?—You may probably have noticed how immensely they do get flooded, and the fact is, that the water remains there longer than on any others, and I may explain that that arises from three different causes, first of all, the construction of the railway has very much limited and prevented the water from running away, but the greatest reason is the Stort river. There is no escape for the water from the Rye Meads, except under the Stort, and it simply goes through a small hole, that is formed, I believe, by a hollow tree, and all the water passes through it in that particular way.

5561. Therefore you think I presume that a comparatively small expenditure would give relief to a very large area that is flooded?—Yes. I may mention also that there is no exit from the Stort in case of flood, except that which passes through Roydon mill; any surplus water is thrown back as back water, and runs through the old back river, and so is thrown on to these Rye Meads.

5562. To whom do the Rye Meads belong?—The land is Lammasland, and it belongs to a variety of persons.

5563. I suppose it would be allotted to several people?—Yes. I believe that no effective drainage can be carried out unless the parties can agree upon some one plan. The valuer has applied for power to drain the meads, but the parties interested would not give their consent. This is all I have to mention.

The witness withdrew.

Mr. JOHN MARCHANT, jun. (Hertford), further examined.

Mr. J. Marchant, jun.

5564. (*Chairman.*) You have some documents which you promised to furnish the Commissioners?—Yes, I produce an "Abstract of the receipts and payments of "the trustees of the river Lee" from the year ending 31st December 1856, and downwards to the year ending 31st December 1865. I have also appended a statement showing the result of the operations of the trust upon the revenue account, to show that the operations have been successful, and that we have not expended more than we were warranted in doing (*handing in the same*). Evidence was given at Hertford by Mr. Manser in which he seemed to reflect upon the management of the trust, and seemed to think that we ought to have in hand a large surplus to pay for any extraordinary expenditure. I show by the papers handed in that we have not overrun the expenditure. I will also put in an "Abstract of trade for the year end-"ing 31st of December 1865, showing the amount of "tolls received at different points upon the river" (*handing in the same*). I also produce the form that we adopted in the year 1864, to serve upon every person whom we found creating a nuisance in the navigation (*handing in the same*). We sent a number of these forms to different parties, but having no parliamentary power to carry them out, we found that they were insufficient.

5565. (*Professor Way.*) Will you be kind enough to state whether the trustees are changed from time to time?—Not by rotation, a change is caused only by death, unless on the ground of nonattendance for a certain period, that will disqualify.

5566. Are the members removed if they become disqualified in that way?—In practice they seldom return to act.

5567. How often is the body really changed?—It is difficult to say, because it is principally by death, almost entirely by death, that any change takes place.

5568. (*Chairman.*) Will it be fair to ask you whether you have formed any definite opinion, and that you wish to express, as to the constitution of the trust?—My opinion is distinctly this, that a certain limited number of trustees, or a limited body of any kind will generally act better than a body unlimited in numbers. The points which you have elicited to day from the witnesses go quite to this opinion, that you ought not to have so large a number that a majority can come in and swamp the rest upon any question by being whipped up at a particular moment. Such a power I think ought not to exist.

5569. In your opinion would a limited and properly defined body be better fitted for active work than an unlimited and ill-defined body?—As a general principle, I should say, yes; but we have not found any practical difficulty with the trust, it has worked marvellously well. I believe there were days many years ago, perhaps 30 years ago, when, if certain questions were coming on, there was a whip up, and those who were interested in the questions to be decided won the day as against the judgment of those who were not so particularly interested. I have heard my father say that there were days when 50 trustees were brought to a meeting by a whip up for particular purposes, and that is certainly not a condition of things which I think is desirable.

5570. You do not think it would be right that the acting working trustees, upon whose shoulders the burden of the business usually rested, should be, if some important arrangement was about to be made, overwhelmed by the votes of trustees who were usually dormant?—No; and if now such a thing were likely to happen, I should challenge the right of a trustee to vote, because I know that if he has absented himself for six months, he is undoubtedly disqualified.

The witness withdrew.

Adjourned.

Victoria Street, Monday, 4th February 1867.

PRESENT:

ROBERT RAWLINSON, Esq., C.B., IN THE CHAIR.

JOHN THORNHILL HARRISON, Esq.

BAILEY DENTON, Esq., examined.

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5571. (*Chairman.*) You are a civil engineer?—Yes.

5572. You are very largely engaged in drainage and other engineering works?—Yes.

5573. Has your practical experience been extended beyond England to Scotland or Ireland?—Yes; I have recently reported on the large estate of Connemara, in Ireland, belonging to the Law Life Society, and I have had many foreign works to report upon, both in Italy and France.

5574. How many years have you been in practice as a drainage engineer?—20 years.

5575. Have you any idea as to the acreage you have dealt with in round numbers, within a few 1,000 acres?—I should think something like half a million, in some way or other.

5576. I suppose I may take it for granted that in that area your experience has been in soils and subsoils of very varying and diverse characters?—No doubt; although my practice has not been so much in town sewerage, yet, I have had a share of that business also.

5577. Besides land drainage, I believe you have been consulted and concerned in carrying out river improvements?—Yes, considerably; district drainage, as I should term it.

5578. Including the improvement of river and streams?—Yes.

5579. I believe you furnished us with information about that in the evidence you gave before?—I did.

5580. Do you frequently find that land drainage to be properly carried out, involves the dealing with streams and rivers, and occasionally more or less with mills?—Decidedly, and in the evidence which I gave before this Commission with respect to the Thames Proper, I explained in what way the drainage of land was very much prejudiced by the condition of the rivers and tributary streams, and by mills. I also explained, I think, that there was a great prejudice against mills, which might be overcome if the proper treatment of rivers was well understood. I believe that drainage may be made the means of very much improving the water supply of this country, and by a proper division of the main valleys into subordinate districts, the mill power may be very much increased. In some instances the improvements I should suggest would involve the destruction of mills, but in many others it would lead to the improvement of the power of the existing mills, and to the establishment of new ones, which, in the aggregate, would amount to much more water power then now exists.

5581. In your land drainage operations, have you adopted and carried out what is termed deep drainage?—Uniformly.

5582. Does that mean deep draining of from four to six feet?—It means starting with a minimum of four, to suit the depth to the difference of subsoil, and in many instances I have gone from 10 to 15 feet deep for the main under-drains.

5583. Besides being acquainted with the valley of the Thames and the valley of Lee, are you acquainted with the other water sheds of England, such as the Severn or Yorkshire valleys?—I might almost say that my operations have extended nearly to every river shed in the country, because that is very nearly the fact. I know of very few rivers upon which I have not carried out some operations.

5584. Have you noticed in the public newspapers that in the last month or three months there have been very destructive floods, especially in the northern parts of Yorkshire?—Yes.

5585. Without pressing the matter further, is it your opinion that that state of things is a disgrace to us as a civilized people, and that we should have now to suffer such enormous destruction from floods in that part of the country?—No doubt, but the difficulty of dealing with it is immense, from the circumstance that the injury is accruing and is cumulative, and what may be a correct mode of dealing with it to-day may not be sufficient to-morrow, the addition of water from under-drainage very much affecting the question. I am also led to the conviction that under-drainage, which is various in result, is nevertheless so uniform in producing a benefit of one sort or another, that it is certain that all the wet lands of this country will be drained in the course of time. With the under-drainage of land, which should have the effect of reducing floods, there is necessarily an improvement of outfalls, by straightening and deepening and keeping clear the watercourses; and although the water of under-drainage is detained in the soil as the rain passes from the surface to the 4-feet drains, yet what is collected from the under-drains with that which flows over the surface to the outfalls, is so quickly discharged by the improvement of those outfalls, that the effect upon the rivers is great, and it will be greater every day.

5586. Are you aware that until this autumn it was a very popular opinion, at all events it was all through the Aire and Calder district, that floods had diminished; evidence was given day after day to that effect, and the witnesses seemed to anticipate that they would never have any more. But while this Commission was sitting, floods came that damaged them to the extent of thousands of pounds?—I am aware that that idea, founded upon ignorance, did prevail, but I have done my best to correct that impression, although my influence is very small.

5587. Do you really think that the under-draining you have spoken of affects so seriously the question of river flooding as to account for the damage which has been done by them?—I do not say that it accounts for it wholly, because there are many other causes, for instance, the silting up of rivers from the influx of sewage, and various effects which it will be necessary to take into account to explain it; but that the discharge from under-drainage now proceeding and accumulating every day does throw down the water at a greater rate than it did before is quite certain, although I admit at the same time that if we could deal with the under-drainage only, the floods would be diminished.

5588. Are you sure that it sends the water down more quickly in all cases than it did before?—Yes, as far as observation enables me to judge of it.

5589. Take as an example 10,000 acres of a retentive clay soil under-drained to the extent of 4 or 6 feet, and more or less porous, are you certain that from that area the flood water is sent down more quickly than it was before it was drained?—I should observe that I have gone very carefully into this matter and made experiments, which have been published in the Royal Agricultural Society's Journal, and I think I have shown to demonstration that the efflux of water out of a soil by under-drains is, after a repetition of rain for several days, almost uniformly half the fall in 24 hours, I therefore deduce from that, that if there are outfalls properly made to discharge that efflux into the river, and in addition to the water that passes

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through the soil there is a large quantity of rainfall which never does enter the soil, which must in rapid rains and great falls pass over the surface without entering it; then the discharge of the under-drains, plus the surface discharge quickly let down as it is into the rivers by improved outfalls must lead to a great accumulation of water in the main valleys.

5590. (*Mr. Harrison.*) I think you mean that when the soil is thoroughly saturated from the surface to the drains, and so saturated that the rainfall subsequently runs off the surface simultaneously with the full discharge from the drainage pipes, then, after a continuance of rain the discharge into the river is greater than it was before the drainage was carried out?—Decidedly; but allow me to explain, even by repetition, what I would say upon this point,—when clay becomes full to repletion, that is, when it can hold no more, the water falling upon the surface acts in two ways, first coming upon the water in the soil it presses out and takes the place of the latter which is directly discharged and about amounts, as I have said, to half the rainfall; and secondly, that which cannot enter flows off the surface and goes away by what I call land gutters, and passes to the tributaries of the rivers, and by those down to the main valleys. Let me say again that this is a very important philosophical question; if the outfall discharged the water of under-drainage only, I think, upon the whole, floods would be diminished, that is to say, the number would be reduced, though when the rainfall exceeds a certain limit they would be increased in quantity of water.

5591. You mean, I think, that this excessive discharge into the rivers only occurs on rare occasions when there has been such a continous rainfall for days that the soil is thoroughly saturated, and there is a discharge from the surface simultaneously with that from the drains?—Exactly.

5592. That does not occur after most heavy rains?—Perhaps not.

5593. (*Chairman.*) To return to the river Lee, have you considered that river in all its tributaries with any particular view to the improvement of the streams, the water supply, and the land in the valleys?—Yes, I have, and the extent to which I have gone will appear from the evidence I propose now to give.

5594. You are aware that the Lee is a navigation for a considerable portion of its length?—Yes.

5595. That it also is a very large source of water supply to the eastern part of the metropolis?—Yes.

5596. The water of the East London Waterworks Company and the New River Company being entirely drawn from the Lee and its tributaries?—Yes.

5597. And that the East London Water Company and partially the New River Company are in some degree concerned with the navigation works, that is to say, that the water which they take has been used for navigation purposes before it comes to their lowest point of abstraction?—Yes.

(*Mr. Beardmore.*) That would apply to the New River Company to a very small extent.

5598. (*To the witness.*) Will you be good enough to describe the points to which you wish to draw our attention?—I should preliminarily observe that I was led into the question of the drainage of the valley of the Lee at the instigation of some of the landowners of the marshes of East and West Ham, including what is called Plaistow marsh. The plan which I now produce was prepared with a view to the formation of this area (*pointing to the plan*) into a district for its drainage which I have partially explained in the paper you have before you.

5599. (*Mr. Harrison.*) The object was to drain it so that it should become capable of being built upon?—Yes.

5600. What is the level of that surface (*pointing to the plan*) as compared with Trinity high water-mark?—The section that I propose to put before you, and which you may find useful will explain that particularly. This (*pointing to the section*) is the surface of the marsh, and this is Trinity high-water mark, that (*pointing to the same*) is Ordnance datum.

5601. The whole of this area appears to be several feet under Trinity high-water mark?—Yes; in fact it occupies something like a mean between the two, Trinity high-water mark and Ordnance datum.

5602. What is the difference between the two?—12 feet 6. The views entertained by the landowners at West Ham in consultation with me were, that this was a district essentially valuable for dwellings for the labouring classes, not valuable for a high class of buildings; that it was also peculiarly available for the establishment of obnoxious trades which we wish now to expel from the metropolis.

5603. Is it not now being built upon for that purpose?—No, I know of no buildings on the great part of the marsh, but that this is the right view is proved by the fact that at the present moment there is a bill before Parliament for the consolidation of the various gas companies of the metropolis. I believe it will be brought forward or encouraged by the Metropolitan Board of Works, whereby the manufacture of gas will take place in the parish of North Woolwich, adjoining the outlet of the northern outfall of the main drainage of the metropolis, with a frontage to Gallions reach, and with a line of gas pipes following as nearly as possible the line of the main drain which I have proposed for the drainage of the district, and over which I have proposed also to construct a road so as to open up this wide and large area.

5604. That line is about midway between the northern outfall sewer, and the northern edge of the Victoria Docks?—Yes. I bring these objects before the Commission because I really think they are worthy of consideration in any scheme of drainage that may be carried out. This area comprising 1,800 acres of land is particularly suitable for the dwellings of the lower classes and for the location of obnoxious trades.

5605. (*Chairman.*) You are aware perhaps that all this district of West Ham and part of Plaistow has been sewered?—I am quite aware of that, still the larger part of the land there remains in its primitive condition.

5606. (*Mr. Harrison.*) Are you aware that in the agreement or arrangement made for an outfall at West Ham at this spot (*pointing to the plan*) it was always fully intended that the sewage of West Ham should be carried eventually to a lower part down the river?—I was not aware of that.

5607. Is the drainage of the West Ham area coincident, to any great extent, with the area you have pointed out?—It is. I believe that the lowest part of the 1,800 acres I was first proposing to deal with is somewhere here (*pointing to the plan*) in the West Ham meadows.

5608. So that the natural fall is rather up the river Thames than down it, at that particular part?—Yes, the fall of the surface is contrary to the arterial.

5609. Could you make use of the West Ham sewerage system so as to continue it eastward over the remainder of the area, carrying your outfall to the northern outfall sewer near West Ham, and pumping the whole of the sewage into the northern outfall?—I consider it unadvisable to raise the sewage of this district into the northern outfall. I have considered that the Metropolitan Board of Works would object to it, and on grounds of my own reasoning I consider it objectionable. But I wish to state that while this was under consideration, the information sought regarding West Ham led me into communication with Mr. Marshall, of Stratford, the engineer to the local board of West Ham, and he suggested to me that with other parishes of the valley there should be a combination, and that a larger work should be the result; that my original plan, in point of fact, should give way to a more extensive system of drainage. Following that suggestion I was led into communication with Mr. Marshall, no relation, but one of the same name, the engineer of Tottenham, and the design

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I first made was altered to suit the whole drainage of the valley. I think it right to mention that, because we desired to suit the interests of the various parishes. The original scheme that I had formed has very much suffered thereby, for what we might have done has literally now been stopped by the difficulty of dealing with a number of parishes. The result of this joint consideration of the matter was that without altering the site of the drain I proposed for the Ham marshes, but increasing its size and altering its character, it was prolonged up the valley to the Walthamstow marsh ,and from thence took the shape of a fork, passing to the east and west of the river and the navigation. This (*handing in the same*) represents the whole section of the valley; that is the Stratford sewer (*pointing to the same*) of which I believe Mr. Rawlinson was the originator. That is at the point where the sewer which I propose crosses the main sewer from Stratford (*describing*). This is the invert of my proposed sewer, which has a fall of two feet to a mile, meeting Mr. Rawlinson's sewer which is just below Ordnance datum, and therefore more than 12 feet below Trinity datum.

5610. Through the lower part you propose, as I understand you, to put your sewers at such a level as to intercept the sewage of West Ham?—Yes, and then to come on, first by an inclination of two feet to a mile, then by an inclination of three feet, and rising to five, up to a point which I considered was at that time the highest point to which the low-level system of drainage, that is, the lifting system, would apply.

5611. As far as the sewers extend, they would not at all affect the question of the East London water supply?—They would not affect it in any way except this, that in a bill which I believe the East London Water Company have now before Parliament, they propose to extend their reservoirs at the Copper mills, and the sewer that I propose would pass under the intended reservoirs though outside the existing ones.

5612. As far as keeping out sewage from the river Lee, your scheme as you have explained it, would not at all improve the condition of the East London Company's water?—No; they have an intercepting sewer there (*pointing to the section*), and the reservoirs are fed from the water above the point to which the low-level system would apply.

5613. The water is taken from a higher point than the highest of your low-level sewers?—Exactly so, but the district that I would include in those works extends as high as Waltham Abbey, with a view to dovetail into the system the intercepting sewers from those higher grounds marked on the map, the intention being to apply that sewage for irrigation, or for any other mode of purification that might be deemed best, and to allow the overflow from those works of purification to return into the Lee; but in no case would the discharge of the sewage water into the river be above the point of abstraction by the East London Company or the New River Company. I assume that under any circumstances that would be prevented, or rather that the water companies will extend their works upwards to the point where the sewage is radically intercepted. I have prepared a statement of figures showing the cost of the proposed works, and I am prepared to give them to the Commissioners if they think it desirable. The point of discharge would be at the same point as the North London main drainage, and I have provided in my estimate for making a reservoir at Barking creek to hold one million and a half of cubic feet, upon the assumption that 8,000 cubic feet would be brought down if the low-level system were made to this point (*pointing to the plan*) and that it would be there lifted.

5614. (*Chairman.*) What would become ultimately of the whole of the waters brought down there by that system?—My idea was, that the Metropolitan Board of Works might possibly take the sewage into their system of reservoirs with a view to the sewage being carried on for utilization beyond, but failing that, I proposed, as I have just now said, to have an independent reservoir, and that it should conform to the same arrangement as the works of the Metropolitan Board.

5615. With regard to the times of discharge?—Yes, and whatever was done with the sewage.

5616. (*Mr. Harrison.*) If they were obliged to carry it on to the land, you would do the same, and if they discharged it into the river you would do so also?—Yes, with this advantage; that the sewage from the district I propose to form by an amalgamation of the parishes up the valley of the Lee would not be so impure as the sewage of the metropolis; that is, there would be more water in it.

5617 Are you aware that the Thames Conservators have a bill before Parliament this year to obtain similar powers below Staines that Parliament gave them last year, to prevent any sewage being thrown into the river?—I was very glad to see the notice of that bill, but I do not know whether to read it as extending to the river Lee; if so, all the large tributaries of the Thames will be under the conservancy of the present board. I can hardly fancy that they would stop us at Barking creek when there does not appear to be any other way open of discharging it. It must be a very great improvement to discharge it there than where the Stratford sewage is at present discharged, near the mouth of the river Lee.

5618. By this system you would do good thus far, that you would divert all the sewage from near Waltham Abbey downwards on each side of the river Lee, and discharge it at Barking creek, or pump it for irrigation lower down in Essex?—Exactly so.

5619. You would relieve the Lee from all the pollution of the district?—I have divided this plan of mine into three parts, the first being that which must be lifted, and which I call the low-level system, and which is represented by the darker colour on the map; the next is the part from the uppermost margin of the low-level district up to Waltham Abbey; or it may be continued to Feilde's weir, of which the drainage on each side may be intercepted, and after being purified by irrigation or otherwise discharged into the river. But I have assumed that water will not be taken out of the river between those two points for domestic purposes, but above the highest point, Feilde's weir.

5620. Is your scheme one embracing the whole of the valley, or is it merely confined to the lower part?—The scheme that I laid before, or desired to lay before the united parishes for adoption, extended from Barking creek to Waltham, but that consisted, as I hope I have explained in the paper, of two characters of work; the low-level system into which all the sewage must go, and the medium system where the higher land sewage would be intercepted and applied in irrigation, if irrigation should be deemed the best.

5621. You do not propose to deal at all with the towns of Luton, Hertford, Ware, and Hoddesdon?—I have in view the continuation of that plan as I think I have stated in that paper, as far as a united system would facilitate the utilization of the river water for domestic purposes. The third part of my plan was this, to intercept the sewage from Feilde's weir to Hertford, and even to Hatfield on the one side, and to Bishop Stortford on the other, and having intercepted the sewage perfectly bya system of intercepting drains to discharge that sew- age below Feilde's weir.

5622. On to the land?—Yes; for irrigation, or it should be used on its way from Bishop Stortford to Feilde's weir, to run the effluent water into the river in its clarified condition, but below the point of abstraction for domestic use.

5623. Will your scheme appear before Parliament of that general character that you represented just now?—Not so; one of my great motives for desiring to give evidence before this Commission was to show that if that scheme of low-level drainage in connexion with an intercepting system, and the application of the sewage to irrigation is carried out from Barking creek to Waltham it may be continued to Bishop Stortford and Hatfield by an extension of works of a similar character whereby the water of the Lee may be utilized to a very large extent, more than it is at present. I see Mr. Beardmore present, and I am not at all sorry to promulgate my views in his presence. I consider that a system of interception might be carried out from Feilde's weir upwards by the fork, that is, to Bishop Stortford on the one side and to Hertford and beyond on the other, and that reservoirs or a reservoir might be constructed of very large dimensions below Feilde's weir. I consider that the section which you no doubt are familiar with, the section that was printed of the river Lee, called a profile of the Lee, shows that this can be done very clearly. I consider that a reservoir might be made of large dimensions below Feilde's weir, and the water conducted from above the weir into this reservoir. I do not look to that reservoir as the only means of storage for the Lee, because I am well aware that there are many places in the tributaries of the Lee where reservoirs may be constructed. I know intimately what was proposed by Mr. Rendel in 1849-50; I saw great objections to several of his reservoirs when I was consulted on the subject, and when I propose supplemental reservoirs higher than Feilde's weir I am not proposing exactly those which Mr. Rendel proposed. There were some, I have reason to know of those which he did propose, which might be still adopted, while others might take the place of those that were objectionable.

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5624. Below Feilde's weir do you get on to the London clay?—You get upon a drift of the London clay.

5625. Is your objection to reservoirs above in consequence of their being in the chalk formation?—It was proposed to raise the water in the valleys to a height above the margin of the clay, that is, to where the chalk was exposed, so that the water would be absorbed by the chalk, and of course drop down to the subterranean level of the water in the chalk—that was my objection at that time. The cost of the system of drainage as proposed up to Waltham, including the main sewer and its two branches, a reservoir at Barking creek, engines, and a pumping station, would be 252,000*l.*

5626. Did that include the main sewers?—Yes; and the reservoir, which was a costly item.

5627. No tributaries whatever?—None whatever, but the whole drainage is so laid out as to intercept all the tributaries now existing, or which might exist in the subordinate drainage of places on either side, such as Tottenham, Edmonton, and part of Hornsey.

5628. You would divide the area of the Lee into three sections, utilize the upper part as the gathering ground for the rainfall, and the streams for carrying the water to a certain point; you would form intercepting sewers to Bishop Stortford, to Ware, Hertford, and other towns, and carry the sewage from them to below Feilde's weir; there you would utilize the sewage upon the land, and after irrigation pass it into the navigation below the point from which the water companies would draw their water?—Yes.

5629. At the lower part, not being able to irrigate you would carry it in the low-level sewer to Barking creek, and there dispose of it in the same way as the Metropolitan Board would do?—Yes.

5630. Do you know the valley sufficiently well to say whether there is land in the district between Tottenham and Feilde's weir that would be suitable and sufficient for irrigation?—It is impossible I think to find a better site for irrigation than is to be found in the valley of the Lee, with this reservation, that there will always be amongst the residents on the sides of the valley objectors to any irrigation; but viewing the suburbs, and having due regard to the character of them, I believe that no place will be found where irrigation could be carried out less objectionably. With regard to the soil, I cannot call it a stiff clay, but it is a stiff loam, and it would require to be under-drained, both for the sake of purifying the sewage as well as benefitting the land when irrigated. There is every capability of doing it, owing to the rapid fall of the river itself when you get above Enfield marsh. The river, I think falls something like 5 feet in a mile, or between four or five, so that the drain has only to be carried a little more than a mile to discharge the water of drainage after the sewage has passed through the soil.

5631. (*Chairman.*) Have you any idea what area of marsh land there is to be found in the valley of the Lee and its tributaries above Stratford?—I have not calculated that.

5632. You know that there are many thousands of acres of land now comparatively useless because it is water logged?—It commands a good rent as it is, but it might command, if it were irrigated and drained, a very much larger rent.

5633. Does it command as much as 1*l.* per acre?—It now lets, I should think, at someting like 50*s.* or 3*l.* an acre.

5634. (*Mr. Harrison.*) Looking at it apart from the value it has from its nearness to London, and looking at the intrinsic value of the land, is there not a large area in the valley which is capable of very great improvement?—Very great subordinate improvement, were it provided with a sufficient outfall.

5635. An outfall of this kind would be the most efficient way of obtaining the improvement it requires, that is good drainage?—There is no doubt that up to a certain point, say Enfield marsh, there is no other means of draining the land—I speak of from Barking creek to the lower end of Enfield marsh—but with a system of low-level lifting drainage. Above that you may drain the land by ordinary land drainage, and I believe that there is every capability of applying the sewage to irrigation.

5636. Do you not believe, looking at the Lee as a whole, that there should be a scheme proposed embracing all those points to be carried out as a whole throughout the river Lee rather than any partial work?—My notion is decidedly what you express, and I only proposed a part rather than the whole because I considered that if we had the large figures that would be involved in so large a work it would not be entertained at all, and, therefore, my idea was at the time to limit the work to Waltham Abbey, but that what was done in such a way should be conformable to a more extended scheme hereafter. I would add, that in the plan that I proposed, which extended up to Waltham, I added to the works which I have already stated would cost 252,000*l.* intercepting sewers from the higher ground to lead the sewage to the lands which I propose to irrigate, and a further system of subordinate outfalls by which the irrigated lands would be drained into the river at a lower point, so as not to carry the water into the sewers, and the cost of that work would be 52,500*l.*, to which I added for the expense of lands and easements 20,000*l.*, making the total cost of the low-level system, in connexion with the interception of the high land sewage as far as Waltham, 324,500*l.*

5637. (*Chairman.*) Have you at all considered the rateable value of the property to be dealt with, and the rate in the pound per annum that it would take to pay the interest upon that money?—I have calculated it, and I have stated it in the paper before you.

5638. With a view to getting rid of that burden would you prefer to pay it in 30 or 40 or 50 years?—I recommended, particularly in this report, that it should be extended to 50 years.

5639. Would you propose to borrow a loan from the Exchequer Loan Commissioners at a low rate of interest?—That was part of the scheme; and the reason why I stated 50 years was, that the works were designed for prospective benefit rather than an immediate one, and, therefore, it was only just that the term should be lengthened one.

5640. (*Mr. Harrison.*) So as to let the property as it became improved pay for the improvement which had increased its value?—Just so.

5641. (*Chairman.*) Have you entered into any question of profit and loss, taking the value of the lands to be dealt with now, and taking the probable improved value after dealing with them, and after the expenditure of the sum of money you have named?—No. I looked upon the outfall as essential, not for the drainage

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of the land, but for the sewerage of the inhabited portion.

5642. Therefore it would be a matter the cost of which you could reasonably call upon the towns to meet, because they are now polluting the whole area by their sewage, and those works would enable them to sewer more completely, and not to commit an injury upon their neighbours?—Just so, and for another reason, that any improvement of land would not involve objectionable water, any discharge from the land being, under the present circumstances, a great improvement to the sewage discharged from the inhabited portions, there would be no objection to its being discharged into the river.

5643. (*Mr. Harrison.*) Are you going to appear before Parliament with a scheme in connexion with Tottenham and other towns?—At the present moment we are at a standstill; plans were prepared for deposit and they were deposited. Notices were given, and the parishes had a meeting at which they determined to do nothing, but consider it further on the ground that if through any report emanating from this Commission, or from compulsion, they were bound to combine in the general outfall, that Parliament would suspend the standing orders, and give them the power of doing so. Therefore, the result of the meeting of the parishes was to suspend our proceedings, and the consequence has been that the original scheme for the Ham marshes has been sunk in the indifference of the parishes to their present emergency.

5644. (*Chairman.*) We may assume that this inquiry has rather retarded than facilitated your operations so far?—It is so.

5645. (*Mr. Harrison.*) I suppose the result of our inquiry, if it ended in a more general scheme, would be beneficial?—It would exactly fit my notion of what ought to be done. I should mention, passing from the low-level drainage to the highest part of the district, that in my practice I have had to deal with two or three works which bear very closely upon the question before us, for instance, I have just finished the drainage of an estate immediately above Luton; it is but a small quantity of land, but there is a very large and constant discharge of water. The works have been in my hands something like 18 months, and I can speak with some certainty as to the large quantity of water that has been discharged from those lands. They are the property of Mr. Crawley, and the works consist of a system of under-drainage running up the valley here (*pointing to the plan*). The quantity of water delivered at that point I believe would go a great way towards supplying the whole of the town of Luton. I cannot state it positively, because I have never measured it; but I consider there is half a million of gallons discharged daily from that drainage area alone. I believe that the people of Luton are now considering some mode of pumping the water from the chalk, and the difference between that proposal and the utilization of Mr. Crawley's water would be, as we have seen in the Thames, that the pumping would draw the surface water down into the ground to be pumped up again.

5646. (*Chairman.*) Suppose you had to deal with the sewage of Luton, seeing that you have a choice of going up or down, the land being equally favourable both above and below, should you go up or down?—In the case of Luton I believe you have an exception to that which I consider the best plan generally, which is to go down and to discharge by gravitation. Here is an exceptional case, the ground round Luton is of an absorbent character, and would be very grateful for the sewage that might be spread over it; and the height of the hills is such that when the sewage penetrated them and found its level down into the soil, the water that could pass through the soil would return to the river in a pure state. I mean chemically pure as well as clarified.

5647. You think that there are exceptional circumstances at Luton that would induce you to irrigate the upper part of it rather than the lower?—Decidedly. Luton is surrounded by high lands of various characters, there is chalk, sand, and clay, and whatever sewage was pumped above Luton would, from the physical state of the country, pass into the soil and find its way ultimately into the springs without any injury to the river itself.

5648. If you could get an area of land sufficient to absorb all the sewage that you had, a couple of miles below, to which it could be conveyed by gravitation, might not that be cheaper than pumping it to the land above?—Yes, cheaper; but of course it would be disadvantageous to use that water after irrigation for domestic purposes. I have taken some pains, speaking only as one of the multitude interested in the question, to discover whether water, after passing through land or over land by irrigation, enters the river in a condition fit to drink, and the result of all the attention I have bestowed upon the point has been, that it is not fit to drink. Now, I do think, that Luton, standing at the head of the Lee system, might be compelled to pump its sewage to a height that should result in the passage of that sewage through a depth of soil which should lead to its discharge in a chemically pure condition into the river.

5649. Do you know what they do at Luton with their sewage now?—I do not.

5650. You do not know what it costs them to deal with it?—No.

5651. Do you know what the sewage consists of at Luton?—No, not precisely.

5652. You are not aware that there are tons of oxalic acid which go into the river every year after being used in bleaching the straw, and many tons of acids of different kinds, and sulphur, and in fact that there are exceedingly deleterious ingredients mixed to a large extent with the sewage of Luton, and coming from the neighbourhood of Luton?—Then I consider that an additional reason why the sewerage of Luton, if it is to be utilized at all, should be utilized in such a way as that the discharge should enter the river after every possible means had been taken to purify it. I do not think that any utilization of the sewage by irrigation in the valley can lead to the result we desire, which is a chemical purification of the water.

5653. (*Mr. Harrison.*) You think that its passage through a great depth of chalk or soil would so chemically purify it as to make it unobjectionable?—I do think so; but I do not speak from sufficient knowledge to be able to affirm it without some slight doubt, but it is very slight.

5654. (*Chairman.*) At present the authorities of Luton are compelled to filter the sewage of the town, and they are doing it at an annual expense of many hundreds, by a series of sediment beds. The sewage is treated by lime, and it is allowed to stand in open shallow reservoirs until deposition takes place, then the effluent water runs away into the Lee, and the mud is wheeled away?—Can anything be worse than that, except the simple discharge of the sewage at once into the river. Passing from Luton, which I referred to, because I consider it is one of the difficulties in utilizing the upper streams of the Lee, I will just mention another case on the Stort, showing the absolute necessity for strict supervision, and the necessity for complete interception of sewage water. I was called upon by one of the Courts to inquire into the discharge of sewage from some dog-kennels belonging to the Reverend Mr. Arkwright. He was master of the Essex hounds, and his dogs were dressed with arsenic, as I believe is the custom for mange and other skin diseases. The dogs were occasionally fed with glandered meat by accident, at any rate glandered horses had found their way to those dog-kennels. This was near the Stort, some six miles above its junction with the Lee. It was found that the drippings of horse flesh when glandered, and the arsenic from the washing of the dogs, found their way into Harlow brook and poisoned the horses that drank out of the brook. The consequence was that Baroness North brought an action against Mr. Arkwright for the damage that her tenants had suffered, and particularly one Mr. Barnard, and the Court ruled that the practice should be discontinued, and I was called upon to see whether the discontinuance was perfect. Mr. Arkwright, finding that the Court had given this order, adopted various plans of purification and filtration, and even irrigation also; Dr. Voelcker, at my instigation, accompanied me to the spot and obtained some of the water and analysed it; although perfectly clear to the eye, and so satisfactory to all appearance, that I was very nearly drinking some of it, it was found on analysis to be as chemically impure as ever. Again, to convey to you what information I possess with regard to another tributary of the Lee, viz., the Mimram, I may state that I have just devised a scheme for draining the small town of Welwyn, and there there is no mode that I can see of dealing with the sewage, except by filtration, and discharging it into the river lower down, the difficulty being that it is not a town sufficiently large to warrant any expensive works, and the consequence is that without some very rigid rules as to the interception of the sewage, and conveying it down to a distance where it could be used for irrigation, I at present see no means of carrying out that drainage satisfactorily.

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5654*a*. (*Mr. Harrison.*) Can you tell us the area of the upper portion of the river Lee which you have marked above Feilde's weir?—I cannot.

5655. Do you know the population of that area?—I do not.

5656. The principal towns are Luton, Hertford, Ware, and Bishop Stortford; what others are there?—There is Hoddesdon and Harlow and Sawbridgeworth; but there would be no difficulty in intercepting the irrigated sewage from Bishop Stortford to Feilde's weir, nor from Feilde's weir to Hatfield, though it might be considered best to lift the sewage and apply it at a high level.

5657. It is your proposition that Luton and Welwyn and other towns and villages similarly situated should be obliged to pump their water on to a high level, so as to purify it before it passes into the Lee?—I mentioned Luton as being a town where some special mode of arrangement should be adopted; as to Welwyn, I mentioned that merely as illustrating one of the many difficulties there are in dealing with these cases, but it is not an insuperable one. If a system of interception was generally carried out, that is, by combination, there would be no difficulty in dealing with it; but to deal with Welwyn without combination, certainly it would be too small, and in a very difficult position. Reverting to the question of storing water, there is no doubt whatever that if proper storage reservoirs are constructed there is no difficulty. I know I am speaking in the presence of those who appreciate it, and I do not hesitate to say, from a long acquaintance with valley drainage, and of the soil which exists in those valleys, that many places might be selected for the construction of reservoirs. I remember very well investigating the plan which was proposed by Mr. Rendel, and being struck with one reservoir which was to be made in Lord Salisbury's park, at Hatfield, I have noticed since a capability that exists in several parks to carry out what Lord Salisbury would have been glad to have seen carried out there. I refer to Pansanger, where there is a capability of storage, and to Brochet, Luton Hoo, and Welwyn Hoo, though there would be objections by some owners to drawing down the water. Again on the Rib near Wade's mill, and above Thundridge, I believe, there is a capability of constructing reservoirs, but, as I said before, they would have to be specially constructed, partly in the ground, and partly above; but not in connexion with those porous grounds which would allow of the escape of the water as fast as it got in.

5658. What was the extent of the reservoir that you proposed below Feilde's weir?—I took 610 acres as that which I considered would allow of a reservoir being made to hold a reserve of 20,000,000 gallons a day for 182 days, that is assuming the mean depth to be 22 feet.

5659. Have you gone into the probable expense of that reservoir?—No; not with sufficient accuracy to mention it; but I should tell you that looking at that, occupying 610 acres, and extending the supplemental reservoirs on the tributaries to 300 acres, and allowing 100 acres for banks and spoil, I considered that the whole would be done for half a million of money, exclusive of the cost of the covered conduit to bring the water down to the pumping stations.

5660. What volume of water have you calculated you could impound in the upper reservoirs?—Half as much more, making 30,000,000 gallons, in addition to that which is now obtained by the East London and New River Companies.

5661. Is there any other point upon which you wish to give us information?—I should certainly like to add, by way of explanation, that in the scheme which I have endeavoured to explain to you, we have made the extent of area tributary to the river Lee after irrigation, and after the water has been clarified by it, as large as possible and that of the low-level district as small as possible. I do not know whether you have observed it, but it is a very interesting feature in the consideration of this subject, that the New River expresses a tangible contour line to illustrate this division. You will find here (*pointing to the plan*) that it is 100 feet above Ordnance datum; it rises up a little, very imperceptibly, about 1 in 10,000, and you cut off that land (*pointing to the plan*) which can be made subservient to an irrigating system. I just observe upon that ot show the extent of land which might be made tributary to a system of irrigation on the Lee; of course it would extend lower than the New River as it approaches nearer to the place of distribution; but that line (*pointing to the plan*) conveys to the mind a very clear line of demarcation. Again, let me observe, as to a point upon which perhaps I was not explicit enough that with regard to the intercepting drains which I should propose as a means of keeping the river above Feilde's weir pure enough to drink, they would be open drains. I should not propose any covered drains where irrigation clarified the sewage, or else the expense would be very greatly increased.

5662. Would you take the sewage of Hertford, Ware, Hoddesdon, and the sewage of Stortford down the valley of the Stort in an open drain?—In open cuts after irrigation.

5663. You propose to take the sewage of Hertford, Ware, and Bishop Stortford and other towns to this mid-area, and there apply it?—Yes.

5664. Then until it arrived at Feilde's weir, you would carry it, in a close sewer?—No. I have not explained myself upon that point. I am assuming that the sewage of those various towns and villages would be applied for irrigation as it passed on its way towards Feilde's weir; if it were not purified by any system of irrigation, I am not prepared to say but that a covered conduit would be better than an open one.

5665. You would apply the sewage of Hertford, Ware, Bishop Stortford, and all the villages and towns on the river Lee and its tributaries, to land in the most convenient places adjoining to those towns; but you would intercept the effluent water from the irrigated fields, and carry it down in open ditches to below Feilde's weir?—That is precisely what I meant.

5666. Where it might be applied to the land, or be passed into the navigation?—That is the plan. If there were places where the sewage could not be used for irrigation, I cannot say at this moment that it would be better to convey it by a covered channel than an open one. The object would be to keep the cost of the works as low as possible.

5667. Is there any other point that you wish to mention?—Mr. Rogers Field, who is here, has taken some pains in getting out details, but perhaps they will be surplusage at this moment; he is perfectly willing and able to answer any question as to the way in which the quantity of sewage that we propose to discharge at Barking creek has been arrived at, and the details of the cost, if you wish to examine him upon it.

The witness withdrew.

LONDON.

B. Denton, Esq.

4 Feb. 1867.

The witness subsequently forwarded to the Commission the following letter:

22, Whitehall Place, London, S.W.,
April 16th, 1867.

GENTLEMEN,

MR. BAZALGETTE has addressed a report to a committee of several parishes on the river Lee in which he says that the sewage of the whole valley, including East and West Ham and Leytonstone, as shown by colour on a map appended to his report "can be conveyed by "gravitation to Barking," and that "no portion" of the district between Hertford and Stratford is suited for irrigation by sewage.

As this is in direct contradiction to the evidence given before your Commission on the 4th February last by Mr. Field and myself, I am desirous of an opportunity of placing before you, if it be not too late, proofs of the accuracy of the statement then made, and of the plan and section submitted to you upon which was based a proposal to form a drainage district of the whole valley, to comprehend a low level in conjunction with a high level system of works and lifting of a portion of the sewage.

You will observe in Mr. Bazalgette's report, that he proposes to remove the whole of the sewer of the Lee Valley to Barking Creek, there to be either utilised by the Essex Reclamation Company or discharged into the Thames, by both of which modes of disposal the water containing the sewage will be lost to the navigation and mills of the Lee.

It is unnecessary for me to remind you that, if the benefits of irrigation shall turn out to be greater than the cost of lifting, the sewage will be readily utilized by agriculturists on the high grounds within the Lee watershed with the twofold advantage of fertilizing the district from which it is derived, while helping to maintain the river system by the return of the effluent water after utilization. I think too it is equally unnecessary to point out to you that there are many reaches of low land on the sides of the Lee to which sewage may be applied with advantage by gravitation, owing to the rapid fall of the river (see section) which will afford a ready means of underdraining the lands to which the sewage may be applied. By removing the sewage of the Lee valley to Barking Creek on the other hand, and delivering it over to the Essex Reclamation Company for application, no part of that sewage can be applied to land without lifting, mixed as it will be with the sewage from Tottenham which can only be discharged at a lower level than the surface of the land.

Should your Commission be unable to hear me in further explanation of the data upon which my evidence was based owing to the time that has elapsed since I gave it, I have to beg you will allow this letter to appear in the appendix of your report as a reiteration of the following conclusions:—First, that it is utterly impossible to form a district of the whole of the Lee valley, the drainage of which shall be discharged by gravitation at all times of tide; next, that the sewage of Tottenham itself cannot be wholly discharged above high tide without recourse to mechanical agency; and last, that there are special capabilities in the upper part of the Lee basin for the utilization of the sewage of the different towns discharging into the river profitably and without objection, if the river be placed under a proper conservancy, having due regard to drainage, water supply, navigation, and mill power.

I have, &c.,
(Signed) J. BAILEY DENTON.

To the Rivers Commissioners.

Mr. R. Field, C.E.

Mr. ROGERS FIELD, C.E., examined.

5668. (*Mr. Harrison.*) You have been engaged with Mr. Bailey Denton in devising this scheme of interception?—I have.

5669. Have you entered to a considerable extent into the particulars of that scheme?—I have.

5670. I see that one of the main drains on the fork passes the towns of Tottenham, Edmonton, Enfield, and other places?—Yes, at least provision is made in the scheme for the drainage of all these towns.

5671. Are you aware of the difficulties that those towns lie under at present, as to carrying out a complete system of sewerage?—I am.

5672. Are you aware that Tottenham is, at present, lying under an injunction not to extend its sewerage system, which it proposed to do; and Barnet, which is an extensive parish, has been discharging its sewage into a cut that was made by the East London Water Company?—Yes.

5673. An injunction has been obtained to prevent the authorities of Barnet from discharging any more sewage into that cut?—Yes, I am aware of that.

5674. Would this scheme that Mr. Bailey Denton has devised and explained to the Commissioners get over the difficulty in the case of Tottenham?—Entirely.

5675. Are the sewers sufficient to carry off the sewage from the extensive districts to the west of the Lee, in case it becomes covered with a dense population, such as appears to be growing rapidly upon it?—The sewers shown on the plan are calculated with reference to the population merely of the district that is distinguished here (*pointing to the plan*) as being the low-level; the sewage of the high-level district is intended to be utilized for irrigation, and the effluent water discharged by gravitation into the river Lee or navigation. I may explain, in reference to the principle upon which the sizes of the sewers were determined, that the population according to the census of 1861, of the low-level district extending from Enfield to Barking creek, may be taken at 68,000, and the present population will be about 94,000; the area is 26½ square miles.

5676. If that was built upon, and so densely populated as the parts now occupied by the poorer classes of London, what would be the population upon it?—We have allowed for a different density of population in different portions of the district; for instance, the first portion, consisting principally of East and West Ham parishes, contains an area of 10¾ square miles, with a population in 1861 of 41,000, and I have considered it might have eventually a population of 200,000. Going upwards, I consider the district would not be populated to anything like the same extent, and I have therefore taken about three times the population of 1861.

5677. Why should the district not be largely populated?—Because it is getting further away from London, and judging by the rate of increase that has already taken place in West Ham, the population has doubled itself in 10 years, in the parishes above it has only increased from 20 to 45 per cent. in 10 years.

5678. The lower part is nearer to the river and Victoria docks?—Yes; in calculating for the other portions I have allowed about three times the population of 1861, amounting in the gross to 280,000 for the entire low-level district, the present population being 94,000 on an area containing 26½ square miles.

5679. Have you any facts as to the area of land in the valley of the Lee which is applicable for irrigation? The intermediate district you calculate can be brought in and the sewage applied to the land; the population is an item of importance, and also the area of land to which the sewage could be applied?—The present population of the high-level district up to Waltham may be taken at 55,000.

5680. What is the prospective increase that you expect?—That point has not been gone into further than to ascertain that there were capabilities for irrigation for any probable increase of population. There is a long and wide tract of level land here (*pointing to the plan*) which would be available for irrigation. It is considered that it would not be advisable to irrigate below the point B at the upper end of Tottenham marsh; but there is a considerable extent of land from B to C, near Broxbourne, which might be available, and would give an ample area for irrigation, several thousand acres.

5681. Would that land be so close to dwellings, towns, and villages as to be a nuisance?—An ample area, I think, would be found here (*pointing to the plan*) that would be sufficiently distant from the villages, so that irrigation would be perfectly feasible; the populated parts are not nearer to the river than a mile.

5682. Are there any other points that you wish specially to explain?—I may explain as to the principle on which the works were designed, that it was considered advisable to make the sewers of sufficient capacity for the maximum volume that they

LONDON.

Mr. R. Field, C.E.

4 Feb. 1867.

would eventually have to take, but that the engine and reservoir need at present only be constructed of a small size with reference to the population for the next 8 or 10 years, as they could be enlarged when required. The estimate therefore includes sewers calculated for the maximum population stated, and reservoirs and engines only for half the maximum population.

5683. (*Chairman.*) Do you remember what your engine power is to be?—The full engine power that would be required would be 370-horse, and we propose to provide, 200-horse power for the present.

5684. What would be the lift?—It would vary from 12½ to 30 feet; when the sewers were running full the lift would not exceed 24 feet, and the maximum power required is calculated for this lift.

5685. What volume of sewage would you have to lift for 24 hours, or for an hour?—The maximum flow, including rain, that would have to be lifted ultimately would be 8,000 cubic feet a minute, half of this, or 4,000 cubic feet per minute, is what we have provided for in the first instance.

5686. (*Mr. Harrison.*) This scheme is one just beyond the limits of the metropolitan district, and devised to carry out a general system of intercepting sewerage for the whole of the suburban districts of the metropolis that now drain into the Lee, and to which the system of irrigation cannot be applied?—Precisely. The low-level district has been confined strictly to those portions from which it was considered impracticable to utilize the sewage by means of irrigation. Of course the precise limits of this district could only be defined by an accurate survey, but they have been arrived at approximately for the purposes of calculation. I think another point on which you wished for information was the rateable value of the district. This is a little over 600,000*l.* for the entire district below Waltham, including both high and low level.

5687. What was the rateable value of all the lower portion?—I have not got that separately.

5688. Is this lower limit (*pointing to the plan*) the portion which you intend to rate for the execution of the works.

(*Mr. Bailey Denton.*) No, it extends to the whole of the tributary area from Waltham to Barking creek; for instance, we should bring in Hornsey, which lies immediately about the New River, which I have spoken of as giving a contour line, dividing that part of the district of which the sewage could be utilized from that which must go to the low level for discharge.

The witness withdrew.

Adjourned *sine die.*

LEE VALLEY AND HAM MARSHES SEWAGE.

Memorandum as to Data on which the Project is based.

The valley of the Lee from the Thames to Waltham Abbey was proposed to be divided into two districts, a Low-level District and a High-level District. The sewage from the Low-level District would be intercepted by a deep main sewer and branches which would convey the whole of the sewage of the district to Barking Creek, where it would be raised by steam power into a covered reservoir similar to the present one of the metropolitan Board of Works, thence to be discharged into the Thames, or dealt with in any other way in which the metropolitan sewage may eventually be treated. The sewage from the High-level District on the other hand would be used for irrigation, and for this purpose would be intercepted by a series of main sewers and conveyed to various points on the meadows adjoining the Lee, the effluent water being discharged by gravitation into the river or navigation.

The following observations refer only to the Low-level District:—

AREA AND POPULATION OF LOW-LEVEL DISTRICT.

Names of Parishes.	Area within District.	Approximate Population within District.		Increase per cent.	Approximate present Population.	Prospective Population provided for.
		1851.	1861.			
	Square Miles.					
Woolwich, Barking, East and West Ham.	10¾	20,367	40,596	99	61,000	200,000
Leyton and Wanstead.	3½	4,400	5,500	25	6,500	16,000
Walthamstow and Chingford.	4½	3,300	4,800	45	6,000	14,000
Tottenham - -	5	8,000	11,600	45	14,500	34,000
Edmonton - -	2¾	4,500	5,400	20	6,000	16,000
Total - -	26½	40,567	67,896	—	94,000	280,000

Sewage provided for.

The volume of sewage is taken at five cubic feet per head per diem, and it is assumed that half this amount will flow off in six hours, giving a maximum flow of double the average daily flow.

Rain provided for.

The amount of rain provided for varies with the nature of the districts. In the Stratford and Ham Districts, which are for the most part below the level of high water, provision is made in the sewers for a quarter of an inch of rain *flowing off the ground* in the 24 hours, and it is assumed that the whole of the area capable of being built upon will be populated. In the districts above Stratford it is assumed that the rainfall will, to a considerable extent, be discharged into the river by the natural channels, independently of the sewers, and that storm overflows will be constructed in connexion with the sewers, so that only one eighth of an inch of rainflow per diem is provided for, and a deduction is made from the whole area for the portions it is considered will not be populated.

The table on p. 192. gives the details of the prospective population, sewage, and rainflow provided for in the different districts, and the calculated diameter of circular sewers capable when running full of discharging such sewage and rainflow. The sewers provided for in the estimate are somewhat larger than the sizes given by calculation, and an allowance is made for their being, where desirable, egg-shaped instead of circular. There would of course be intermediate changes of dimension between the points specified in the table, so as to graduate the sewers to the work they have to perform.

Engine Power required.

The maximum prospective sewage and rainflow is 7,941, or say 8,000 cubic feet per minute. The lift will vary from 12½ to 30 feet, but the maximum lift will not occur at times of maximum flow, when the main sewer is running full, which it will be at times of maximum flow; the lift (to the top water of the reservoir) will not exceed 24 feet. The engines must therefore eventually be capable of raising 8,000 cubic feet per minute, 24 feet high, or an aggregate power will be required of (say) 370 HP. It is proposed in the first instance to provide 200 HP.

Reservoir.

Assuming that the reservoir must be capable of holding six hours maximum flow of sewage and rainfall (which exceeds the provision made in the metropolitan reservoirs), a capacity will eventually be required of 2,880,000, or say 3,000,000 cubic feet. It is proposed in the first instance to provide a reservoir of one-half this capacity, or 1,500,000 cubic feet.

(Signed) ROGERS FIELD,
6, Cannon Row, Westminster,
March 15th 1867.

Description of separate Districts drained by various portions of proposed Sewers.	Area of Districts.		Prospective Population.		Maximum flow of Sewage from prospective Population.		Rainflow.				Sum of maximum Sewage and Rainflow.		Conditions of Sewer capable of discharging maximum Sewage and Rainflow from accumulated Districts.	
							Separate Districts.			Accumulated Districts.				
	Separate Districts.	Accumulated Districts.	Separate Districts.	Accumulated Districts.	Separate Districts.	Accumulated Districts.	Area provided for.	Depth of Rain flowing off per Diem.	Flow per Minute.	Flow per Minute.	Separate Districts.	Accumulated Districts.	Fall per Mile.	Calculated Diameter of Sewer (circular).
	Sq. Miles.	Sq. Miles.			Cub. Feet per Min.	Cub. Feet per Min.	Sq. Miles.	Inches.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Feet.	Feet. In.
					97	97	2	½	403	403	500	500	5	2 3
EAST BRANCH: District draining above junction with main sewer (near Copper Mills).	3¼	3¾	14,000	14,000										
WEST BRANCH: District draining above Edmonton and Tottenham Parish Boundary.	2¼	2¾	16,000	16,000	111	111	2	½	403	403	514	514	5	2 3
Additional district draining above the crossing of the River Lee.	5	7¾	34,000	50,000	236	347	4¼	½	856	1,259	1,092	1,606	5	3 7
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Additional district draining above crossing of Great Eastern Railway, (main line).	5½	17	25,000	89,000	174	618	5	¼	1,008	2,670	1,182	3,288	3	5 3
Additional district draining above crossing of Barking Road (including Plaistow.)	4	21	100,000	189,000	694	1,312	3½	¼	1,412	4,082	2,106	5,394	2	6 11
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(2.) Storage reservoirs. Five reservoirs covering 120 acres, and capable of holding 170,000,000 gallons, or about six days' supply, 548, 615–22, 628, 974–9; therefore enabling the company to dispense with taking the first flood water which is thick, 90–5, 613–34; but not with taking polluted water when river is low after a long summer drought, 529–31. Reservoirs made in 1861, and yet no great deposit, 974–9; company is applying to Parliament for power to increase reservoir room, 94–5, 218–9.
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(4.) Service reservoirs &c. From filter-beds part of water pumped immediately into mains at Lee Bridge, 291–4, 395, 992; other part passes by covered conduit of cast-iron, two miles long, to covered service reservoirs at Old Ford, 362–8, 374–5, 394–5. These service reservoirs occupy 2½ acres, and are emptied daily into mains to extent of one-third, 936–8. The mains of both Lee Bridge and Old Ford works join each other promiscuously throughout area supplied by the company except as to two portions of high elevation, 381–2; but the waters of the two mains might have travelled over a long distance before mixing, 398–9. Both works must be in operation at the same time; not power enough in Lee Bridge works to serve upper elevation, nor in Old Ford works to supply whole district within the proper time, 377–8; usually for lower district night-work done at Lee Bridge; day-work at Old Ford, 384. Engine power 1,000–1,200 horse, 186; height to which water is lifted, 194.

VI. Quantity and quality of water:
Volume pumped 20,000,000 gallons daily, 193. 90,000 houses supplied, 19. Proportion of waterclosets to each house, 916–8, 658–9 [Appendix No. 1.] Quality of water, see analyses, 658–9 [Appendices No. 3 and 4.]

VII. Distribution:
Partly constant—Mains permanently charged, and from these about 1,200 large consumers, traders, &c. have a constant supply by meters, 235, 319, 322; also some poor tenants also who are found to consume from 12–15 gallons daily, 108–20. Chiefly intermittent, under fixed arrangement, generally for about 20 minutes every day, 1008–15; but no Sunday supply, 236–50. In case of small cottages, company prefer to deal with landlords, but arrangements made by landlords to receive water frequently insufficient or else wasteful, 236–50, 3217–22, 3314–35. Total supply insufficient; company could sell twice as much if they had it, 214–8; but Lee will not yield enough, 226–8. Company are applying to Parliament to draw from Thames, 219.

VIII. Miscellaneous particulars.
Water for fire-extinction supplied gratuitously, 26; usual head of water, 256–261. Hospitals and parishes supplied at half rates, 26. No incrustation in mains, 268–70; no pollution from gaspipes, 277–85; dead ends of pipes occasionally foul, 263–5; fractures in frost time rare, 271–7.

IX. Supply during outbreak of cholera in 1866.
After Act of 1852 two open reservoirs at Old Ford went into disuse, and were never regularly refilled since 1855; they nevertheless remained filled, partly by overflow from upper filter beds when choked, partly by soakage, 143–4, 177–85, 931–2; also were adjoining to tidal portion of Lee, where are exposed mudbanks exhaling foul gases, 927–8, 940–7. Communication between open reservoirs and closed reservoirs of filtered water at Old Ford possible up to autumn of 1866, 165–74; then cut off; before that, open reservoirs were very rarely drawn upon to supplement covered reservoirs of Old Ford; this done in 1864 with no bad effect, 557–9. In 1866, just before outbreak of cholera, a small quantity thus taken from open reservoirs, 145–64, 556; and thus the district in which cholera raged was during the day supplied from Old Ford covered reservoirs, which contained some water from open reservoirs, mixed with body of filtered water, 401–8, 3154–63; but in cholera district there were other nuisances enough to account for cholera—exposed mud-banks, ditches full of stagnant sewage, crowded dwellings, and polluted wells, 405–17, 465–8, **828–49**, 1037–49, 923, **3190–239**. Could main pipe from Lee Bridge to Old Ford, as it passed under River Lee, have taken in any polluted water through a fracture from open reservoirs? 3162–79. Could there have been any infiltration through subsoil from old reservoirs to new covered reservoirs? 165–74; in spring of 1866 the larger of open reservoirs was emptied by steam power, and after some weeks was found to be full again, partly from rain, partly from infiltration from adjoining open reservoir or from river, 950–63.

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EDMONTON:
Witnesses examined,
Chairman of Local Board, Mr. Busk, 3710–94.
Surveyor to Local Board, Mr. Gosset, 3795–854.
Population about 10,000, 3777. Health fair, 3743. SEWERAGE, none but a few short sewers, 3800–2. Not more than 200 waterclosets, 3813. CESSPITS usual, cleaned out by occupiers, 3742–4, 3776; cost, 3828–48; cost to community, 3751. Local Board are being sued by Tottenham Local Board for a nuisance, 3543; are suing Tottenham Local Board for the nuisance of Wood Green sewage, which the Lee trustees will not suffer to be added to Tottenham sewage passing into Lee 3778; are suing Colney Hatch Lunatic Asylum for fouling brook, 3717, 3738–40; have been at litigation with Enfield for a like reason, 3741. WATER SUPPLY, partly from New River, partly by private wells, 3746–51, 3820–4. Water of wells ochrey, 3748; according to analysis not bad, 3849; is it liable to infiltration from cesspools dug in same gravelly subsoil? 3533–7, 3785–6.

ENFIELD:
Witness examined:
Surveyor to Local Board, Mr. Ironside, 3855–949. Population now between 12,000 and 13,000, 3860–1. Rateable value, 3921. SEWERAGE, town of Enfield and town of Ponders End, containing together about 6,000 inhabitants, drained; parish of Enfield not drained, 3873–8, 3919–20. Cost of sewers, 3902–4. Sewers partly ventilated, but free from foul air, 3891–9. Sewage from sewers led through settling tanks, 3881–9; solid matter strained out but of little value, 3908–18; effluent liquid passed into Catchwater dyke and thence into Lee, 3881–9, 3937–44, 4440–1. Local Board a few years ago placed by Edmonton under an injunction not to commit nuisance by sewage, 3905–7. WATER SUPPLY, partly from artesian well at Ponders End, partly from land springs which give a hard water, 3866–72. Water laid on to most houses, 3879–91, 3904. Waste ashes no trouble, 3890. Road-scrapings disposed of, 3900.

EVAPORATION:
658–9—TABLES.

F.

FAIRMAN, Mr. (of Stortford):
Evidence of, 2346, 2409.

FLOODINGS:
Whole valley of Lee liable to, 87; but chiefly below junction of Stort, where river passes on to London clay, 535–41. Liability to, reduced partly by dredging and other navigation works, 778–81, 798, 4888–92, 5087–8. In Stort valley also reduced, 2080–9, 2796. Mischief to land, 2518, 2527–8, 2589–602, 2612–6; to mill power, 2271–3, 2286–8, 2594; to navigation, 2797. Causes of, silting up of bed, 4932–5; artificial obstructions, 1947–68, 5558–63; mill-weirs, **2581–6, 2618**, 5421–9; want of embankments, 542; river not embanked except below Old Ford, 727. Riparian property to a large extent unenclosed, 543, 783–4.

G.

GARRATT, Mr. (of Stortford):
Evidence of, 2546–626, 5330–42.

GEE, Mr. (of Stortford):
Evidence of, 2627–705.

GEOLOGICAL:
Character of basin down to Cheshunt mostly chalk, covered in the valley by beds of sand, gravel, drift, and clay, and in some places patches of boulders, 480, 518, 680–3, 1490–1, 1841–51. Bed of Lee a natural filter. 683, 799–800, 808–11; but at lower end of Stort valley clay, 502–3; and at Broxbourne London clay begins, 693; at Tottenham a bed of gravel over London clay, but only at bottom of valley, 3500, 3514–21, 3524–9.

GLASS, Mr. (Traffic Manager of Lee Trust):
Evidence of, 4733–830.

GLASSCOCK, Mr. (of Stortford):
Evidence of, 2125–248.

GOSSET, Mr. (of Edmonton):
Evidence of, 3795–854.

GREAVES, Mr. (Engineer to East London Waterworks Company):
Evidence of, 66–658; 916–1049.

GRINDLE, Mr. (of Hertford):
Evidence of, 4970–5017.

GUY, Mr. (of Tottenham):
Evidence of, 3556–676.

H.

HAGGAR, Mr. (of Hertford):
Evidence of, 4894–969.

HALL, Mr. (of Tottenham):
Evidence of, 3236*–86*.

HATFIELD:
Sewage, led formerly into a chalk-pit, now into dumb wells, 4586–8.

HAWKES, Mr. (of Stortford):
Evidence of, 2890–924.

HEATH, Mr. (of Tottenham):
Evidence of 3287*–3363.

HERTFORD:
Witnesses examined.
Mayor, Mr. Armstrong, 4176–249.
Town Clerk, Mr. Longmore, 4250–328.
Inspector of Nuisances, Mr. Jarrett, 4654–97.
Surveyor to Corporation, Mr. Wilds, 4698–729.
Manager of Sewage Outworks, Mr. Grindle, 4970–5017.
Mr. Haggar, Seedcrusher, 4894–969.
Mr. Pollard, 5018–21.
Population about 7000, 522: 1069. Local Government under special Acts 4187. Trade, Oil Mills 4190. SEWERAGE: under Hertford Sewage Act of 1854. New River Company has constructed a main sewer intercepting all drainage from river; with this main sewer Corporation has nothing to do except to make connecting house drains with it, and New River Company has nothing to do with house-drains; neither sewer nor house-drains ventilated; hence bad smell; 1078–82, 4292–308, 4660–1, 4720–1, 5001–17. Outlet of Sewer below intake of New River Company from Lee 1078–82; 4258–64. SEWAGE, before discharge, is dealt with by Higgs' process of precipitation by lime, chloride of lime being added, 1170, solid matter taken out and sold, but fetches a small price, 3766–8, 4972–7, 4992 effluent water discharged into Lee, 4258–64. Sewage much diluted from spring water in sewers, **1083–4**; **2977**. But sewer-outlet very foul, 4401, 4404–8. Effects of pollution felt at Ware, 4407, 5138–41, 5208; at Stanstead, 2303–4. Total outlay by New River Company upon sewer and outlet works, 22,000*l*, annual expense 600*l*. 1312, 4986–92. WATER SUPPLY, two sources both in hands of Corporation, one from Lee above town, the other from well in Hartam, also private wells, 4204–11, 4265–87, 4319–28. Quality, 4200; **4328–9** [PAPER,] 5018–21. Volume, equivalent to 30 or 40 gallons per head of population supplied; gross waste, 4666–97.

HIGGINS, Mr. (of Luton):
Evidence of, 1931–46.

HITCH, Mr. (of Ware):
Evidence of, 5240–329.

HODDESDON:
See evidence of Mr. Manser, 4831–93. Population, 1898, 523. Sewage partially carried out into river, 4430.

HUNT, Mr. (of Stortford):
Evidence of, 2249–2345.

I.

IRONSIDE, Mr. (Surveyor to Enfield Local Board):
Evidence of, 3855–949.

J.

JARRETT, Mr. (of Hertford):
Evidence of, 4654–97.

K.

KNIGHT, Mr. (of Mile End):
Evidence of, 3116–335.

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L.

LEE RIVER:
Acts concerning 532–3 *Paper*. Area of basin, 500 square miles, 481. Population of basin down to Hackney exclusive of Hackney and Walthamstow, 174,000, 611–2. Geological character of basin, see *Geological*. Source in a series of springs at Leager Marsh two or three miles from Luton, 1820–4. Height of range of Watershed, 801. Essentially a spring-fed river, springs rising in bed, 684–699, 802, 3049. Liable to be flooded; see *Flooding*. Clears itself very quickly after flood, 816–8. Tributaries, 532–3 [PAPER.] A Tida- river; extreme point of tide Lee Bridge Mills, five miles from Thames, 86, 725–6. A navigable river, see *Navigation*. Volume of, as gauged at Fielde's Weir at junction of Stort, 702–8, 804–7, as estimated at intake of New River Company, 816–8. Appropriation of water, see *Navigation; East London Waterworks Company; New River Company:* total volume daily abstracted 43,300,000 gallons from rivers with basin of 450–500 square miles, as compared with 48,375,000 gallons daily taken from Thames basin of 3,500 square miles, 1027–32. Mills upon, see *Mills*. Pollution of, see *Pollution*. Conservancy required for, see *Conservancy*.

LEE RIVER TRUST:
See *Navigation*.

LEGISLATION:
For River Lee, see *Conservancy*.

LIMEHOUSE CUT:
An open cesspool, 843–7.

LITIGATION:
To prevent pollution of rivers and streams.
Edmonton *v.* Colney Hatch, 3717, 3738–40.
" *v.* Enfield, 3741, 3905–7.
" *v.* Tottenham, 3543.
Lee Trustees *v.* Metropolitan Board, 4469.
" *v.* Tottenham, 3263–5, 3280–1, 3303–11, 4451, 4458.
Leigh - *v.* Luton, 1604–14.
Tottenham *v.* Hornsey Board, 3360, 4453.

LONGMORE, Mr. (of Hertford):
Evidence of, 4250–328.

LUTON:
Witnesses examined:
Chairman of Local Board, Mr. Pledge, 1367–419.
Surveyor of Local Board, Mr. Sandoe, 1420–600, 1684–717.
Clerk of Local Board, Mr Bailey, 1601–43.
Officer of Health, Mr. Kit Tomson, 1644–83.
Member of Local Board, Mr. Davis, 2021–46.
Local Registrar and Sanitary Inspector of Board of Guardians in hamlet, Mr. Maffey, 1870–930.
Mr. Willis, straw hat manufacturer, 1718–806.
Mr. Higgins, straw plait merchant, 1931–46.
Mr. Lye, straw plait dyer, 1969–2020.
Mr. Taylor, Bailiff to Mr. Crawley, 1947–68.
Largest town in Watershed of Lee, 477. Population nearly 20,000, 478, 1069, 1371; and fast increasing, 1372, 2021–32. Rateable value, 40,000*l.*, 1373. Health improving, 1409, 1682, 1870–930. SEWERAGE; all houses drained in township, 1421–33; only intercepting sewer ventilated, 1430–1, 1591–5; evil effects of no ventilation, 1676, 1709. Drains cannot be flushed, but are kept tolerably clear by abundance of subsoil water, and water from dye-houses, 1578–91, 1695; and the fall is good, 1694. Sewers carried under river, as town is on both sides, 1497–9; not liable now to be flooded, as storm-water bed has been made, 1701. SEWAGE from sewers is discharged into river, after treatment by Higg's process; this treatment ordered by injunction procured by neighbouring landlord, 1074–5, 1604–14. Volume of sewage, 1000; contents of 500 watercloseets, 1434–9; outlet discharge about 240 gallons per minute, but great portion of this is spring water which has found its way into sewers, 1457. Sewage first led into settling beds below town, there lime and chloride of lime applied, and liquid allowed to evaporate, 1523–7, 1534–46; sewage then pumped in semi-solid state across the river; when dry, bought by farmers, 1465–6; formerly difficult to dispose of, from 2,000 to 3,000 square yards having been on hand, 1471–7; more than 2,000 tons of solid matter thus annually taken out of depositing tanks, much of it road grit, 1461–70. Original outlay upon sewer and works nearly 15,000*l.*, 1478–9. Annual expense nearly 500*l.*, 1451–6. WATERCLOSETS supplied only by pumps and rain-water, 1434–9; inconvenience of want of water very great, 1743–8. PRIVIES usual amongst poor, 2,000 or 3,000, near to houses, 1503–12. Cesspits, made in chalk, 1513–22; some emptied under directions of Local Board, 1440–9; others not emptied at all, 1921–30. WATER SUPPLY, deficient and unwholesome; no public supply, but 1200 wells, 1376; in a dry summer half of these become dry, 1671; wells liable to infiltration from cesspits, 1513–22, 1921–30, 1907–8; probably not from sewers, 1678–80, 1696–700. Want of water cause of ill health, 1654–76; in dry summer of 1864 death-rate rose to 35 in a thousand, 1889. Proper supply needed also for use of watercloseets made and to be made, and for bleaching purposes, 1743–8. Abundance of water in district, 1618–24, 5645. Trade, straw plait. Pollutions from dyeing and bleaching plait, see *Dyeing* and *Bleaching*. All refuse goes into intercepting sewer, 1401–2. SEWAGE IRRIGATION, land available below town, 1615–6, 1852–4; and above town, where soil more favourable, 5646–53. Outlying districts, no sewerage, 1907, 1919–30, 1944–6; no water supply, in time of drought people were reduced to drink out of ponds and out of river, 1891–901.

LYE, Mr. (of Luton):
Evidence of, 1969–2020.

M.

MAFFEY, Mr. (of Luton):
Evidence of, 1870, 1930.

MALTINGS (pollution of river from):
Witnesses examined:
Mr. Barnard, of Bishop Stortford 2546–626.
Mr. Fairman, " " 2346–409.
Mr. Hawkes, " " 2890–924.
Mr. Miller, " " 2410–446.
Process of soaking barley, 2381–92, 2405–9; effluent water passed into sewers and thence into river, water is thick, 2393, 2400; and if left to stand would ferment, 2419–20; but is cause of little nuisance in the river, 2072–3, 2353–7, 2475–80; contains nothing mischievous to vegetation, and would improve sewage for irrigation, 2421–2, 2480. Malting trade increasing at Stortford, 2349–52, 2361–4; at Ware, 5033, 5055–60.

MANSER, Mr. (of Hoddesdon):
Evidence of, 4831–93.

MANUFACTURING REFUSE:
Pollution of rivers from. See *Bleaching*, *Dyeing*, *Malting*.
Mills on Lee, corn and oil mills, except Government mills at Enfield, 756–8; mills on tributaries of Lee, corn mills, except one small paper mill at Luton, 760.

MARCHANT, Mr. (of Hertford):
Evidence of, 4329–501, 5564–70.

MARSHALL, Mr. (of Tottenham):
Evidence of, 3364–555.

MARSHALL, Mr. (of West Ham):
Evidence of, 4016–118.

MILE END:
See evidence of Mr. Knight, surveyor to vestry, 3116–335. Infiltration of wells from cesspits, 3190–213.

MILLER, Mr. (of Stortford):
Evidence of, 2410–46.

MILLS:
(1.) Number of, on Lee above Hertford 12, 2621; below Hertford, ; on Mimram, 8, 2618; on Stort, 2818–20.
(2.) Discontinuance of; water power superseded by steam, 2466–7; and itself from various causes diminishing, 2316. 2319. See *Water Supply*.
(3.) Pollution from, very little. All mills on Lee, except Government mills at Enfield, are corn or oil mills, 756–8; but other mills are being started below Enfield, 792–4; mills on tributaries of Lee are corn-mills except one small paper mill at Luton, 760. All mills on Lee between Ware and Lee Bridge (except Government mills and one mill at Broxbourne) belong to Lee trustees, or to one or other of the two water companies, 756.

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(4.) Right of, to take water. On Lee no difficulty, the Lee Trust having a paramount statutory right to water for navigation, 4501–2 [Appendix No. 1]. On Stort occasional difficulty between millers and Navigation Company, but mills have superior vested right, 2803–5, 2813–5.
(5.) Floodings occasioned by. Some mills not equal in value to the damage they inflict, 2581–86, 2618, 5421–9. With proper arrangements mill-power may not be diminished, and all flooding prevented, 5580.

MIMRAM:
The purest stream that flows into London, 686–8, 2617; but polluted by sewage at Whitwell and Welwyn, 2617–8; and by tanyard, 5338. Never overflows its banks, 5338; unless ponded up by mill-weirs which cause great mischief, 2616–8.

MUIR, Mr., Engineer of New River Company:
Evidence of, 1050–366.

N.

NAVIGATION:
I. Of Stort.
Witness examined,
Surveyor of Navigation, Mr. Davis, 2767–889.
Established by statute, 2791; now property of a private firm, 2776–9. The firm do not carry goods, only maintain navigation, 2833. Length of, 2768–71; locks, traffic, and tonnage of boats, 2772–5. Usual draught of water, 2837. Power to dredge, 2792–4. Power to prevent pollution insufficient, 2790, 2806–11, 2888–9. Right to take water subject to that of mills, 2802–5, 2814. Lock dues, 2863–75. Waste of water in use of locks, 5340–1. Commissioners appointed under Act have died out and their places have not been renewed; want of authority felt, 5340.
II. Of Lee, by Lee River Trust.
Witnesses examined,
Chairman of Trust, Marquis of Salisbury, 4502–653.
Clerk, Mr. Marchant, 4329–501, 5564–70.
Engineer, Mr. Beardmore, 659–915.
Traffic manager, Mr. Glass, 4730–830.
Mr. Manser, 4831–4893.
1. Constitution of Trust.
2. Powers of Trustees.
3. Extent and course of Navigation.
4. Extent and value of Traffic.
5. Financial condition of Trust.
1. Constitution of trust, fixed by statute; now an incorporated body with power to acquire land, 4501–2 [Appendix No. 1]. Trustees, 67 in number, consisting of (*a*) ex-officio members, viz., Mayor and Corporation of London, members of Parliament for certain counties and boroughs, officers of New River Company, and others, 4335, 4501–2 [Appendix No. 1], 4555; and (*b*) of members with property qualification chosen by the Trust, chiefly riparian owners, 889–90, 4557, 4865. All unpaid, 866–8. Some objection felt outside that few business men are elected to the Trust, and that there is no appeal from the Trust, 4866–4869, 5459–68.
2. Powers of Trustees. Ownership of bed of river, 750. Paramount right to fixed volume for navigation, and of entire volume below Tottenham, 4501–2 [Appendix No. 1]. Obligation to execute works for water companies at the expense of the companies, 4489–90. Power to dredge, systematically used, 753; ballast sold and profit made, 4747–8; reaches have been deepened, 4889–92; canal carries barges of 100 tons instead of 40, 4878; in 15 years 160,000*l.* spent in improvements, 874. Power to scavenge exercised, 753. Power to stop casting in of rubbish, if injurious to navigation, 4384–93; but power to prevent pollution insufficient, 4535. Trustees send notices to prevent pollution, 4501–2 [Appendix No. 2]; refuse to grant wharf except upon condition that sewage is kept out, 4462–5; invoke intervention of Thames Conservators for lower part of Lee, 4393–4401. No power to look to drainage of valley, 769. No power over parts of river not used for navigation, 775.
3. Extent and course of navigation, 664, 728; partly in river canalized, mainly in canals, 774–8. Locks, 20, 730; their construction, 738–42; draught and tonnage, 744. Barges drawn by horses, not by steam power, 745–7. Trustees not themselves carriers; only maintain navigation.
4. Traffic, extent of, 4372–3; 4501–2 [Appendices No. 3 and 4]; 4512–13 [Tables]; 4521 [Tables]; 4830–1 [Appendix No. 1]. Manure carried free, 4497. Rates, 4376–8; 4830–1 [Appendix No. 2]. Value of navigation to Hertford, 4309–18; Hoddesdon, 4843–4, 4849–50; Tottenham, 3547–54; to powder magazines, 4861; to health, 4492; to country at large, 5357–61.
5. Financial condition of Trust. Sources of income. Tolls and payments by water companies, rentals of mills, and sale ballast, 876–81, 966, 4501 [Appendices No. 1, 3, and 4]. Profit goes to diminish mortgage debt, 4340, 4358–70, 4379–82, 4483–8, 4615–30.

NEW RIVER COMPANY:
Witness examined.
Engineer to Company, Mr. Muir. 1050–366, 2976–3115, and 3115–6, [Paper].
I. Constitution.
II. Supply from Lee.
III. Other sources of supply.
IV. Treatment of water.
V. Quantity and quality of water.
VI. Distribution.
VII. Miscellaneous particulars.
I. Constitution.
By Acts of Parliament, 532–3 [Paper], 3115–6 [Paper]. Capital more than 3,000,000*l.* sterling, 3013–4; more about to be raised, 3115–6, Paper.
II. Supply from the Lee.
Right to abstract water fixed by Act of 1855, subject to right of navigation, but superior up to a certain point to right of East London Waterworks Company, 4501–2 [Appendix No. 1]. Payments to Lee Trust, 53,000*l.*, 3104–5, 876–81. Point of intake of water, Balance engine between Ware and Hertford, 473. Area of basin above intake, 244 square miles, 482. Population of basin above intake, 1069–73. Pollution of Lee; by sewage from Luton, see *Luton*; by manufacturing refuse from Luton, see *Bleaching* and *Dyeing*; not by sewage of Hertford, which is intercepted by sewer constructed by company, see *Hertford*. Company has expended 30,000*l.* on sewerage works, 3109.
III. Other sources of supply.
Chadwell spring, and wells at Cheshunt, Amwell Hill; also, in reserve, wells at Amwell, Hampstead Road, Hampstead Heath, and Hoddesdon, 493–4, 1053–8, 1063, 1182–5, 3005, 3115–6 [Paper]. These give company a command over 35,000,000 of gallons daily, 1182–3. Volume actually used, 22,500,000 gallons, 1185. For non-domestic uses company has right to draw from ponds on Hampstead Heath, and from Thames below Blackfriars Bridge, 3115–6 [Paper].
IV. Treatment of water.
(1) Conduit. Water led to London by New River, a conduit 28 miles in length, 1288–320; carefully looked after, and protected from contamination, 3947–9, 1314–20.
(2) Store reservoirs, 3115–6 [Paper]. Area, 100 acres; capacity, 200,000,000 of gallons, 1103–16.
(3) Filter beds, 11½ acres, the medium being sand; not so large in proportion as those of the East London Waterworks, because water less turbid from flood and less polluted, 1112–24, 3115–6 [Paper]. Expense of charcoal filtration, 1125–37.
(4) Filtered water service reservoirs; capacity 20,000,000 gallons, 3115–6 [Paper].
V. Quantity and quality of water:
Volume supplied about 22,500,000 gallons daily, 1185. Quality, water pure, 1139–41, 2977, 3115–6 [Paper]; but hard, 1146–65; Dr. Clarke's process for softening expensive, and if it superseded filtration would cause deposit in pipes, 1175–81.
VI. Distribution:
Pumping arrangements, 3115–6 [Paper]. Area supplied, 1331–2; Tenements supplied, 111,958; houses, 3115–6 [Paper]. Most have watercloseets, 1186–8. 18,000,000 gallons pumped; 4,000,000 pass by gravitation, 1340. Supply equivalent to 30 gallons per head of population of district, 1339. Supply constant only to those who take proper precautions against waste, about 1200 in number, 1192–8, 1210–11, 3115–6 [Paper]. To others intermittent; on six days in the week for a time long enough to fill cisterns; and on Sunday, also in some poor districts (nearly 50,000 houses) where provision to receive water is bad, 3115–6 [Paper]. Arrangements by landlords to receive water miserably defective even for intermittent supply; and constant

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supply impracticable; poor very ill off for water, 1211–35, 3115–6 [Paper]. Much water wasted; 7 gallons a head really enough; the cistern system might be usefully extended, 3080–97. Maximum prices with many exceptions, 1199-201, 3115–6 [Paper]. The supply might be increased and improved if flood waters of river stored in reservoirs; if sewage were kept out; if water economised, and filtered water not wasted in watering streets, 3008–21, 3099–102.

VII. Miscellaneous particulars:
Water for fire extinction supplied gratuitously; also cheap plug, but not expensive hydrants, 1203–4, 3115–6 [Paper]. Head of water, 1280–7. Water rarely injured by proximity of gas-pipe, 1257–8, 3062–77. Complaint book, 3032–3.

O.

Old Ford:
Pestiferous from discharge of manufactories, &c., 4462.
Outfall of works of Metropolitan Board, 469–4482.

P.

Parker, Mr. (of Ware):
Evidence of, 5343–485.

Perry, Mr. (of Stortford):
Evidence of, 2925–75.

Phillips, Mr. (of Tottenham):
Evidence of, 4141–60.

Pledge, Mr. (of Luton):
Evidence of, 1367–419.

Pollard, Mr. (of Hertford):
Evidence of, 5018–21.

Pollution of Lee:
A. Above intake of New River Company.
By sewage, and bleaching and dyeing refuse from Luton, see *Luton, Bleaching, Dyeing*. By privies at Welwyn and Whitwell on Mimram, 2617–8, 5654–7. By sheepwashings, 5332–6.
B. Between intake of New River Company and intake of East London Waterworks Company.
By sewage of Hertford, see *Hertford;* of Ware, see *Ware;* of towns on Stort, see *Stortford*, 655; and by Maltings, see *Maltings*. Stort gets fouler and fouler, every house and farm drains into it; mud sludged out by millers, 2559–64, 2571–5, 5654. By sewage of Hoddesdon, Broxbourne, Cheshunt, Waltham Abbey, Waltham Cross, 101, 514–28, 655, 3337–9.
C. Between intake of East London Waterworks Company and Thames.
By sewage of Enfield, Ponder's End, Upper and Lower Edmonton, and part of Tottenham, which comprise 52,000 persons, intercepted in Catchwater Dyke made by East London Waterworks Company 612, 4501–2 [Appendix No. 1], 3266*, 3314*, 3465–71, 3666–9, 4443–6. By sewage of Tottenham, see *Tottenham*. Below Tottenham river very foul; from manufactories, 4751–2, 4768–9; from sewage of more thickly populated neighbourhood; Leighton, Leightonstone, Walthamstowe, 3555; Old Ford, 4462, 832–3; Metropolitan outfalls, 4469–82; West Ham, 4059, see *West Ham*. Silvertown, 4087; Limehouse cut, 843–7, 4501–2 [Appendix No. 1]; pollution increased by effects of tide, 826–8, 842–9, 923, 1037–49, 4060–4.

Privies, see *Barnet, Edmonton, Luton, Mile End, Stortford, Tottenham, Ware, Welwyn.*

R.

Rainfall:
In east London district averages 26 inches in the year, 596, at Fielde's Weir, 700–1 [Paper].

Reservoirs:
For flood waters none, 531; scarcely possible in porous soil of upper Lee Valley, 3047–9; *secus*, in lower valley on London clay, 3050–3, 5623–5, 5657–60; recommended by Mr. Rendel, 5390–408.

Riparian Property:
Much of it unenclosed, might be improved by drainage and embankment, 783–91. See *Floodings*, and evidence of Mr. Taylor, 1947–68.

Road Scrapings:
Sold, 3579–80.

S.

Salisbury, Marquis of:
Evidence of, 4502–653.

Sandoe, Mr. (of Luton):
Evidence of, 1420–600, 1684–717.

Sawbridgeworth:
Population of, 524.

Scavenging:
Done systematically by Lee Trustees, 753, 4926–8; not done on Stort, 2565–7, 2811.

Sewage:
Pollution by, see *Pollution, Litigation, Barnet, Colney Hatch, Edmonton, Enfield, Hertford, Hoddesdon, Luton Stortford, Tottenham, Ware, West Ham.* Irrigation with, see *Barnet, Colney Hatch, Luton, Stortford, Ware, West Ham.* Interception of, at the lower end of Lee Valley, 3450–75, 3545–6, 3770, 5593–644, 5654*a*–667, 5668–88. Suggestion by Mr. Bailey Denton. For low level an intercepting sewer to Barking Creek, there to join metropolitan system or sewage to be treated like metropolitan sewage; for high level, irrigation, and delivery into Lee below intake of East London Waterworks Company. Scheme might be enlarged beyond Waltham Abbey, 5667–8 [*Paper*].

Sheep-washing:
Pollution of rivers from 5332–6.

Silvertown:
Not drained by West Ham Local Board, 673-5.

Solid Refuse:
Not much thrown into Lee: power of trustees to stop it, 763–72.

Straw Plait Manufacture:
Witnesses examined.
Mr. W. Willis, of Luton, 1718–806.
Mr. Higgins ,, 1931–46.
Mr. Lye ,, 1969–2020.
Trade more than a million sterling annually, 1801, 1935 half of population of Luton engaged in, 1750. Pollution of river from, see *Bleaching* and *Dyeing*.

Stort, Valley of:
Chalk overlaid with clay, 2090–3; the floodiest stream running to London, 2594: but in drought quickly falls off, 813–5, 2080–4. Pollution of, by sewage of Stortford, see *Stortford:* by refuse from dog-kennels, 5654: the river getting fouler and fouler: every house and farm drains into it: at Raydon mill the miller sludges mud down stream, 2559–75. Navigation of, see *Navigation*, and evidence of Mr. Davis, 2767–889.

Stortford:
Witnesses examined.
Clerk to Board of Guardians, Mr. Taylor, 2047–124.
Surveyor to Highway Board, Mr. Glasscock, 2125–248.
Clerk ,, ,, Mr. Gee, 2627–705.
Surveyor of Stort Navigation, Mr. Davis, 2767–889.
Manager of Gasworks, Mr. Perry, 2925–75.
Mr. Hunt, mill owner, 2249–345.
Mr. Garratt, ,, 2546–626, 5330–42.
Mr. Fairman, maltster, 2346–409.
Mr. Miller, ,, 2410–46.
Mr. Barnard, ,, 2447–545.
Mr. Hawkes, ,, 2890–925.
Mr. Odams, ,, 2706–66.
Population more than 5,000, not increasing, 2050–1, 524. Rateable value, 23,700*l.*, 225. Local Government Act just about to come into operation, 2059–62, 2499–500, 2634. Public health pretty good, 2063–4. Trade, malt, 2070. Sewerage nearly throughout town, but unsystematic, 2134–5; sewers not ventilated, 2153–8; ill-constructed, have to be opened for a great length in order to be cleaned, 2144–52, 2433. Sewage from sewers discharged into river at seven outlets, 2136–8; river falls very low in summer and becomes very foul, 2203–23, 2256–63, 2428–9, 2689–700, 2710–5, 2718–22, 2786–90, 2806–10, 2851–2, 2879a. Ill health caused by sewage deposit, 2450–5. Authorities flush

[*Numbers* 3236–3336 *are repeated in the Evidence: when in the Index the reference is made to the numbers as used the second time, the numbers are distinguished by an asterisk.*]

sewage accumulations down stream by means of barge and rake, 2105–6, 2460. Complaints made by people at Sawbridgeworth, 2103, 2495–6, 2661–6, and at Harlow, 2457. Waterclosets 300, supplied by water pumped up, 2141–3. Privies, some discharge into river, 2906–7, 2667–9. Ashpits cleansed once in the last seven years from fear of cholera, 2165–72. Cesspools common in houses which have access to sewers, 2233–4; 400 in number, 2141; generally in impervious stratum, 2161–4. Sewage Irrigation, 15 feet of fall within one and a half miles of town, 2437–46, 2481, 2716–7; land might be had, but liability of low land to flooding, a difficulty perhaps to be met by choosing a higher site and pumping, 2166–9, 2199–202. Water Supply from private pumps, but abundant, 2089, 2189–98; 2917–24.

T.

Tan:
Refuse on Mimram, 5338.

Taylor, Mr. (of Luton):
Evidence of, 1947–68.

Taylor, Mr. (of Stortford):
Evidence of, 2047–124.

Tomson, Mr. (of Luton):
Evidence of, 1644–83.

Tottenham:
Witnesses examined.
Chairman of Local Board, Mr. Hall, 3236*–286*.
Clerk, Mr. Heath, 3287*–3363.
Surveyor, Mr. Marshall, 3364–555, 3555–6, [Paper].
Inspector of Nuisances, Mr. Guy, 3556–676.
Registrar of Births, Mr. Ross, 4161–75.
Mr. Delano, 4119–40.
Mr. Phillips, 4141–60.
Population nearly 18,000. Area, 4,624 acres. Houses, 4,000. Rateable value, 91,000*l.*, 3555–6 [Paper]. Health improved by sewerage and sanitary works, 3242*–82*. Mortality, 3282*–6*. Sewerage, formerly only cesspools, discharging into Lee, 3292*–6*, 3561–4. Now sewerage constructed throughout one half of district, 3555–6 [Paper,] 3303*–6*. Sewers well flushed, but with no special ventilation, 3475–96. Wood Green district sewered, but sewers not used, 3280*–1*. Some cesspools in gravel in Page Green district, 3531–6. Sewage from about 2,000 watercloset, 3408; of 7,000 to 10,000 persons, 3407; is subjected to liming process, then cast into River Lee, 3241*, 3276*–9*, 3401–2; process entirely fails to purify, 4447–60; outlet a nuisance by pollution to river, 3262*. Lee trustees have obtained an injunction against Tottenham Local Board adding sewage of Wood Green district to sewage of Tottenham proper, 3280*–1*, 3263*–5*, 3303*, 4458; consequently house drains of Wood Green not connected with sewer recently made, and cost of sewer, 9,000*l.*, thrown away, 3280*–1*; temporary cesspools made in Wood Green district, chiefly in clay, 3311*, 3522, 3618–21; and are a nuisance to Edmonton, 3778. About 4,000 watercloset in parish, 3555–60 [Paper]. Higgs' process of treatment of sewage now disused; a commercial failure; works bought by Local Board for one fourth of prime cost, 3376–427. Now only lime used, 3646–63; about 100 tons per annum, 3395, 3405. Solid refuse sold at 2*s.* 6*d.* per ton, 3396–8, 3609–17; accumulated in large quantities, 3592–603. Annual cost of works to Local Board 130*l.*, 3413–23. 3555–6, [Paper.] Sewage Irrigation, soil, marsh land and stiff clay; valuable, 3322*–5*. Irrigation tried for a while successfully on 40 acres, 3428–40; but prejudice against it, 3440–6; best plan. Tottenham sewerage to be merged in Metropolitan sewerage system, 3326*; or combined with other parishes, 3329*–31*, 3450–75; and sewage pumped into Essex, 3537–9. Nuisances in parish; Muswell River very filthy in summer from sewage of Wood Green and Hornsey 4144–60; and from drainage of cemetery, 4162–3. Catchwater Dyke, a ditch made by East London Waterworks Company, intercepting sewage from Ponders End and other villages passing through parish, and delivering into Lee, 3758–64, 3266*, 3314*, 3465–71, 3666–9, 4443–6. Discharge from works between outfall of Catchwater Dyke and Tottenham outfall; sewage from Edmonton, Enfield, &c., 3314*–7*, 3340–2. Water Supply; in hands of board partly from pumps, 3267*–75*; partly from land springs in gravel overlying clay, 3497–513, 3555–6 [Paper]. Water from gravel, hard, ochrey, and corrosive of iron pipes, causing leakage and short supply, 3677–709, 3555–6 [Paper]; liable to injury by infiltration of sewage from Edmonton cesspools, 3531–6; *secus* 3785–6. Wood Green district supplied by New River Company, 3275.

W.

Waltham Abbey:
Population 5,000, 522; sewage of, a nuisance, enters London above intake of East London Water Works, 4437–40.

Ware:
Witnesses examined.
Clerk to Local Board, Mr. Cobham, 5022–184.
Officer of Health, Mr. Butcher, 5285–239.
Surveyor, Mr. Hitch, 5240–329.
Inspector of Nuisances, Mr. Bond, 5486–536.
Mr. Parker, 5343–485.
Mr. Brown, mill owner, 5537–55.
Mr. Beningfield, auctioneer, 5556–63.
Population over 5,000, 522, 5024. Trade, malting, 5033, 5055–60. Sewerage; entire town underdrained, 5036; about 220 watercloset, 5256; sewers not ventilated, but not complained of, 5272. Sewage of sewers passes into Lee by five outlets; net, except from dilution of spring water escaped from subsoil into sewers, 2305, 5038, 5255, 5290–4. Great nuisance at outfall, 3766, 4408–17, 4572, 4501–2 [Appendix No. 1]; *secus*, 5289. Privies also and drains discharged into river, 4428, 5308–13. Houses not having watercloset, have cesspools, which are emptied by owners, 5069–77, 5295–301, 5529–36, 5492. Refuse cast into gravel pits, 5507–20; finds no sale amongst farmers, probably because devoid of liquid passed into subsoil from cesspools, 5535–6. Sewage Irrigation; land available below town, and fall convenient, 5147–52. Water Supply, no public supply; only from private pumps in gravel; cesspools also in gravel, the new ones cemented not the old ones, 5062–8, 5262–71; no ill-health traced to corrupt water supply, 5224–31.

Watercloset:
See *Barnet, Edmonton, Enfield, Luton, Stortford, Tottenham, Ware, West Ham, East London Waterworks Company*, 312, and 658–9 [Appendix No. 1], *New River Company*, 1186–8.

Water Power:
Irregularity of 2550, 2589–90, injured by floods 2271–3, 2594; 2286–8; decreasing on tributaries? 2316–9 on Lee 2305–25, 2329–45, on Lynch unaltered 4840. See *Mills.*

Water Supply:
See *Barnet, Edmonton, Enfield, Hertford, Luton, Stortford, Tottenham, Ware, West Ham, East London Waterworks Company, New River Company.*
Difficulty of increasing; water-bearing subsoil of Lee Valley is so porous that if tapped it would give out into sewers the sewage it had absorbed, 709–11, and if intercepting sewers laid down, they would carry away spring water, 712–23, 822. Possibility of Storage Reservoirs, see *Reservoirs.* Economy in supply possible; 11 gallons enough with care 3131, 1018–20, and see *East London Waterworks Company, New River Company* and *Tottenham.*

Weeds:
Good for water, except in autumn, when they decay, 1142–5.

Weirs:
Ancient, on Lee, 677–9; now iron instead of wood, so as to give more waterway 4888, disputes as to, on Stort, 4875–6.

Well:
Infiltrated with sewage in East London, 1022–6, 3190–203. Edmonton? 3533–7, 3785–6. Luton, 1513–22, 1921–30, 1907–8, 1654–76. Tottenham? 3531–6, 3785–6? Ware 5062–8, 5262–71.

Welwyn:
Pollution of Mimram at 2617–8.

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WEST HAM:
Witness examined:
Engineer to Local Board, Mr. Marshall, 4016–118, 4118–9 [Paper].
Population 60,000, fast growing 4021, 4028–31. Area 5,000 acres, 4118–9 [Paper]. Rateable value 160,000*l.*, 4032. Health improved by sanitary arrangements, 4118–9, [Paper]. SEWERAGE; 10,000 out of 12,000 houses drained, 4118–9 [Paper]. Cost of, 4033–5. Sewers work well, ventilation perfect, 4050–7. Silvertown, cut off by Victoria Docks, unsewered and a cause of pollution, 4066–7. Sewage passes into Lee; partly pumped at cost of 1,000*l.* per ann., partly by gravitation, 4038–9 Place of outlet Bow Creek, 4020. Time chosen whilst tide is receding to prevent sewage returning to Lee, 4096–100. Proposed outlet to Barking, 4085–90. WATERCLOSETS no trouble, 4024; and a vast improvement upon former condition when privies and cesspools discharged into ditches, 4118–9 [Paper]. SEWAGE IRRIGATION tried experimentally and promised to be successful, but land in neighbourhood too valuable, 4040–8, 4077–84, 4111–8. WATER SUPPLY, East London works, 4025–7; Local Board endeavours to compel owners to provide means at houses for receiving water, but legal powers insufficient, 4101–10. Low cellars by Barking Road 14 feet below high-water line, 4073–7.

WILDS, Mr. (of Hertford):
Evidence of, 4698–729.

WILLIS, Mr. (of Luton):
Evidence of, 1718–806.