Report upon inquiry as to the truth or otherwise of certain allegations contained in a memorial from the vicar and other inahbitants of Barking, in the county of Essex, calling attention to the pollution of the river Thames by the discharge of sewage through the Northern Main Outfall Sewer of the Metropolitan Board of Works / by Robert Rawlinson... together with minutes of proceedings, abstract, and index.

REPORT

UPON

INQUIRY AS TO THE TRUTH OR OTHERWISE OF CERTAIN ALLEGATIONS

CONTAINED IN A

MEMORIAL FROM THE VICAR AND OTHER INHABITANTS OF BARKING, IN THE COUNTY OF ESSEX,

CALLING ATTENTION TO THE

POLLUTION OF THE RIVER THAMES

BY THE

Discharge of Sewage through the Northern Main Outfall Sewer of the Metropolitan Board of Works.

BY

ROBERT RAWLINSON, ESQ., C.B.

TOGETHER WITH

MINUTES OF PROCEEDINGS, ABSTRACT, AND INDEX.

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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REPORT.

TO THE RIGHT HONOURABLE HENRY AUSTIN BRUCE, M.P., HER MAJESTY'S PRINCIPAL SECRETARY OF STATE FOR HOME AFFAIRS.

Local Government Act Office, Whitehall, London,
November 1869.

SIR,

IN May 1868, the memorial now under consideration was forwarded to the Home Office, and was received by the Right Honourable Gathorne Hardy, M.P., Her Majesty's then Principal Secretary of State for Home Affairs, who at once communicated with the Conservators of the River Thames and with the Metropolitan Board of Works. Subsequently he ordered that inquiry should be made, but the change of administration caused delay.

On the 6th May 1869, E. B. Eastwick, Esq., M.P., in the House of Commons asked you "whether a memorial from the vicar, churchwardens, medical practitioners, and other "inhabitants of Barking, in the county of Essex, calling attention to the present condi- "tion of the river Thames, in consequence of the discharge of sewage through the main "outfall sewers of the Metropolitan Board of Works, and praying that the subject of "the memorial may be taken into consideration, and that Her Majesty's Attorney "General may be instructed to apply to the Court of Chancery for an injunction against "the Metropolitan Board of Works to restrain them from discharging the sewage of "London into the river Thames, has been presented at the Home Office, and, if so, "whether any steps have been or are to be taken in consequence; and whether copies of "the memorial in question will be distributed amongst members?"

On the 1st of June 1869, the memorial asked for was ordered by the House of Commons to be printed. Early in June you instructed me to make the inquiry.

On the 10th day of June 1869, notice was given, "That, on Monday the 21st day of "June 1869, at 12 o'clock at noon, in the Town Hall, Barking, I would proceed upon "the inquiry, and would then and there be prepared to hear all persons entitled to be "heard upon the subject."

On Monday the 21st of June 1869, I attended in Barking, and commenced the proceedings by reading over the memorial.

George Brady, Esq., solicitor, appeared on behalf of the memorialists.

W. Wyke Smith, Esq., solicitor, F. A. Philbrick, Esq., barrister, and subsequently Sir John Karslake, appeared for the Metropolitan Board.

There were also present the Rev. Mr. Such, Dr. Davidson, Dr. Parsons, and others. The evidence taken at the inquiry is appended to this Report.

INTRODUCTION.

The inquiry, as it progressed, took a much wider range than I anticipated, and the evidence is, in consequence, much more voluminous, as witness after witness when called merely confirmed facts previously stated, or spoke to the same points slightly varied in the questions; but, for purposes of reference, if this should be requisite, I have had the evidence indexed and abstracted. The complex questions of tidal flow and of scour, of the accumulation of mud banks in specified parts, and of the weight of detritus brought from the metropolitan road and street surfaces, mixed with the sewage and discharged into the Thames, I cannot pretend to settle. There are however the simple facts that all town sewage does contain certain proportions of solids, which solids can neither be oxydized nor annihilated; and therefore, however small or however large in quantity they may be, if turned into the Thames they must ultimately deposit somewhere. There is also the additional fact that the London sewage is discharged into the Thames with whatever detritus there may be, just as it flows down the main sewers. It was contended by the engineer to the Metropolitan Board of Works, that streets and roads within the metropolitan area are far better scavenged than those in provincial towns, such as Birmingham, and that all the detritus which can be retained is regularly emptied from the numerous gullies, or is raised by hand from the tributary sewers. Admitting the general regularity and perfection of London street and road scavenging, yet very dirty (muddy) streets are seen occasionally, and no mechanical arrangements of gulley catch-pits can prevent some of this mud and detritus flowing with the vast volume of sewage to the outlets.

Mr. Leach, engineer to the Thames Conservators, has calculated the amount of London sewage detritus, as deposited in the Thames at Barking during three years, at 700,000 cubic yards, and the cost of dredging from the Thames and landing the same, at upwards of 60,000*l.*, or 20,000*l.* per annum. The secretary to the conservators, Captain Burstal, when asked if a subsidy to the extent of 20,000*l.* to enable the conservators to dredge would be satisfactory, answered, "We would rather the silt should be kept out than receive any subsidy.

Messrs. Bazalgette, Bidder, Hawksley, and the other scientific witnesses who gave evidence on the question of the weight of detritus brought down with the sewage, repudiated the 700,000 cubic yards statement, and showed, from soundings and calculations, that the river as a whole, in the vicinity of Barking and Crossness, was at the present time rather better than previous to the opening of the main sewerage outlet works. (Evidence No. 1481).

The statements in the memorial as to the loss of water by silting in Barking Creek, it was proved only had reference to the first few hundred yards of the entrance, and this merely involved half or three quarters of an hour of waiting for the rising tide.

Topography.

The parish of Barking is situate in the southern division of Essex, and is bounded on the south by the river Thames, and on the east by the river Roding. The length, north and south, is about seven miles, and the breadth, east and west, four miles. The land is flat but fertile. The town of Barking is situate on the river Roding, and about two miles north from the Thames.

The population of the town of Barking, with the small village of Ripple and Creek's Mouth, is about 5,500.

The town of Barking has no local government. There is one drain which opens into the basin at the town quay, and any foul matter, or sediment, passed through this drain pollutes the water of the small basin bounded by the town quay. Barges also bring up London muck, which is loaded into waggons and carts for removal into the country, and the nuisance so caused is, at times, very offensive. The town of Barking is not sewered, and therefore the houses are not properly drained. There are numerous cesspools, the subsoil around which has become sodden with putrid sewage, and, as a consequence, the cesspools get full to the surface. One witness stated that the moment the house door was opened the stench of the cesspool was perceptible. There is no supply of water other than from pumps, wells, and water carts. Those who have neither pump nor well (and this is the case with the greatest number of the inhabitants) have to purchase the water used by buckets or cans full. The result is, that the sanitary destitution of the inhabitants is as bad as it can be, and in the event of any epidemic, or contagious disease, breaking out, all experience teaches that a population, so situated, will suffer in excess. Mr. Crowe, in his evidence, stated of Barking—"The town is governed by nobody, and consequently "there is nothing done. The roads are allowed to get out of order, and no footpaths "are made." . . . . . .

"The mortality of this town has been very high, indeed fearful. I believe it was "something like at a rate of 50 in the 1,000 during last summer (1868). . . . . I am "not able to define the causes of such high rate of mortality, but it is clearly to my mind "from some local sanitary defects, and my opinion is, such ought, if possible, to be "removed."

A town population having no local government is not in a condition to devise and execute proper sanitary works, and complaints from the inhabitants of reputed sanitary evils several miles distant affecting health, do not bear much force.

Allegations.

The allegations in the memorial are 13 in number, and are commented upon in their order. The substance of these comments may be found in the evidence.

"Sheweth,

"1. Your memorialists beg respectfully to call your attention to the present dangerous condition of the river Thames—dangerous alike to navigation and to the health of the inhabitants of the parish of Barking, and of all the populous and industrious towns below London, consequent upon the concentrated discharge of sewage through the main outfall sewers of the Metropolitan Board of Works."

The evidence given at the inquiry is clear and distinct, that the navigation of the Thames has not been endangered; there is no loss of water in the main channel; neither do the engineer nor secretary to the Thames Conservancy Board anticipate damage to the

(*Note.*)—Medical evidence was not taken by me in any full and direct manner, as the Medical Officer to the Privy Council considers that such an inquiry should be conducted by a medical officer.

low-water main channel; the movement of steamers up and down, with the scour of the tides and land-floods, being sufficient to keep the waterway open; any extra deposit of silt is on mud banks and the shores betwixt low and high water. No medical proof was given by evidence that the health of the inhabitants of the parish of Barking, and other populous and industrious towns below London, suffered in consequence of the discharge of sewage through the metropolitan main sewerage outfall works. The men and their families situate at and over these works it was stated do not suffer specially.

"2. On the 21st of November last, in his place in the House of Commons, the Right Honourable the Vice-President of the Board of Trade, in answer to a question by one of the members for the city of London, made the startling statement that owing to the continuous silting up of the river by the deposition of sewage mud from the outfall sewers of the Metropolitan Board, a bank has been formed in the channel of the river, on which one vessel has already been stranded. On inquiry at the office of the Thames Conservancy, your memorialists have been informed that the diminution of water in the channel of the river, consequent upon such deposition of sewage mud, is no less than from 21 feet to 10 feet at ebb tide, or a loss of 11 feet of water."

This allegation was disproved, as previously explained. The statement as to a bank of mud (11 feet in depth) should, according to the evidence 964–967, have referred to the shore bank of mud opposite the new works of the Chartered Gas Company. This portion of the river has not been used for navigation purposes, being out of the main tideway; and the Admiralty and Thames Conservators having sanctioned the construction of a pier which projects forward into the river, so that this bay will most probably further silt up.

It is, however, stated in the evidence that for many years previous to the opening of the metropolitan main sewers outlets no accumulation of mud had taken place on this shore, but that the deposit of mud did commence after this event, and that a gradual accumulation has gone on up to this time, amounting, in some parts, to a vertical depth of six or seven feet. The Talbot, a powder magazine, had been berthed about 2,000 feet above the northern main sewer outfall, on the side opposite the Chartered Gas Works, in 12 or 13 feet of water; but in consequence of the silting and shoaling, the Talbot had to be removed to the opposite side of the Thames, as vessels in attempting to come alongside had stuck in the mud. Evidence was also given that barges grounding on this bank had to be freed by drawing chains or ropes under them, to prevent the mud sucking them down during the rise of the tide. Anchors and chains were also said to be drawn up covered with mud and refuse of a very foul character, where formerly the shore had been clean shingle. The engineers who appeared for the Metropolitan Board of Works stated that, in their opinion, this silting was not due to the admission of metropolitan sewage, but rather to the obstructions allowed to be placed on this portion of the shore, and probably also to some alterations in the estuary scour. The engineer to the Thames Conservators estimated the amount of deposit from the main sewers at 700,000 cubic yards in three years. Mr. Bidder (Evidence 1806 to 1814) states that the 700,000 cube yards is an impossible quantity, as the annual discharge on the ebb tide of sediment, in round numbers, does not exceed 90,000 tons, and that, therefore, if this entire quantity could come back to that bank, there would not, in three years, be half Mr. Leach's quantity. But Messrs. Bidder and Bazalgette dispute the fact that any silt discharged from the outlet sewers returns again with the flowing tide to and above the mouth of Barking Creek.

"3. On the 21st of February 1867, in answer to a question put by one of the members for South Essex, you, sir (the Home Secretary), stated that the Thames Conservancy had already vainly applied to the Metropolitan Board of Works for redress of this nuisance, and that you had yourself failed in your endeavours to induce the Metropolitan Board to refer the matter to arbitration, or to take any other action, and that the only course now remaining, in your opinion, was to proceed by way of indictment."

With respect to this allegation, it was decided by the law officers to whom the papers were submitted, that a preliminary inquiry and report would be necessary before any action could take place. This report is the result of that decision:—

"4. Sir, in this opinion your memorialists very cordially agree, but the nuisance and danger are far in excess of anything implied in the statements made in the House of Commons before referred to. The filth and refuse of the largest city in the world is concentrated in all its horrors and abominations in the immediate vicinity of the dwellings of your memorialists, and they feel that while every town and village and private house above London is forbidden to pollute the river in the interest of the great metropolis, yet that they and the inhabitants of all the populous towns below London are completely sacrificed to the comfort and convenience of the latter. There are banks within a few hundred yards of the houses of some of your memorialists composed of solid sewage, six, eight, and ten feet deep; and the backwater of nearly undiluted sewage sweeping up Barking Creek is so great that it must infallibly, beyond the possibility of doubt, breed a pestilence sooner or later. It is only a question of time. Foreshores which formerly were hard shingle are now pestilential mud; and what were formerly valuable fishing grounds are now spawning beds of fever and cholera. This is an injurious state of things which is against every principle of law and equity, and it is in violation of the provisions of the special Act of Parliament, 21 & 22 Vict. c. 104."

The sewage of the metropolis, as intercepted, is brought to the northern and southern

outlets, and on the turn ebb of each tide is discharged into the Thames. There are banks of mud on the foreshores, where formerly there was hard shingle; but the evidence as to the probable source of the mud forming these banks is very conflicting, both as to the quantity of mud deposited and as to the sources from whence it comes. The metropolitan sewage is discharged on the ebb tide, and the northern outfall sewer is a short distance only above the mouth of Barking Creek, and the set of the ebb out of the creek tends to push the sewage further into the main stream, where it is dispersed. The southern outfall is at some distance below the mouth of Barking Creek. (There has been no complaint from the inhabitants near the southern outfall sewers.) Before any of the metropolitan "undiluted" sewage can sweep up Barking Creek, the sluices must be opened, or be left open, while the first of the tide is flowing, which will be contrary to the requirements of the Act of Parliament. Evidence was given by Mr. R. C. Driver, that on the evening of the 6th August 1869 he and others saw the northern sluices open at low water, but with a rising tide. There had been a considerable fall of rain the previous day; and Mr. Bidder explained that the sluices had been left open contrary to orders, but to prevent an overflow, which has been provided for and must otherwise have taken place. Heavy falls of rain can only be exceptionally dealt with, but at such times there is extreme dilution both of the sewage and of the river water. Rivers in the manufacturing districts of Lancashire and Yorkshire are very much more polluted than the Thames, and do not breed pestilence.

"5. The terrible evils of the past and present have arisen chiefly from the discharge of the high and middle level sewers of the northern area of the metropolis. Your memorialists, however, learn with dismay that the pumping station at Abbey Mills, for raising the sewage of the third or low-level sewer, is now approaching completion, and that the intolerable nuisance now complained of will, ere long, be still further increased."

The completion of the low-level sewers and Abbey Mills pumping station, will certainly be a completion of the scheme of metropolitan main drainage as sanctioned by Parliament. Any additional evil, however, which may arise can only be estimated subsequently.

"6. Very shortly after the opening of the northern outfall sewer the coastguard station, formerly at the mouth of Barking Creek, had to be removed to the other side of the river, the old site having become simply untenable."

The evidence shows that the coastguard station was moved, principally, because the large artificial manure works belonging to Mr. Lawes blocked the view of the look-out men, and it was stated that the gases from these works were, at times, very offensive. It was not proved that the site had been made "untenable," exclusively, by the discharge of the metropolitan sewage into the Thames.

"7. In former days it was no uncommon thing for a vessel of 200 tons to 250 tons burden to be brought up the creek to the port of Barking; the port is now closed to all such vessels."

This allegation was distinctly disproved; vessels of 250 tons burden, drawing 11 feet of water, can now be brought up to the port of Barking, as formerly. 364–65, 451–454.

"8. Formerly fish abounded in the tidal waters of the creek, especially flounders and shrimps; not one can now live either in the creek itself or in the river near the mouth of the creek, owing to the concentration of the sewage. This is a severe and cruel injury and damage to the poor of the parish."

The establishment of Esparto paper-pulp works at Ilford, a short distance above Barking town, has, most probably, been more injurious to fish than sewage.

"9. Bathing has, of course, become impossible."

The water in the creek may be more polluted now than formerly, but if the experience of other places may be taken, this will not prevent bathing. Bathing is no more impossible than formerly.

"10. Formerly large ships could be moored within a short distance of the mouth of the creek, and lighters could approach them with ease; now they have to lie a long distance out, and lighters can only approach them by a circuitous and therefore expensive route."

There is the bank of mud which has accumulated on the shore of the Thames opposite the works of the Chartered Gas Company, and this mud has shoaled the water so as to prevent vessels floating and berthing as formerly. The evidence as to where this mud has come from is however contradictory; the balance of evidence is against the assertion that it has come from the metropolitan sewage detritus.

"11. It appears from a return to an Order of the Honourable the House of Commons, dated 26th November 1867, and moved for by Sir George Bowyer, M.P., supplying, among other things, copies of 'Notices given by the Conservators of the River Thames, under section 64 of the Act 29 & 30 Vict. 'c. 89. and the Act 30 & 31 Vict. c. 101,' that the conservancy are carrying out with vigour and promptness the special powers thus conferred upon them, so that in the course of a few months not a drop of sewage will find its way into either the Thames or any of its tributaries above London, yet the nuisance to your memorialists will be worse than ever, owing to the opening of the low-level sewer."

The pollution of the upland waters of the Thames and of its tributaries, has not ceased; but, most probably, Parliament will bring rivers generally under more practical and therefore better workable clauses than are in force at present, both to forbid and to prevent river pollution. The Thames, as a whole, may then be included.

"13. Your memorialists therefore humbly pray that you will take the subject of this memorial into consideration, and instruct Her Majesty's attorney general to apply to the High Court of Chancery for an injunction against the Metropolitan Board of Works, in terms of the 31st section of the Act 21 & 22 Vict. c. 104, to restrain them from discharging the sewage of London into the river Thames, or to take such other proceedings as he may advise and the urgency of the case demands.

"And your memorialists will ever pray, &c."

This inquiry has been made under the powers of the Act and clause quoted above (Act 21 & 22 Vict. c. 104, section 31). Section 32 states that "in the construction of "this Act the expression 'deodorize' shall be deemed to include any process whereby "the solid suspended matters in sewage may be precipitated or separated from the "liquid before the discharge thereof, or whereby the noxious or offensive properties of "sewage may be neutralized; and the expression 'sewage' shall mean and include the "contents of the sewers before the employment of such process."

The means for doing the work contemplated in this clause have, it appears, been provided in the design and construction of the main sewerage outlet works, both on the southern and on the northern sides of the metropolis.

The Board's engineers, Messrs. Bidder, Hawksley, and Bazalgette, objected to the more distant outfalls into Sea Reach, as recommended by the Government referees. Because of the great cost, probably upwards of 9,000,000*l*., and that as a work of construction they would have been all but impracticable, and also for the additional reason that town sewage, mixed in salt or brackish water, becomes more offensive; they therefore unhesitatingly selected for recommendation as points of outfall places situated in approachable situations, as near as possible to the metropolitan boundary, and as far as possible from human habitations—Barking Creek on the north side, and Crossness Point on the south side. Both are situated in low and dreary marshes, where neither the works nor the sewage can give reasonable cause of offence to anyone. Barking Creek is about two miles from Woolwich, and about four and a half miles from Erith. Crossness Point is midway between these two places.

The mean cross sectional area of the river Thames at these places is four times as great as at London Bridge, and the average volume of tidal water about 400 times as much as the volume of the sewage water to be admitted into it. The river is fresh, or nearly so, at low water, and only moderately mixed with salts of marine origin at high water.

The sewage reservoirs have been constructed so as to enable the precipitation of the sewage matter, to be effected by the application of lime, as at Leicester, "where the process is most successful;" the effluent water being completely deodorized, as well as being rendered bright and tasteless. The reporters stated:—

"We do not, however, believe this process to be needed for the prevention of injury "to the Thames, or to the health of the population residing on its banks, and we "certainly do not recommend it for adoption, because, when produced in large quantities, "the precipitated matter is unsaleable (as a manure), and must be removed at consider-"able expense."

The metropolitan sewage, it is stated, "will not create shoals in the navigable channel, "because the detritus of the roads and streets will be detained and removed from the "gullies and sewers before the sewage is pumped into the outfall reservoirs, and because "sewage sediment, being nearly of the same specific gravity as water, is most easily "moved by water, and is, moreover, always undergoing the process of destructive "decomposition." The reporters, therefore, expressed a decided conviction that shoals would not be created by the admission of sewage water into the Thames.

In their conclusions they state that the causes of the visible impurity of river Thames water have been "greatly exaggerated and much misunderstood." They also state that the discoloration and turbid appearance of the river Thames water is not altogether due to the presence of town sewage; but that, in the tidal reach, the discoloration is occasioned by the scour of flowing and ebbing tides lifting up silt from the estuary, banks, and shores of the river, and that the upland portion of the Thames, and its tributaries, are occasionally discoloured by land floods, which bring in from the watershed sand, silt, and dissolved vegetable matter; the sewage only adding a small portion to the visible discoloration of the Thames water.

The waters of the river Thames and of its tributaries, above tidal influences, are at ordinary times bright; but within tidal influences, from the sea to Teddington, the river

water is and always must have been more or less turbid, spring tides most disturbing sand and mud on the banks and shores. Upland floods also bring down silt (detritus and mud). The estuary silt, which is moved up and down with each flow and ebb of tide, discolours the Thames water sufficient to disguise the sewage poured in; and this mud also, in some degree acts as a disinfectant, so that within a comparatively short distance from the main outfalls the metropolitan sewage is "lost to sight and smell." The more correct description, however, would be, that the sewage, within this short distance, mingling with the silt and mud-laden tidal water of the ebbing river, rapidly became disguised to the senses of sight and smell; any solid detritus there may be remains; any material capable of being oxidized and evaporated may be dissipated. If the river Thames opposite Barking consisted of bright water, the metropolitan sewage would, however, be traceable by its colour and smell for much greater distances than at present. All tidal estuaries, similar to that of the Thames, as the Severn, the Mersey, and the Humber, flowing over sand and mud banks, have silt-laden and turbid waters. and this silt is in excess during spring tides and land floods. The banks and shores of such tidal estuaries are constantly altering by this unceasing scour, and there is as constant a redeposit of the sand and mud from the flood and tidal waters, so that it would be very difficult to define (legally) where any increase of deposit has come from in the Thames at Barking. There is, however, the simple fact that *all the detritus* brought down by the metropolitan sewers, much or little, passes, at present, with the sewage direct into the river Thames; and that portion of detritus which is not soluble in water must be deposited, part on the shores in the mud found there, and part on the estuary banks—annihilation is impossible.

Recapitulation.

The memorialists anticipate permanent silting in the navigable channels, both of the creek and of the Thames, as they say that the diminution of water in the channel of the river Thames amounts to 11 feet; and in paragraph No. 7 they say, "In former days it "was no uncommon thing for a vessel of 250 tons burden to be brought up the creek "to the port of Barking; the port is now closed to all such vessels." The statement as to a loss of 11 feet in depth of water in the main navigable channel of the Thames was, at the inquiry, admitted by the memorialists to be an error, arising out of a misunderstanding, and the statement as to the closing of Barking Creek was disproved by the balance of evidence. The rise, or grade, in the bed of the creek, from the Thames to Barking quay, is about 10 feet; there has been a temporary accumulation of mud on "Horse End Shoal," and inwards up the creek for a short distance, which mud prevents vessels entering so early on a rising tide as formerly; but when the water has risen so as to be sufficient in depth to pass over this bar, the channel of the creek, up to Barking Quay, is as deep and as easily navigated as formerly. The bottom of the creek at Barking Quay has not been silted by metropolitan sewage, neither does it appear to have been raised by upland mud nor by the town of Barking sewage.

The eighth paragraph states that "fish formerly abounded in the tidal waters of the creek." There are other causes for the disappearance of fish from the creek than the metropolitan sewage, as it was proved in evidence that a paper mill has been established on the river Roding, at Ilford, a short distance above Barking town, for the manufacture of paper or "fibre," from Esparto grass. This material requires that more chemicals should be used than in bleaching rags. Twelve tons of Esparto grass produce about six tons of white paper material, and to prepare this weight of fibre 2½ tons of soda-ash are expended, rendered caustic by quicklime. The waste liquid, which is of a dark coffee colour, is then drained away. There are subsequent washings to remove as much as possible of this alkaline liquid; the whole volume of waste water, waste fibre, chemicals, and sediment being finally drained off into the river. In preparing Esparto grass pulp, about one half in weight of the grass treated is refuse; and in making paper the weight of water required is about *one thousand times* that of the paper made; that is, 1 lb. of paper needs about 1,000 lbs. weight, or 100 gallons, of water to be used in its manufacture; and this water is, for the most part, polluted. Fish are killed by such waste fibre and chemicals when drained into a river. That the waters of the Thames and of Barking Creek have suffered deterioration during the last 20 years may be admitted. Population has increased, and nuisance manufactures have also increased in the district; river pollutions having consequently increased also, so that vessels are not now watered from the Thames, and live fish, in wells, are not brought up to Barking quay as formerly; the general pollution of the waters by sewage, and by waste chemical refuse from manufactures having caused this deterioration; and unless measures to diminish river pollution are established and enforced this evil will go on increasing.

The ninth paragraph states that "bathing in the creek has become impossible." If the statement had been that the water has been deteriorated for bathing purposes, it would have been true; but bathing takes place not only in London, but also in many parts of Lancashire and Yorkshire, in water far more polluted than that of Barking Creek. This fact does not, however, justify any further pollution of the water of the creek, but disproves the allegation.

Extracts from the Metropolitan Board's annual reports, as set forth in the Appendix, show the difficulties and delays which the numerous attempts at negotiating for a sale of the sewage have led to; and there is no reason to conclude that, in future (if similar stringent conditions are insisted upon), the Board's attempts in this direction will be more successful. A company formed for such a purpose as that of utilizing the sewage of the metropolis (valued by chemists at upwards of one million sterling per annum, and requiring possession, or command, over some 70,000 statute acres,) is not to be easily established. The failure of the "METROPOLIS SEWAGE AND ESSEX RECLAMATION COMPANY" to proceed with their works will act prejudicially. There are undertakings of the nature of metropolitan sewage irrigation in India, as the great canal and irrigation schemes, which, when completed, have proved successful, but which private enterprise alone could not, or would not have accomplished. Large public improvements of various kinds have, from time to time, received Government countenance and support, in the form of subsidy or guarantee, without which such works must either have been entirely executed by the Government, or have been left unaccomplished.

The purification of the Thames is of the utmost importance; the task of its accomplishment, as imposed by Parliament, rests upon the Metropolitan Board; and negotiations with private companies, if they fail, cannot free the board from this responsibility. If the works can be executed without loss, the metropolitan ratepayers have a right to be exonerated from any charges; if there accrues an income above a stipulated per-centage, they ought to share the profits; but if the work of freeing the Thames from pollution can only be accomplished by a rate in aid, it is the duty of the Metropolitan Board to meet this difficulty, and to levy such rate as may be required.

CONCLUSIONS.

That the allegations in the Memorial have only been partially proven.

That the memorialists are not in a position to establish deterioration of health to emanations from the metropolitan main sewerage outfall works, as the town of Barking is without local governing powers, is unsewered, contains many cesspools, a sewage tainted subsoil, and has a defective water supply.

That the river Thames is polluted by the metropolitan sewage, and receives such road and street detritus as the aforesaid sewage contains.

That the main channel of the Thames has not been reduced in depth of water by such detritus.

That Barking Creek has not been closed to vessels of 250 tons burden.

That fish have been destroyed in the creek, but most probably by chemical refuse.

That an accumulation of mud has taken place, both on the shore of the Thames and at the mouth of Barking Creek, but from what special cause has not been proven.

That the Metropolitan Board of Works, in their annual reports, recognize their obligation to purify the Thames, and to effect this purpose have negotiated with second parties for the utilization of the northern sewage by irrigation.

That the Board, throughout their transactions for the utilization of sewage, have stipulated for pecuniary relief to the metropolitan ratepayers.

That the Metropolitan Board have objected to the admission of sewage into the Thames from towns situate above London, and therefore inferentially justify the objections to river pollution below London.

That deodorization and disinfection of the metropolitan sewage by chemicals would be very costly to the ratepayers, and in the results imperfect.

That river pollution by town sewage, in the case of the Thames, may be prevented.

ROBERT RAWLINSON.

APPENDIX TO THE REPORT.

Observations.

That the question of the metropolitan main sewerage works may be better understood, as also the question of the prevention of rivers pollution and of sewage utilization, I have abstracted the titles of some of the reports prepared by royal commissions and by select committees, as also some of their conclusions and recommendations. I have also abstracted certain details from the several annual reports prepared and published by the Metropolitan Board, which enable me to give a fuller view of the subject than I otherwise could have done. The Metropolitan Board have evidently fettered themselves throughout with striving to obtain what they consider the full value of the sewage, when this ought to have been a secondary consideration, prevention of pollution to the Thames being the first consideration.

During the last 10 years there have been numerous experiments with town sewage, both in the chemist's laboratory and in the field, and it has been proven that town sewage has most value in its liquid state, if it can be applied direct to land for agricultural uses. The mechanically suspended solids of sewage can be partially extracted by mere subsidence, and the remaining liquid can be further clarified by an admixture of chemical ingredients; but the salts of sewage remain in the clarified water, and the residuum has no value equivalent to the cost of the materials and the manipulative labour; and if ingredients are added to make a saleable manure, no better commercial result is attainable. Extraction of the solids of town sewage and chemical clarification of the water may, in some cases, be permitted; but, as may be inferred, there will be money lost in the transaction; and if the clarified water is allowed to stagnate, putrefaction will take place in it. Clarified sewage water may, however, be an amelioration where irrigation is not practicable, as in many sewage polluted rivers the mud derived from the sewage year by year accumulating on the bed and banks, when exposed during dry and hot summers, becomes most offensive. The exposed mud on the banks of the Thames, at times of low water in hot summer weather, is more offensive than the water.

The passage of sewage over and through land, in volume proportioned to the soil, the crop to be grown or growing, the season, and the time of year, will extract nearly the whole of the salts contained in sewage water, a true chemical change taking place, the manurial ingredients being combined with the soil, and certain salts of the soil being taken up and removed by the effluent water, which is frequently bright and sparkling. If there is turbidity the dose of sewage has been too strong, the drains are too shallow, or there has been disturbance of the soil by carts, horses, and men working on the land at the time of irrigation, or the sewage carriers have been allowed to become foul.

Sewage irrigation, if carried on to the best advantage, is a complicated operation, and requires special knowledge in the farmer. The produce of ordinarily good land under sewage is so much greater than is obtainable by ordinary modes of agriculture, that on some town sewage farms this has been the greatest difficulty. A crop of Italian rye grass, 20 tons to the acre, which requires to be cut and to be consumed within a few days, is something new to the farmer, and may at first be troublesome; but time and experience will enable him to apportion his crops to his means and to his markets, and thus obtain the full value of his products. There is not the same trouble with root crops, such as potatoes, turnips, mangolds, and beet; and with market garden produce, which may be grown under judicious sewage farming, and having the metropolis for a customer, the heaviest crops, sound, wholesome, and nutritious (as sewage-grown produce has been proved to be) will command a ready market. The experimental farm at Barking has shown the manurial effects of the metropolitan sewage on the soil of the district, and that which has been accomplished on a small area may, under similar conditions, be rivalled on a larger scale. Sewage irrigation ought not to be practised so as to swamp the land; the fluid dressing of each day should be on, over, through, and off the land, leaving the manurial ingredients in the irrigated soil. In winter the excess of heat brought with the sewage is an advantage.

Several questions springing out of the Barking inquiry came before me incidentally, As to the appropriateness, or otherwise, of the present sites of the Northern and Southern Metropolitan Main Sewers Outfalls; As to the necessity for the clarification of the sewage and removing the sediment, before discharging the same into the Thames; As to the advisability of utilizing the sewage by irrigation over land; As to the propriety of more distant outfalls (as proposed by Messrs. Galton, Simpson, and Blackwell) for the discharge and wasting of the sewage into the Thames at Sea Reach; And as to the Board's negotiations for the disposal of the sewage for agricultural uses.

With respect to the existin ; sites of the outfalls at Crossness and at Barking, These were recommended after full consideration and were approved and finally adopted by the Metropolitan Board. All things being considered I think no more appropriate places could be found, if sewage irrigation is ultimately to be carried out. The entire works have been well executed in every respect. No city, ancient or modern, can show such an extent of main sewerage works as now exists in the metropolis, in main intercepting sewers, sewage tanks, and pumping stations. They are appropriate in design, sound in workmanship, and efficient in use. The sewage is, however (with a slight exception), still discharged into the Thames in bulk, but at the times and in the manner stipulated by Parliament; any sediment washed down by and with the sewage being also discharged into the Thames. The mud found on the banks and shores of the Thames, in Barking Reach, upon analyses by Drs. Miller and Odling is found not to differ in its chemical elements from Thames mud generally, as deposited on the shores of the river from Teddington to Erith. The whole of the mud found in this portion of the Thames containing elements partially derived from sewage, the mud at Barking town quay, and in the river Roding above, being slightly worse than the Thames samples.

The engineer and secretary to the Thames conservators stated, at the inquiry, that they had an impression that disinfection of the sewage was to have taken place, and that *clarified sewage water* was alone to be discharged at the outfalls, Messrs. Bidder, Hawksley, and Bazalgette state in their conclusions, that provision for such disinfection and clarification has been provided for at the outfalls, but that after careful examination and inquiry they did not then recommend such clarification, neither do they now.

The question of utilizing sewage by irrigation over land has been inquired into and reported upon extensively, as is shown in Official Reports, extracts from which are given. These reports show that royal commissions and select committees, after full inquiry, long-continued and costly experiments, have come, for the most part, to similar conclusions, namely, that the only practical mode of clarifying town sewage, and of preventing river pollution, is to utilize it for agricultural purposes on land. If this conclusion is accepted and is acted upon, more distant outfalls for the purposes of wasting the sewage into the Thames at Sea Reach would only have been to incur a needless expenditure of money, as such lengthened outfalls would have carried the sewage past land most suitable for irrigation, as being nearest to the London market.

Messrs. Hope, and others, expressed themselves confidently as to the success of the system of sewage irrigation now being carried on at Barking. Complaints were made at the inquiry, that the irrigation works had been stopped because doubts had been expressed as to the financial success of these works. I could not, however, enter at any length into this dispute; but if hereafter Parliament enacts that rivers shall not continue to be polluted by town sewage (and the Thames is not exempted), ways to complete sewage irrigation works must and will be found. The manurial value of town sewage has over and over again been settled by the most eminent chemists, and the practicability of using it in agriculture, beneficially, is year by year being tested and proved.

TITLES OF OFFICIAL REPORTS, AND EXTRACTS FROM THE SAME.

REPORT on the MAIN DRAINAGE of the METROPOLIS, by Messrs. DOUGLAS GALTON, JAMES SIMPSON, and THOS. E. BLACKWELL, dated 31st JULY 1857.

Proposed outfall on the northern side beyond Mucking Flats, in Sea Reach.

On the southern side into Higham Creek (these points are some 16 or 18 miles below Barking). Daily volume of sewage estimated at 95,000,000 gallons. This report contains chemical investigations of the metropolitan sewage, by Messrs. Hofman and Witt.

REPORT of R. ETHERIDGE, Esq., on THAMES MUD and THAMES WATER.

Thames mud according to this report is composed of vegetable matter and some animal matter in a state of decomposition, and of living organisms of the class Infusoria, Diatomaceæ, Zoophyta, and Crustacea. The detritus consists of abraded road material, granite, porphyry, and other crystalline rocks, crushed flint, gravel, and earthy deposit of the basin of the Thames.

From the analysis of mean specimens of London sewage it is found that 100 tons of liquid sewage possess a value of 17*s*. 7*d*. The suspended matter amounts to 82·72 lbs. in weight, and is only worth 2*s*. 2½*d*. The dissolved matter is 245·95 lbs. in weight, and is worth 15*s*. 4½*d*.

Every chemical process tried for the deodorizing and consolidating sewage into a manure had been tried, and it was found all these processes leave a large quantity of putrescible organic matter still in solution, which in hot weather would be apt to undergo decomposition and give rise to the generation of effluvia offensive and dangerous. So-called deodorizing works could not in practice be carried on in inhabited districts on a large scale without becoming a nuisance to the neighbourhood.

The total annual value of the fertilising matter in the whole of the metropolitan sewage is estimated at upwards of 1,000,000*l*. sterling, nearly seven-eighths of this value being in the liquid.

SEWAGE OF TOWNS.

REPORTS of the ROYAL COMMISSIONERS appointed to inquire into the best mode of DISTRIBUTING THE SEWAGE OF TOWNS and applying it to BENEFICIAL and PROFITABLE USES.

PRELIMINARY REPORT, dated 26th March 1858.

SECOND REPORT, dated August 1861.

THIRD and last REPORT, dated March 1865.

The conclusions embodied by the Commissioners in this last report are:—

"As the results of our labours, extending over eight "years, we have confidence in submitting the following "conclusions:—

"1. The right way to dispose of town sewage is to apply "it continuously to land, and it is only by such application "that the pollution of rivers can be avoided.

"2. The financial results of a continuous application of "sewage to land will differ under different local circum-"stances. First, because in some places irrigation may be "effected by gravity, while in other places more or less "pumping must be employed. Secondly, because heavy "soils (which in given localities may alone be available for "the purpose) are less fit than light soils for continuous "irrigation by town sewage.

"3. Where local circumstances are favourable and undue "expenditure is avoided, towns may derive profit more or "less considerable from applying their sewage in agri-"culture. Under opposite circumstances there may not "be a balance of profit; but even in such cases a rate in "aid, required to cover any loss, needs not be of large "amount.

"Finally, wherever rivers are polluted by a discharge of "town sewage into them, the towns may reasonably be "required to desist from causing that public nuisance."

ROYAL COMMISSION—RIVERS POLLUTION.

FIRST REPORT, RIVER THAMES.

Report, Evidence, Maps, and Appendices, March 29th, 1866.

SECOND REPORT, RIVER LEE.

Report, Evidence, Maps, and Appendices, May 6th, 1867.

In these reports pollution of rivers by town sewage is shown to be injurious, and where the waters are taken for town supplies dangerous to health.

Acts of Parliament are now in force both for the Thames and for the Lee, containing clauses framed on the recommendations of the Commissioners.

THIRD REPORT—AIRE and CALDER.

Report, Evidence, Maps, and Appendices, August 15th, 1867.

Legislation has not yet taken place on this report.

SALMON FISHERIES REPORTS.

Evidence, Maps, and Appendices; in which reports the Commissioners also detail river pollutions and recommend restrictions.

SPECIAL REPORT from the SELECT COMMITTEE on the METROPOLIS SEWAGE and ESSEX RECLAMATION BILL together with the proceedings of the COMMITTEE and the MINUTES of EVIDENCE. Dated 30th March 1865.

The Committee state:—

"Upon this evidence your Committee are of opinion that "the scheme which has been submitted to them is a useful "and profitable mode of applying the sewage of the "northern portion of the metropolis, and they have no "reason to suppose that any more useful or profitable "scheme could be devised."

REPORT from the SELECT COMMITTEE on SEWAGE (METROPOLIS), together with the proceedings of the COMMITTEE, MINUTES of EVIDENCE, APPENDICES, &c. Dated 14th July 1864.

In the minutes of evidence, page 1, the chairman of the Metropolitan Board of Works explains to the committee the details of the tenders for dealing with the sewage of the metropolis called for 27th January 1860, and re-advertised upon the 6th March 1863, and again in May 1863.

These advertisements were to enable the Metropolitan Board to meet and comply with the requirements of the 21st and 22nd of Vict. c. 104, section 31, which reads thus:—"It shall be lawful for one of Her Majesty's Principal "Secretaries of State, at his discretion, on representation "or complaint made to him of any nuisance committed "in execution of any works, or in deodorizing any sewage, "or in disposing of any sewage or refuse from sewers, or in "any other manner under this Act, to cause inquiry to be "made into the matter represented or complained of to "him, and to direct such prosecution or prosecutions, or "to take such other proceedings, as he may think fit, in "order to insure the prevention or abatement of such "nuisance as aforesaid." The chairman stated that having regard to this section, and also to the Main Drainage Act (the 18th and 19th Vict. c. 120, section 135), he felt it incumbent to advise the Metropolitan Board to require a description of the area of land, and a general outline of the plan proposed for sewage irrigation.

The area of the metropolis it is incidentally stated is 117 square miles.

FIRST REPORT from the SELECT COMMITTEE on SEWAGE of TOWNS, together with the MINUTES of EVIDENCE and APPENDIX. Dated 10th April 1862.

SECOND REPORT, with MINUTES of EVIDENCE and APPENDIX. Dated 29th July 1862.

The Select Committee report as under:—

ANALYSIS OF EVIDENCE.

1. The evidence proves that sewage contains the elements of every crop which is grown.

2. That as compared with solid manure there are advantages in the application of sewage manure to land.

3. The evidence proves that town sewage contains a large amount of heat, which in itself is beneficial in stimulating vegetation.

4. The evidence also proves that the water alone of sewage is of great benefit for agricultural purposes.

5. The evidence further proves that one ton (224 gallons) of average town sewage contains an amount of manure which, if extracted and dried, would be worth a little over 2*d*., taking Peruvian guano (at 11*l*. per ton) as the standard.

6. A judicious use of town sewage permanently improves land.

7. Sewage may be applied to common grass, Italian rye grass, and also to roots and grain crops, with great advantage, dressings with sewage hastening vegetation.

8. Sewage-grown grass has a great effect in increasing the quantity and richness of the milk of cows, as well as improving the condition of the cattle, which prefer sewaged grass to all others.

9. The earth possesses the power of absorbing from sewage all the manure which it contains, if the dressings in volume are proportioned to the depth and quality of the soil.

10. Those who use sewage should have full control over it, that they may apply it when and in what quantities they may require it.

11. Heavy dressings of sewage (8,000 to 9,000 tons per acre) are wasteful; less dressings (500 to 2,000 tons per acre), when more carefully applied, produce better results. The enormous dressings recommended by some witnesses would be agriculturally useless, as the sewage would flow over and off the surface unchanged.

12. When the sewage of our cities, towns, and villages is utilized to the best advantage over suitable areas, little or no imported or manufactured manures would be required in such districts.

13. Sewage may be applied with advantage to every description of soil which is naturally or artificially drained.

14. The most profitable returns, as in the case of all other manures, will be obtained when sewage is judiciously applied to the best class of soils.

15. Sewage may be advantageously applied to land throughout the entire year.

16. Some matters used in manufactures which enter town sewers, such as waste acids, would be in themselves injurious if applied to vegetation; but bearing as they do so small a proportion to the entire volume of sewage into which they are turned, they are rendered harmless.

17. Fresh sewage at the outfall of the sewers, even in the hottest weather, is very slightly offensive; and if applied to the land in this state, in such dressings as can at once be absorbed by the earth, fear of nuisance need not be felt, as the soil possesses the power to deodorize and separate from liquids all the manure which they contain.

18. Large dressings and an over-taxed soil may pollute surface streams, subsoils, and shallow wells.

19. Solid manure cannot be manufactured from town sewage with commercially profitable results.

Annual Reports by the Metropolitan Board of Works.

Extracts.

Report for 1858.

"During the week ending July, 763 tons of chalk lime "and 73 tons of chloride of lime were used, making a total "consumption during the summer of 2,872 tons of chalk "lime and 134 tons of chloride of lime, at a cost of 7,995*l*., "to deodorize some of the metropolitan main sewers, and to "abate the offensive condition of the polluted water of the "Thames."

Report, 1859.

The Metropolitan Board, in the year commencing March 1859 and ending March 1860, again found it necessary to deodorize the sewage in certain of the main sewers of London. The total quantity of disinfecting material used during this summer, was 4,281 tons of chalk lime, 478 tons of chloride of lime, and 56 tons of carbolic acid, at a cost of 17,733*l*. The Board (at this time) instructed Drs. Hofmann and Frankland to make experiments and report as to the best deodorizing and disinfecting agents, and they recommended a concentration of perchloride of iron. The Board stated that they fully understood their duty to be as imposed by the statute.

The necessity for this expenditure proves that, in hot and dry summers, the water of the Thames becomes, or did become offensive; and although at the Crossness and Barking outfalls, there will be greater dilutions, it may be assumed that the offence will only, in a degree, be lessened.

Advertisements were issued in this year expressing the readiness of the Board to afford opportunities to any company or individual for testing and developing the agricultural value of the metropolitan sewage; but the Board anticipated difficulties in the task of devising effective arrangements by which reasonable prospects of remuneration to the promoters of such a scheme should be combined with effectual safeguards against nuisance; the general public being exceedingly sensitive to injury to health and to depreciation of property; the Main Drainage Act authorizing most stringent and summary proceedings against the Board, before the Secretary of State, in case any nuisance should arise in the course of their operations.

Report, 1861.

The Metropolitan Board, as early as 1861, in their annual report state, with respect to the utilization of the sewage, that "Applications have been received from "several parties in reference to the utilization of the "metropolitan sewage, which applications the Board "then had under consideration, being anxious to afford "every facility for carrying out any scheme *which may "appear to promise a solution of the question of the commercial value of the sewage, and at the same time to offer "the prospect of some remuneration to the ratepayers.* They "also feel bound to guard against the possibility of "nuisance or injury to health, and therefore reserve to "themselves the power of determining any arrangements "with such parties."

The Board having now had eight years additional experience, and as the questions of nuisance and injury to health are pressed upon them in another form, namely, through the Barking memorial, under the provisions of the Act 21 and 22 Vict. c. 104, s. 31, it may probably in time occur to them that they are also bound to guard against the possibility of nuisance or injury to health, irrespective of the question of the commercial value of the sewage and of remuneration to the ratepayers.

Report, 1863.

In this report the question of sewage utilization for agricultural purposes is again commented upon. The subject the Board, however, say, is one not easy of solution, and involves many difficulties; the vast quantity of sewage to be dealt with, the adoption of any scheme combining proper safeguards to the public health, and the prevention of any depreciation of any property, combined with a prospect of adequate remuneration to the promoters, and of ultimate revenue to the metropolitan ratepayers.

This year it was found necessary to deodorize the sewage flowing into the river Lee at Old Ford, from the high and middle level sewers.

Report, 1864.

In this report the Board state that they have executed main drainage works for the purification of the Thames within the metropolitan area, at a cost of four and a quarter millions, which it appeared to the Board would be of little avail if the towns of Kingston, Teddington, Twickenham, Richmond, Isleworth, Brentford, and Chiswick were still permitted to pour the contents of the sewers into the stream within its tidal influence; and above Teddington the towns of Hampton, Chertsey, Staines, Eton, Windsor, Maidenhead, Marlow, Henley, Reading, Abingdon, Oxford, and other places. Appendix B in this (Metropolitan Boards') report sets forth a letter from the chairman of the board to Lord Palmerston, on the pollution of the Thames, from which the remarks above may be considered an abstract.

The bill for utilizing the northern sewage of the metropolis (Barking), and reclaiming certain lands on the coast of Essex, received the royal assent on the 19th June 1865.

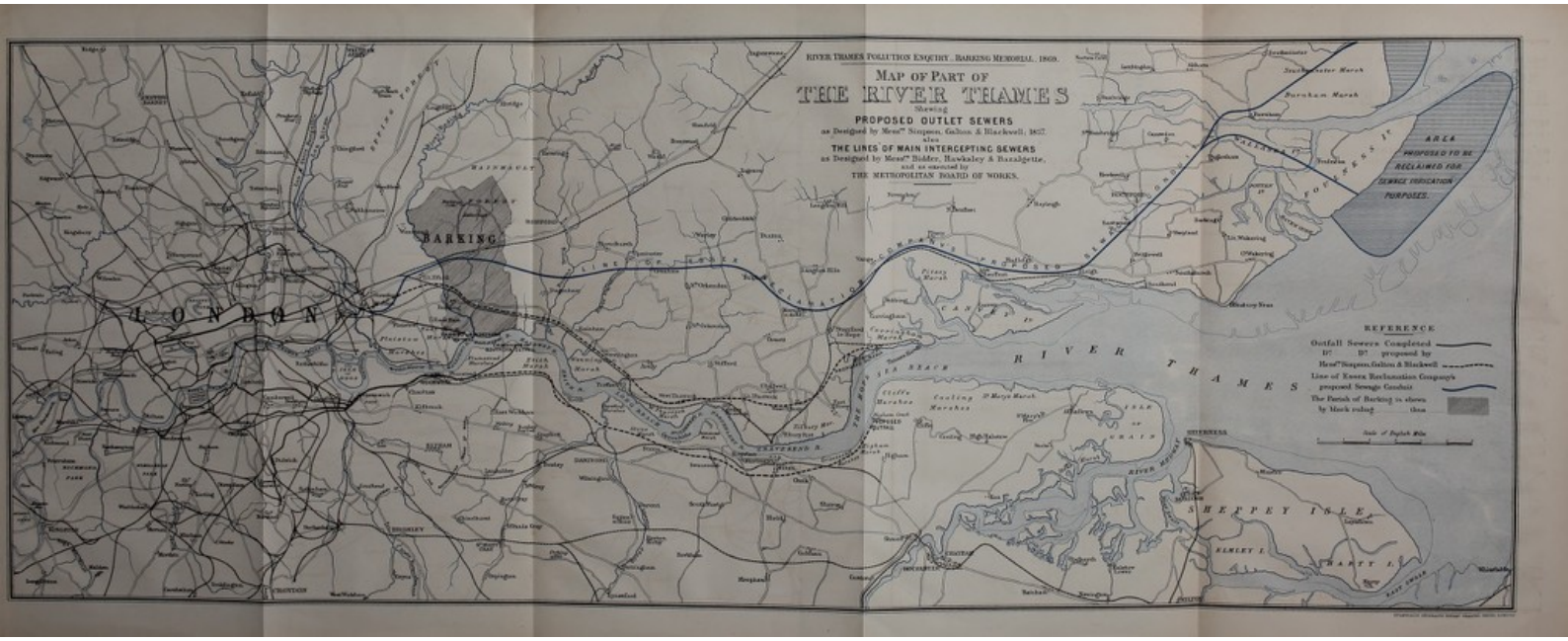
This Act provides for the removal from the river Thames of the whole of the ordinary sewage of the northern part of the metropolis, with the exception of *occasional heavy rain overflows.*

Report, 1865.

The Board, in their report 1864-5, express their satisfaction at the successful issue of their endeavours to obtain a scheme for utilizing the northern sewage, and so avoiding its discharge into the Thames at Barking Creek. The Board had also then turned their attention to making similar arrangements with respect to the Utilization of the sewage from the Southern Outfall Sewers.

Report, 1866.

In the annual report, 1865-6, the Metropolitan Board again report:—"Doubts having been expressed by Baron "Liebig and other persons of scientific eminence, as to the "feasibility of Messrs. Napier and Hope's scheme, the "company have, during the past year, instituted a series "of experiments to demonstrate the effect of the (London) "sewage on the sands to be reclaimed and acted upon, and "samples of the crops grown having been sent to the "offices of the Board, they concluded that the theories of "Baron Liebig and others had not been borne out, and that "there appeared to be no reason whatever to doubt the "ultimate success of the larger undertaking (ultimately) "to be carried out by the Sewage Company in reclaiming "and irrigating Maplin Sands."


RIVER THAMES POLLUTION ENQUIRY. BARKING MEMORIAL. 1869.
MAP OF PART OF
THE RIVER THAMES
Shewing
PROPOSED OUTLET SEWERS
as Designed by Messrs Simpson, Gallon & Blackwell, 1857.
also
THE LINES OF MAIN INTERCEPTING SEWERS
as Designed by Messrs Bidder, Hawksley & Bazalgette,
and as executed by
THE METROPOLITAN BOARD OF WORKS.
AREA PROPOSED TO BE RECLAIMED FOR SEWAGE IRRIGATION PURPOSES.
REFERENCE
Outfall Sewers Completed
D° D° proposed by Messrs Simpson, Gallon & Blackwell
Line of Essex Reclamation Company's proposed Sewage Conduit
The Parish of Barking is shewn by black colour thus
Scale of English Miles
LONDON
BARKING
RIVER THAMES
SHEERNESS
SHEPPEY ISLE
ISLE OF GRAIN
CANVEY I.
HARTY I.
ELMLEY I.

Having arranged for the utilization of the northern sewage, the Board advertised for tenders for the southern sewage, on the 7th July 1865, and they receive five tenders, which, upon being referred to the main drainage committee for consideration, were found not to have complied strictly with the terms of the advertisement, but were mostly suggestions unaccompanied by plans, sections, or other details necessary to fully show what works were intended, or the probable cost of them. The plan of Mr. Ellis, though imperfect, contained the most favourable features, and appeared most capable of being so improved and developed as to meet the ends in view. *The Board, however, felt strongly that the object in view in granting a concession of the sewage was not simply to prevent its flowing into the Thames, but that they had an important duty connected with it in relation to the ratepayers of the metropolis, namely, that they should only agree to such a plan as would ensure a probable substantial return in relief of the burden of taxation.* Mr. Ellis subsequently had several meetings with the committee; but on the 15th May 1866, he and his friends stated that it had become evident that after the financial crisis which had taken place, and according to the then state of the money market, it would be impossible to raise funds necessary for the object in view. The question was therefore adjourned.

Report, 1867.

The Metropolitan Board in their annual report, 1866-7, take credit for the great improvement effected in the Thames through London by the northern and southern main sewerage works, fish having been observed in the tidal parts. The Board draw attention to the fact that in the year 1865–6 they urged upon the Government the necessity of prohibiting the discharge of sewage into the Thames from any town or village above the metropolis, as having been called upon to improve the London portion of the river at a cost of 4,200,000*l*., it follows logically that Kingston and other towns should be required to purify their sewage, or the inhabitants of London will suffer great injustice.

The River Thames Conservancy Acts and the River Lee Navigation and Conservancy Acts, subsequently passed and now in force, contain provisions restricting the admission of town sewage from the main channel of the Thames, and from the Lee throughout its entire watershed.

Further negotiations took place with Mr. Ellis, relative to the utilization of the sewage from the southern main drainage outfall, but no definite arrangement was made.

Report, 1868.

In the report for 1868, the Board state that "in the "year 1865 they granted a concession of the sewage of the "northern portion of the metropolis to the Metropolis "Sewage and Essex Reclamation Company, upon "the understanding that this company would construct "culverts (sewage conduits) for the purpose of conveying "the sewage from the outfall works at Barking Creek for "distribution on sands to be reclaimed from the sea at "Maplin on the Essex coast; and that the company "deposited with the Board the sum of 25,000*l*. as a guarantee for the due execution of the works within four "years from the passing of the Act; that is to say, the "works were to be completed by June in the present year; "but by an amending Act (which the company obtained "in 1866) the time for the completion of the works was "extended till July 1870."

Contracts were entered into and the works commenced, but only a very short length of the sewage conduit has been completed, and the works are now, and have for some time been, at a stand.

Southern Outfall Sewage.

"With regard to the utilization of the southern sewage, the Board have not been enabled as yet to arrange terms with any contractors. This result is mainly attributable to the financial depression consequent on the crisis of 1866, which more or less affected adversely all commercial schemes, but particularly such as partook of a new or experimental character; and as the works of the company who have the concession of the sewage on the north side of the Thames have been for some time in abeyance, any further consideration of the disposal of the southern side sewage is postponed."

The Board, however, trust that this postponement will be only temporary.

EXTRACT FROM REPORT ON MANURE, CHEMICAL, AND GAS WORKS, SITUATE ON THE BANKS OF THE THAMES IN WOOLWICH, GALLEONS, AND BARKING REACHES.

During the inquiry Mr. W. Smith, solicitor to the Metropolitan Board, put in a "Report on an inspec- "tion of Manure and Chemical Works in the neigh- "bourhood of the Northern and Southern Outfalls, "by Dr. Letheby and the Engineer. Ordered to be "printed May 19th, 1865."

Extracted from this Report are the following statements which serve to show the actual condition of the district at present. It is not supposed that one set of nuisances will justify another nuisance being established and continued, but if legal action should be taken against any one set of these so-called "nuisance works," there will be very great difficulty in establishing the fact of that special manufactory, or source of nuisance, being the sole cause of the injury to health complained of.

The land in the parish of Barking on the banks of the river Thames has become what may be aptly termed "A Nuisance District." In May 1865 Dr. Letheby and Mr. Bazalgette, by order of the Metropolitan Board, made an inspection of the manure, chemical, and other "nuisance" works in the neighbourhood of the northern and southern metropolitan main sewers outfalls, and reported to the Board the result of this inspection. They state that in close proximity to the northern outfall, and on the eastern side of Barking, are the manure and vitriol works of Mr. Lawes passing offensive fumes into the surrounding atmosphere. On the same side of the river Thames, and at a short distance below the works of Mr. Lawes, are works of Mr. Crew, where gas-liquor and gas-tar are subjected to distillation; the gas-liquor being converted into sulphate of ammonia, and the gas-tar into naphtha, creosote, and pitch. In the manufacture large volumes of sulphuretted hydrogen are set free, and as this escapes into the air it becomes a cause of great offence. On the same side of the Thames the Chartered Gas Company are erecting the largest gasworks in the kingdom.

On the southern bank of the Thames, and near the southern metropolitan main-sewers outfall, there are two manufactories for the utilization of refuse from the London tanneries, where the scrapings of hides and skins are converted into a manure by boiling, the vapours emitted from the boiling mixture being very offensive. There are also glue manufactures, the glue being made from trimmings of hides and skins, any unused refuse being converted into manure. There are other works for the distillation of bone-oil, which is a very offensive product produced in the carbonization of bones in making animal charcoal.

The result of these inspections, Messrs. Letheby and Bazalgette showed to be; that very large and offensive operations are carried on in the neighbourhood of both the northern and southern metropolitan outfall sewers, the putrid and other vapours emitted from such works being diffused into the atmosphere, to be wafted over wide areas as the prevailing wind for the time may carry them.

No special precautions are used to deodorize, prevent, or to regulate the escape of these noxious vapours as they are evolved from the materials, but they are permitted to escape during all stages of the manufacture.

Persons sailing up or down the Thames, and smelling these fumes, frequently attribute them to the metropolitan sewage, with which the river water is polluted.

MAP.

The map shows the eastern boundary of the Metropolis, Barking parish; the Crossness and Barking outfall sites; the proposed sites for outfall works in Sea Reach; and, the proposed sewage conduit to Maplin Sounds.

MINUTES OF PROCEEDINGS.

LIST OF WITNESSES.

Name and Profession, &c. of Witness.	No. of Question.	Page.
Barnes, W.	2551–2564	84
Bazalgette, Mr. J. W. (Engineer-in-Chief to the Metropolitan Board of Works).	1419–1753	42
Bidder, Mr. G. P. (Civil Engineer)	1786–2025 3560, 3561	55 105
Brown, J. (Waterman)	2912–2914 2923–3221	91
Burstal, Capt. E., R.N. (Secretary to Thames Conservancy Board)	956–1002	28
Clark, Mr. C. (Inhabitant of Barking and Lighterman)	3222–3316	96
Cooper, Mr. E. (District Engineer to the Metropolitan Board of Works).	2525–2550	83
Crowe, Mr. (Chemical Manufacturer)	323*a*–331	10
Davidson, Dr. (Surgeon)	115–136	5
Deay, Mr. W. (Coastguard Boatman)	2815–2911	89
Deveson, Mr. E. (Manager to a Coal Merchant, Barking)	333–568	11
Driver, Mr. R. C. (Surveyor)	3544–3559	104
Grant, Mr. J. (Assistant Engineer to the Metropolitan Board of Works)	2505–2524	83
Gregory, Mr. C. H. (Member of the Institute of Civil Engineers)	2048–2116	65
Hale, Mr. W. (Smack Owner)	682–711	20
Hall, Mr. J. (Barge Owner and Lighterman)	3411–3452	100
Hallett, Mr. S. (Lighterman)	3453–3543	101
Harvey, Mr. H. (Smack Owner)	712–765	20
Hawkshaw, Mr. J. (Civil Engineer)	1754–1785	54
Hawksley, Mr. T. (Civil Engineer)	2117–2207	67
Haywood, Mr. W. (Surveyor to the Commissioners of Sewers for the City of London).	2429–2504	79
Hemans, Mr. G. W. (Civil Engineer)	2363–2428	76
Honey, Mr. J. (Shipbuilder)	603–681	18
Hope, Mr. W. (of the Metropolis Sewage and Essex Reclamation Company).	1003–1066	31
Horsley, Mr. W. (Sanitary Inspector of Barking)	267–322 801–812	9 23
Leach, Mr. S. W. (Engineer to Thames Conservancy Board)	813–955	23
McDougall, Mr. J. (Surveyor and Assistant to Metropolitan Board of Works).	1067–1418	33
Marchant, Mr. H. (Inhabitant of Barking and Smack Owner)	1–114 322*a*–323	3 10
Miller, Dr. W. A. (Fellow of the Royal Society and Professor of Chemistry at King's College).	2208–2273	71
Odling, Dr. W. (Fellow of the College of Physicians and Professor of Chemistry at the Royal Institution).	2274–2362	73
Pollard, Mr. J. (Clerk to Metropolitan Board of Works)	2026–2047	63
Powell, F. (Lighterman)	3317–3410	98
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Quash, Mr. J. (Inhabitant of Barking)	202–266	7
Templeman, J. (Ship Keeper)	766–800	22
Tobey, Mr. C. A. (Coastguard Chief Boatman)	2566–2814	84
Watts, Mr. H. (Lighterman)	569–602	17
Wise, Mr. A. (Surgeon and Physician)	2915–2922	91

MINUTES OF PROCEEDINGS

ON

INQUIRY UPON A MEMORIAL

FROM THE

VICAR AND OTHER INHABITANTS OF BARKING,

CALLING ATTENTION TO THE

POLLUTION OF THE RIVER THAMES

IN CONSEQUENCE OF THE

Discharge of Sewage through the Northern Main Outfall Sewer of the Metropolitan Board of Works;

BEFORE

ROBERT RAWLINSON, Esq., C.B., Civil Engineer.

FIRST DAY.

Town Hall, Barking, Monday, 21st June 1869.

In support of the Memorial *Mr. George Brady*, solicitor, of Barking, appeared.

Mr. Philbrick appeared on behalf of the Metropolitan Board of Works, instructed by Mr. Smith, solicitor to the board.

The following residents in Barking were present: Mr. Fitt, the Rev. Mr. Such, Mr. Stephens, Mr. Williams, Mr. Knowles, Mr. Horsey, Dr. Davidson, Dr. Parsons, Mr. Quash, Mr. Bissell, Mr. Wilding, Mr. Forge, Mr. Hogben, the Rev. Mr. Gilligan, Mr. Glennie, Mr. Crowe, and many others.

(*The Commissioner.*) I have received a note from the vicar, stating that he cannot attend to-day, but that he hopes to be able to attend to-morrow, if the inquiry is adjourned till that time.

Gentlemen, I appear here in pursuance of instructions received from the Home Office. This inquiry is in compliance with the prayer of a memorial, the allegations in which I will read because it will be for the parties who have presented this memorial to the Home Office, to favour me with such evidence as they may have in support of the allegations.

MEMORIAL.

To the Right Honourable Gathorne Hardy, M.P., Her Majesty's Principal Secretary of State for Home Affairs, a member of Her Majesty's Most Honourable Privy Council, &c., &c.

The memorial of the undersigned vicar, churchwardens, medical practitioners, smack owners, and other inhabitants and landowners of Barking, in the county of Essex.

Sheweth,

1. Your memorialists beg respectfully to call your attention to the present dangerous condition of the river Thames—dangerous alike to navigation and to the health of the inhabitants of the parish of Barking, and of all the populous and industrious towns below London, consequent upon the concentrated discharge of sewage through the main outfall sewers of the Metropolitan Board of Works.

2. On the 21st of November last, in his place in the House of Commons, the Right Honourable the Vice-President of the Board of Trade, in answer to a question by one of the members for the city of London, made the startling statement that owing to the continuous silting up of the river by the deposition of sewage mud from the outfall sewers of the metropolitan board, a bank has been formed in the channel of the river, on which one vessel has already been stranded. On inquiry at the office of the Thames Conservancy, your memorialists have been informed that the diminution of water in the channel of the river, consequent upon such deposition of sewage mud, is no less than from 21 feet to 10 feet at ebb tide, or a loss of 11 feet of water.

3. On the 21st of February 1867, in answer to a question put by one of the members for South Essex, you, sir (the Home Secretary), stated that the Thames Conservancy had already vainly applied to the Metropolitan Board of Works for redress of this nuisance, and that you had yourself failed in your endeavours to induce the metropolitan board to refer the matter to arbitration, or to take any other action, and that the only course now remaining, in your opinion, was to proceed by way of indictment.

4. Sir, in this opinion your memorialists very cordially agree, but the nuisance and danger are far in excess of anything implied in the statements made in the House of Commons before referred to. The filth and refuse of the largest city in the world is concentrated in all its horrors and abominations in the immediate vicinity of the dwellings of your memorialists, and they feel that while every town and village, and private house above London is forbidden to pollute the river in the interest of the great metropolis, yet that they and the inhabitants of all the populous towns below London are completely sacrificed to the comfort and convenience of the latter. There are banks within a few hundred yards of the houses of some of your memorialists composed of solid sewage, six, eight, and ten feet deep; and the backwater of nearly undiluted sewage sweeping up Barking Creek is so great that it must infallibly, beyond the possibility of doubt, breed a pestilence sooner or later. It is only a question of time. Foreshores which formerly were hard shingle are now pestilential mud; and what were formerly valuable fishing grounds are now spawning beds of fever and cholera. This is an injurious state of things which is against every principle of law and equity, and it is in violation of the provisions of the special Act of Parliament, 21 & 22 Vict. c. 104.

5. The terrible evils of the past and present have arisen chiefly from the discharge of the high and middle-level sewers of the northern area of the metropolis. Your memorialists, however, learn with dismay that the pumping-station at Abbey Mills, for raising the sewage of the third or low-level sewer, is now approaching completion, and that the intolerable nuisance now complained of will, ere long, be still further increased.

6. Very shortly after the opening of the northern outfall sewer the coastguard station, formerly at the mouth of

FIRST DAY.
21 June 1869.

Barking Creek, had to be removed to the other side of the river, the old site having become simply untenable.

7. In former days it was no uncommon thing for a vessel of 200 tons to 250 tons burden to be brought up the creek to the port of Barking; the port is now closed to all such vessels.

8. Formerly fish abounded in the tidal waters of the creek, especially flounders and shrimps; not one can now live either in the creek itself or in the river near the mouth of the creek, owing to the concentration of the sewage. This is a severe and cruel injury and damage to the poor of the parish.

9. Bathing has, of course, become impossible.

10. Formerly large ships could be moored within a short distance of the mouth of the creek, and lighters could approach them with ease; now they have to lie a long distance out, and lighters can only approach them by a circuitous, and therefore, expensive route.

11. It appears from a return to an Order of the Honourable the House of Commons, dated 26th November 1867, and moved for by Sir George Bowyer, M.P., supplying, among other things, copies of "Notices given by the conservators of the River Thames, under section 64 of the Act 29 & 30 Vict. c. 89. and the Act 30 & 31 Vict. c. 101," that the conservancy are carrying out with vigour and promptness the special powers thus conferred upon them, so that in the course of a few months not a drop of sewage will find its way into either the Thames or any of its tributaries above London, yet the nuisance to your memorialists will be worse than ever owing to the opening of the low-level sewer.

13. Your memorialists therefore humbly pray that you will take the subject of this memorial into consideration, and instruct Her Majesty's attorney general to apply to the High Court of Chancery for an injunction against the Metropolitan Board of Works, in terms of the 31st section of the Act 21 & 22 Vict. c. 104,* to restrain them from discharging the sewage of London into the River Thames, or to take such other proceedings as he may advise and the urgency of the case demands.

And your memorialists will ever pray, &c.

(Signed) H. F. Seymour, M.A., Vicar of Barking.
J. Manley, M.D., Westbury House.
H. V. Tayler, Surgeon, East Street.
(and 121 other Signatures.)

Notice having been given and published in this district (*see Appendix*, p. 106,) that I would hold this inquiry to-day, I think I may very reasonably call on the persons who have signed this memorial to bring such evidence before me as will enable me to report to the Home Secretary as to the truth (or otherwise) of these allegations. The first allegation is that the waterway, as I understand it, of the main channel of the Thames has been reduced 11 feet. Is there any person here capable of proving that allegation?

(*Mr. Brady.*) Sir, as representing the memorialists, will you allow me to ask this question. What is to be the scope and nature of the inquiry? Is it to ascertain the truth of each allegation of that petition?

The Commissioner in reply stated: Here is a paper-laid before Parliament (a printed memorial, the original of which I hold in my hand); I ask that there shall be evidence produced in support of the allegations in this memorial.

(*Mr. Brady.*) I think it desirable that there should be, and no doubt that evidence will be forthcoming, but I simply ask, what is the nature and scope of the inquiry to-day, and how is it proposed to be conducted?

(*The Commissioner.*) If you are prepared to tender evidence upon the allegations, I will take such evidence. If you tell me you have no evidence in support of this first allegation I must (for the present) pass it by. Have you any evidence to prove a loss of 11 feet of water in the main channel of the Thames?

(*Mr. Brady.*) In reply to that, I may state that I have been so very recently instructed that it has been impossible to get together the memorialists who have signed that memorial; and therefore the evidence which is required is not forthcoming on each allegation to-day. Probably I shall find it necessary to ask you to be good enough to adjourn this inquiry. In the meantime the memorialists will be called together, and a public meeting of the inhabitants of the place will be called, and persons will be asked to come forward and tender evidence on those allegations. I have no doubt whatever that we shall be able to supply you with evidence on each allegation.

(*The Commissioner.*) But at present you have no special evidence with respect to this loss of 11 feet of water?

(*Mr. Brady.*) At present I have no evidence to lay before you on that point.

(*The Commissioner.*) The next allegation is with regard to the correspondence with the Metropolitan Board of Works. I do not know that that wants any proof.

(*Mr. Marchant.*) I think that fact about the loss of the water was stated in the House of Commons by one of Her Majesty's ministers.

(*The Commissioner.*) That is surely not the sort of evidence I am to receive—that it is on remarks by one of Her Majesty's ministers.

(*Mr. Brady.*) No, we will put it in a different shape. We will not tender that as evidence.

(*The Commissioner.*) Then the third allegation states:—"On the 21st of February 1867, in answer "to a question put by one of the members for South "Essex, you, sir," (that is the Home Secretary) "stated that the Thames Conservancy had already "vainly applied to the Metropolitan Board of Works "for redress of this nuisance, and that you had "yourself failed in your endeavours to induce the "Metropolitan Board to refer the matter to arbitration, or to take any other action, and that the only "course now remaining in your opinion was to proceed by way of indictment."—That is so?

(*Mr. Brady.*) That is so.

(*The Commissioner.*) Then the fourth allegation is: "Sir, in this opinion your memorialists very cordially "agree, but the nuisance and danger are far in excess "of anything implied in the statements made in the "House of Commons before referred to. The filth "and refuse of the largest city in the world is concentrated in all its horrors and abominations in the "immediate vicinity of the dwellings of your memorialists."

(*Mr. Brady.*) I would suggest that that is a matter of public notoriety.

(*The Commissioner.*) "And they feel that while "every town and village and private house above "London is forbidden to pollute the river in the "interest of the great metropolis, yet that they (the "memorialists) and the inhabitants of all populous "towns below London are completely sacrificed to "the comfort and convenience of the latter. There "are banks within a few hundred yards of the houses "of some of your memorialists composed of solid "sewage, 6, 8, and 10 feet deep." Can you give me any evidence as to these banks of mud?

(*Mr. Brady.*) Yes, I propose to give you evidence as to that.

(*The Commissioner.*) "And the back water of "nearly undiluted sewage sweeping up Barking Creek "is so great that it must infallibly—beyond the possibility of doubt—breed a pestilence, sooner or "later. It is only a question of time. Foreshores "which were formerly hard shingle are now spawning beds of fever and cholera. This is an injurious "state of things which is against every principle "of law and equity." I also want some evidence as to this inflow of sewage up Barking Creek.

(*Mr. Brady.*) I would suggest, sir, that as this is the first meeting it should be merely a formal one. It is impossible at the first meeting, held simply pursuant to public notice circulated in the place, to get together a sufficient number of intelligent persons to give evidence upon every one of these allegations, because the allegations are scattered about in this memorial without order, and many of them are apparently repetitions.

(*The Commissioner.*) There are 124 signatures to this memorial, and one allegation is that "There are "banks of mud within a few hundred yards of the "houses of some of your memorialists." Are not there any of these memorialists here?

(*Mr. Brady.*) Yes, several of them.

(*The Commissioner.*) Who have those banks within a few hundred yards of their houses?

(*Mr. Brady.*) I have not the slightest doubt that I can give you evidence on the subject, but I think it would facilitate the inquiry if the questions upon which you require evidence were agreed on beforehand.

(*The Commissioner.*) You have the Memorial.

(*Mr. Brady.*) Yes, we have the Memorial, but the allegations are scattered about the Memorial in no particular form, my suggestion is, that you should adjourn the inquiry. It will save your time, and the time of the public, and the evidence we should obtain in the meantime will go more directly to the point, or we shall fail in proving the allegations.

(*The Commissioner.*) You must now tender such evidence as you can. There is the 7th allegation, "In "former days it was no uncommon thing for a vessel of "200 tons to 250 tons burthen to be brought up the "creek to the Port of Barking; the port is now closed "to all such vessels."

(*Mr. Brady.*) That, no doubt, I could prove at once.

(*The Commissioner.*) Are there any barge owners here?

(*Mr. Brady.*) Yes.

Mr. HENRY MARCHANT called; examined by Mr. BRADY.

1. How long have you resided in the town of Barking?—I have been in the town 50 years.

(*Mr. Philbrick to the Commissioner.*) Do you propose, sir, to take the evidence on oath, or not?

(*The Commissioner.*) I do not usually do so, but if you desire it I will take the evidence on oath.

(*Mr. Philbrick.*) I am here representing the Metropolitan Board of Works, and I do not wish to interfere, but to leave you to conduct the inquiry in any way you think proper.

(*The Commissioner.*) Then usually I do not take evidence at such inquiries on oath.

(*Mr. Brady.*) Your powers go to that.

(*The Commissioner.*) Yes. I could take evidence on oath if I thought proper; and if any person strongly desires me to tender the oath I will do so.

2. (*The Commissioner to the witness.*) In one of the allegations in this memorial it is stated that, "In former "days it was no uncommon thing for a vessel of 200 "tons to 250 tons burthen to be brought up the creek "to the port of Barking, the port is now closed to all "such vessels"?—That is, the entrance of the creek is worse than formerly.

3. Do no such vessels come up now?—I do not think so many large vessels come up as used to.

4. Do any come up?—I am not aware; I do not think they could; they could not with safety enter the mouth of the creek.

5. How long is it since you have known a vessel of 250 tons to come up to Barking quay?—I do not know that a vessel of 250 tons ever came up; there have been vessels of 100, 150, and 160 tons, but I do not know of any vessel that ever came up of 250 tons. There might have been.

6. Vessels of what tonnage come up now?—Of about 130 tons; but that is according to the tide.

7. Was it not always according to the tide?—Not so much as now.

8. You think not?—No.

Cross-examined by Mr. PHILBRICK.

9. Do you know a vessel called the "Abdiel" now lying up the creek just off the town?—I have not been down there.

10. How many tons is that vessel?—I do not know.

11. Is she 180 tons?—I have not seen the vessel.

12. Do you know that there is a large vessel at this moment lying just off the town?—I was asked the question whether I had known a vessel of 200 to 250 tons come up; there is a vast difference between 180 tons and 250 tons in the draught of water.

13. Perhaps the Government inspector would like to know from you what is the largest vessel you can say positively you ever knew to have come up to this port of Barking?—I do not know that these last six or seven years there has been any vessel over 150 tons to my knowledge.

14. What sized vessels have you seen before?—I have seen vessels in Barking creek 25 years ago, I should think of 300 tons, or probably 350 tons.

15. What were they?—Coal ships.

16. They were chiefly colliers?—I think I saw a vessel once bringing stone.

17. You have ever navigated vessels up the creek?—Yes, I have all my lifetime.

18. How lately?—This last year.

19. Vessels of 70 to 90 tons?—One vessel of nearly 100 tons, a sloop.

20. Within the last 12 months?—Yes.

21. (*The Commissioner.*) Is the creek ever dredged?—Only by the water of rain floods.

22. The town of Barking has no dredge boat?—No, I never knew there was a dredge boat.

23. You expend no money in keeping the channel open?—No.

(*The Commissioner to Mr. Brady.*) Is there a corporation in Barking?

(*Mr. Brady.*) Barking has not a corporation, nor even a local board of health.

(*Witness.*) It is a very difficult matter to take out a vessel of 9 or 10 feet draught; there is great danger in going out, and if I had a ship coming in or out I should not feel safe with 11 feet water without steam, the channel is so narrow—the "Horse End" has grown up 150 feet since I was a boy; but more these last five or six years.

24. (*Mr. Brady.*) In your opinion, has the navigation been impeded since the outfall of sewage at Barking Creek?—These last four or five years I should think it has grown up 100 feet; gentlemen who go out oftener than I do can say more about it than I can, but these last four or five years it has grown up 100 feet—that is between the creek and the sewer. There is mud, I have understood from several of the men that have been there, that has been caused by the sewer not in the mouth of the creek, because if it was filled up 11 feet it would be nearly dry, even at high water.

25. (*Mr. Brady.*) You, as a smack owner, know that the difficulties of navigation have been greatly increased during the last four or five years?—During the last four or five years it has become quite hazardous for a fleet of vessels to go out; it is not safe.

26. (*Mr. Philbrick.*) What this gentleman has said is with reference to the mouth of the creek rather than to the creek itself?—I know the water is now very filthy, and I believe it wants some alteration.

27. (*The Commissioner.*) Has there been any increase in house building above the town of Barking?—I do not think there has.

28. Have there been any additions made to manufactures of any kind above, in, or near Barking?—I think there is a small mill at Ilford, but I do not think that is any injury to Barking.

29. Is not there a large paperworks?—That is the mill I am speaking of.

30. It is a small mill, is it?—Yes.

(*The Commissioner.*) The next allegation states that "formerly fish abounded in the tidal waters of "the creek, especially flounders and shrimps, not one "can now live, either in the creek itself or in the "river near the mouth of the creek, owing to the

FIRST DAY.

Mr. H. Marchant.

21 June 1869.

"concentration of the sewage." Have you any evidence as to that?

(*Mr. Brady.*) It might facilitate the inquiry very much if I were to extract the allegations from the memorandum, number them and supply you with copies, and supply those representing the Metropolitan Board and the conservators with copies, and then supply you with evidence distinctly upon each allegation.

(*The Commissioner.*) What, to-day?

(*Mr. Brady.*) No, I must ask for an adjournment.

(*Witness.*) I only know I have been connected with the fish business all my life time, and I should think myself a madman if I brought a cargo of live fish up to Barking now.

(*Mr. Philbrick.*) Of course you would, because the whole trade has been altered?

(*Witness.*) Not a bit in live fish.

31. (*Mr. Philbrick.*) Do not they send the steamers round to the Nore to take fish from the smacks straight up to market?—That is dead fish caught in the net. I am speaking about fish caught with the hook—haddock and whiting.

32. Do you mean that they are not taken up to Billingsgate in the way I have described?—A small portion of them, but they are not of the quality for the West End, such as are taken in the steam boats.

33. Do they prefer them coming up slow?—No, they prefer the best fish, and the best fish are the live fish. When I was a boy we could bring a "well-cargo" of live fish from the North Sea up to Barking and let it lie there till low water; but now you can scarcely bring it up to Gravesend. This very day I have had live haddock from Grimsby. Why? Because the water in the Thames is so bad. We used to fill our stores of water at Barking Creek when I was a boy.

34. (*The Commissioner.*) You mean these vessels have live fish wells?—Yes. They go to the North Sea and catch live haddock and live cod.

35. You could formerly bring those vessels up to the quay at Barking, and you cannot do so now?—No.

36. Has it occurred to you to inquire at all whether the paper mill at Ilford sends down anything injurious?—The paper mill, I think, is just like an inkstand, like the emptying of this inkstand into the creek, as compared to the London sewage.

37. You do not think the paper mill refuse affects the water?—Not a bit. I do not know that it improves it, but what little injury it would do to the water we should not notice.

38. (*Mr. Philbrick.*) You mean the Ilford mill, the paper mill?—Yes.

39. You used to have roach and dace before that paper mill started, did you not?—I was not in that business.

40. At least you will be candid enough to answer my question. There used to be fresh water fish that came down the river?—Of course; there are a few eels now.

41. They live in the mud, but as to the swimming or floating fish, such as roach and dace, do you get them now?—I am not in that business.

42. You do not know?—I am not engaged there watching the men; I am engaged in other ways.

43. How long is it since you remember being able to bring live fish in the wells up the Thames?—Four or five years ago I had a vessel in the trade, and now we have been obliged to sell many of our vessels, because we cannot bring our live fish up to Barking as we used to do.

44. How long is it since you could get a vessel of that construction with a well of live fish up the river Thames?—I daresay four or five years ago.

45. Have you had one so lately as that?—Me and my brother have had them later than that.

46. With fish alive?—Yes, with fish alive.

47. Where did you take them to then?—We take them now to Lowestoft and Grimsby.

48. Where did you take them to then?—From Barking to Billingsgate.

49. Do you remember the year when there was a complaint about the Thames being so foul, the year 1859?—Yes, I saw it several times myself about London Bridge.

50. Do you mean that in that year you could take up the fish alive in the wells?—Much better than we can now. The hot weather makes a great deal of alteration in the water; in a cold summer like this five or six years ago you could bring live fish up to Greenwich.

51. According to your view of the matter the Thames is not at all purer above Barking than it was?—Yes, it is, above bridge. Sometimes I go up and have a look at the water; there is a difference between up the river and opposite Barking.

52. When you get past Barking you think it is safe, and that fish can live there?—I do not think we should bring them up to chance it past Barking.

53. (*The Commissioner.*) Do you know if there are any fish in the river between Barking and Ilford?—I do not.

54. (*Mr. Philbrick.*) There never was fishing in the Barking Creek?—Only by small boats, peter boats, not large vessels. I saw peter boats there when I was a boy, and since I have been a man, but they were river fishermen.

55. What did they fish for, I mean between the town and the Horse end, or mouth of Barking Creek?—I suppose what the net would produce, a little roach, a little flounder, and little eels.

56. No fish of great importance?—I do not know that it was of importance. I was not in that business, so I cannot give you an answer.

57. (*The Commissioner.*) Do you know anything about the 10th allegation which is this: "Formerly "large ships could be moored within a short distance "of the mouth of the creek, and lighters could ap-"proach them with ease; now they have to lie a long "distance out, and lighters can only approach them "by a circuitous, and therefore expensive route?"—I cannot say much about that; I am not so much out in the creek as I used to be.

58. That is the river Thames?—That is the river Thames. I am only speaking about the mouth of our creek, and the water of the creek.

59. (*Mr. Philbrick.*) You have lived in Barking all your life, have you not?—Yes.

60. Were you one of the gentlemen who proposed to introduce the Local Government Act in Barking, and to have a board of health?—No.

61. Did you oppose it?—No.

62. You took no part in that matter?—No.

63. There is no drainage at Barking except for surface water; it is all cesspools, is it not?—I do not know; the main drain in Barking cost from 1,500*l.* to 1,600*l.* about 20 years ago.

64. There are no sewers in Barking, are there?—Yes, there are, and they empty into Barking Creek.

65. You take your sewage into Barking Creek?—Yes, but ours is only a nutshell full.

66. The town of Barking does drain into Barking Creek?—What little comes from it will not hurt the fish.

67. Never mind that, you are too clever for me a great deal. You drain into Barking Creek?—Yes.

68. You are aware that there was a proposal to have a local board of health?—Yes.

69. You took no part in that, either for it or against it?—No, neither for it nor against it.

(*Mr. Brady.*) Is it necessary that we should go into these questions about a proposed local board of health?

(*The Commissioner.*) Yes, I think so.

70. (*Mr. Philbrick.*) You have no local authority in Barking?—No.

(*The Commissioner to Mr. Brady.*) I think it is necessary on this ground, that persons who make allegations as to impurities brought from other places which affect health really ought to show that they have done all they can to free themselves from their own local nuisances. I cannot therefore say that this evidence is not necessary.

(*Mr. Philbrick.*) Looking at some of the allegations contained in this memorial, and this respectable gentleman telling me that he has been here for many years, I was rather anxious to hear from him what had taken place in this town.

71. (*The Commissioner.*) Is there much manure brought down through Barking by cart, by rail, or by boat; I mean solid manure from London?—I do not know how much; I am not in that business.

72. As a resident in Barking do you ever see barges, carts, or waggons with manure?—I see a little now and then, but to tell you the weight I could not.

(*Mr. Philbrick.*) There was a barge at the quay this morning with some very offensive London muck in it which stunk very much.

73. (*The Commissioner.*) Do you ever see loads of manure standing till it drips and forms pools of filth on the ground?—I have seen that.

74. That may cause a nuisance and cause a smell?—I think that is of very little consequence. I do not think it is worth mentioning.

75. (*The Commissioner.*) Is Barking a parish or a township, or both?—Both.

76. Do you know its area?—No, I do not.

(*Mr. Brady.*) Barking is a very large parish, and contains several townships; it contains several wards: there is Ripple ward, Town ward, Ilford ward, and Chadwell ward; the parish extends to Hainault Forest on the north and the Thames on the south.

77. (*The Commissioner.*) What is the population of Barking?—Just now there is an increase; by the last census it was nearly 6,000.

78. Is that what you call the town proper or the parish?—Not the parish, only the town with the small village of Ripple, and a few houses that may be at the creek's mouth; it does not touch Ilford.

79. What would that population be?—Between 5,000 and 6,000.

80. That was in 1861?—Yes.

81. What is it now do you say?—It may be just now increasing, but we have been decreasing for the last three or four years. Just now owing to the public works that are going on there is an increase.

82. (*Mr. Brady.*) A temporary increase?—Yes; by the persons employed on the works.

83. (*The Commissioner.*) What is the trade of Barking?—It has no particular trade, but it depends on the fishery, but the fishing trade has all left.

84. The fishery has been destroyed?—Yes.

85. Are the inhabitants engaged in agriculture or in seafaring pursuits?—Principally in agriculture.

86. What manufactories have you in the neigbourhood which employ labour?—We have two large factories at creek's mouth.

87. What are they?—I can hardly tell you. There is a jute manufactory near Barking town, that is an extra one; there are two manure works at creek's mouth.

88. (*Mr. Brady.*) There is a malting house, is there not?—Yes, and there is the jute factory.

89. (*The Commissioner.*) Is not the establishment at the mouth of the creek Mr. Lawes' artificial manure works?—Yes, that is at the corner of the creek.

90. Does that form part of Barking town?—Yes.

91. And its population would be numbered in your returns?—It would.

92. Is Barking sewered?—Yes.

93. Sewered into the creek?—Yes.

94. Has it a water supply?—No, it has not.

95. Where do the inhabitants get their water?—From a well on the town quay.

96. Do they carry it from that well?—Yes, and there are several water-carts.

97. Is that the whole supply?—There are private pumps; we are tolerably well supplied with pumps.

98. Do you know what depth they have to sink before they get water?—Not very deep, the deepest well we have is something about 70 feet; I am not quite certain.

(*Mr. Marchant.*) 170 feet.

(*The Commissioner.*) Do they get into chalk or gravel?

(*Mr. Marchant.*) It has supplied the town for 50 years.

(*The Commissioner.*) You mean the present supply of pumps and wells?

(*Mr. Marchant.*) Yes.

(*The Commissioner.*) You go through blue clay, and get into gravel, do you?

(*Mr. Marchant.*) I do not know about the soil it goes through; I know it is very good water.

(*Mr. Horsley.*) The water is very good and I will show you a sample of it.

99. (*The Commissioner to the witness.*) What fishing was it that Barking depended on formerly, was it local fishing?—The North Sea fishery.

100. Has that been interfered with?—No; only the vessels have left the town. They fish in the same locality, but they take their fish to Yarmouth.

101. The railways have given them a better communication I suppose?—Yes.

102. Do you think they go there for railway accommodation, or do they go because of the poisonous quality of the water here?—I have heard that on several occasions there used to be a number of vessels lying at creek's mouth, sometimes 20. I am told now by the men that they cannot lie there because the stench of the river is so great. I think I can say 20 or 30 vessels have been lying there; instead of coming up to Barking town they would all lie at creek's mouth; perhaps, they would lie there two or three days. I think I can say 20 or 30.

103. (*The Commissioner.*) One of these allegations states that there are large banks of mud near to the residences of some of the memorialists. Do you know anything of those banks of mud?—No, I do not; I seldom go to the creek's mouth.

104. (*Mr. Philbrick.*) That means nearer the town than creek's mouth?—There are houses at creek's mouth.

105. (*The Commissioner.*) The allegation says, "there are banks within a few hundred yards of the "houses of some of your memorialists composed of "solid sewage, six, eight, and 10 feet deep." Are you aware whether the back water or inflowing tide brings sewage from the Thames right up to Barking Quay?—I hear it spoken of by people living at the lower end of the town that the stench is abominable at high water.

106. It would only come at high water?—When the water was coming in, it would last some hours.

107. You did not tell me what you think the population of Barking is now?—I should say between 6,000 and 7,000.

108. Do you know what is the rateable value of the township?—I do not.

(*Mr. Brady.*) I will give you evidence on that point.

109. (*The Commissioner.*) How is the town governed?—We have no local authority.

110. You have a town-hall, but no corporation?—Yes.

111. Have you a surveyor of highways?—Yes.

112. You are governed under the parish authority then?—Yes.

113. There is a vestry?—Yes.

114. There is a rate levied to maintain the highways, and a surveyor chosen?—Yes.

(*Mr. Brady.*) The surveyor is appointed at the vestry, and he has the power of making his own rate.

Dr. Davidson.

(*Dr. Davidson.*) You asked a question of one of the witnesses as to whether fish were now seen in the back river. They are, I have seen them myself, roach and dace, not more than a week ago.

115. (*The Commissioner to the witness.*) Do you think the chemicals of the paper mill have any effect upon the creek above the millhead?—Upon the fish they have.

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Dr. Davidson.

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116. Have you ever visited that paper mill?—I have not been over the works, but I have rowed up the creek very frequently to where they let the stuff out.

117. Do you know how long they have been using Esparto grass for paper making?—Not more than two years, about two years I should think.

118. Do you know the process of the manufacture of paper from Esparto grass?—No, my impression is that until within the last 18 months or two years it was made from straw, and bleached by chloride of lime.

119. Do you know what they use for bleaching Esparto?—No, I do not.

120. Or what amount of chemicals remain in the waste?—No, I know nothing about that.

121. (*Mr. Brady.*) You know Barking Creek?—Yes.

122. You frequently go down there?—Yes, I have frequently gone down during the last 15 or 16 years. Some years ago it used to be a very pleasant row, but now it is something intolerable. I attended the men of the coastguard station at creek's mouth, and they complained so that they got the Government to remove their vessel to the other side of the river Thames.

123. In consequence of stench from the sewage?—Yes. I know that in rowing to their vessel on the opposite side of the river there is a distinct line on the water while the sewage is pouring out where it does not mix with the other water, and I was very sick indeed while I was rowing over it, so that I would not go out to the vessel any more.

124. (*The Commissioner.*) Are you affected at all by the Crossness outfall?—I cannot say anything as to that.

125. It is the metropolitan Barking outfall you are speaking of?—Yes.

126. (*Mr. Philbrick.*) When you saw the line of sewage as you call it, that was after high water, was it when the discharge was taking place from the penstocks?—It was straight across the river.

127. Was it at the time when the discharge was going, when the sewage was being poured into the river?—I do not know what time it was. I do not know when they let it run in; it was nearly high tide I think.

128. It is let in as a matter of fact after the tide has just turned. I do not know whether you can tell us when you rowed to this vessel whether the tide had turned or not?—No, I cannot.

129. (*The Commissioner.*) Do you know about the date when you felt these injurious effects yourself?—Six months ago.

130. About mid-winter that would be?—About eight months ago.

131. Last autumn?—About November (1868) I think it was.

132. (*Mr. Brady.*) Do you know as a fact that the coastguard station was removed in consequence of the health of the men being affected?—Yes, they were complaining.

133. (*The Commissioner.*) Do you know if there had been any heavy rain at any time previous to your perceiving the smell from the sewer?—I cannot tell; I only remember the fact as stated.

134. That particular day?—Yes.

135. I assume by your noticing it that it was worse than it had been on any other occasion?—I spoke to the men who were rowing me out, and they said it was always the case.

136. It did not affect them, I presume, and make them sick?—No; they have strong stomachs.

Edward Pyner.

EDWARD PYNER called; examined by Mr. BRADY.

137. You know Barking Creek?—Yes.

138. Have you known it a great many years?—All my lifetime.

139. Is it in the same state now that it was when you first knew it?—No, not by a long, long way.

140. (*The Commissioner.*) What age are you?—I am 55.

141. Then you have known it for a good share of 40 years?—Yes; I have known it over 50 years.

142. You remember it distinctly from that time?—Yes.

143. You cannot remember much of it at five years of age?—Oh yes I can; there is no mistake about it.

144. (*Mr. Brady.*) Do you remember when the sewage began to be first let out in the creek?—I do.

145. Is the water in the same state now that it was then?—No, not by a long way, because we could always fill our store vessels with water at the creek's mouth, and we used to drink that water before that.

146. You used to drink the water before that?—Yes. We used to go to sea with it and boil our victuals in it, and drink the water; now you cannot look at it hardly.

147. Do you see a good deal of dirt and sewage in it now?—I do, and when one of our vessel's anchors is brought up filthy slush comes up on the deck, which is brought up with the chains.

148. The chains come up covered with slush?—Yes.

149. Which smells very bad?—It does.

Cross-examined by Mr. PHILBRICK.

150. When was this foul anchor pulled up?—When we were going to get our vessel out of the way.

151. Where was it?—At the creek's mouth.

152. You have been up and down the creek a good many times?—Some thousands of times in smacks.

153. Before the London sewage began to be put into the river did you notice any alteration in the river in getting up creek's mouth?—Yes, a great deal.

154. Before the sewage?—No. Let us hear your question over again.

155. Be kind enough, instead of relying on your memory of what you saw when you were five years old, to try and listen to the question. I will put a plain one to you if you will give me a distinct answer. Before the London sewage began to be put into the river Thames, did you find that the mouth of the creek was always the same?—No, certainly not.

156. What was the sort of alteration you noticed?—At low-water time we cannot now get a smack's boat out of the creek; we could get a barge out at low water then.

157. I am afraid you are not attending to my question?—I know it is a fact.

158. Do you mean before the London sewage began to be let into the river Thames?—Yes, we could take a barge out of the creek at low water, but we cannot take a smack's boat out now.

159. You either do not or will not attend to me. Put the sewage altogether out of the question, before ever any sewage began to come there was the creek's mouth always in the same state for the purpose of navigation?—As it is now?

160. No, leave the sewage out, leave the present time out, did the creek's mouth ever change before the sewage came there?—Never in the world.

161. Do you mean to say that the shoal did not change its place?—No, only when people came and took it away.

162. Who took it away?—You know if you ask me a question I have a right to resolve it to you.

163. I am asking you the question, Who took the shoal away?—The gentlemen what come down in the lighters.

164. Do you mean the dredgers?—Yes, those things what go over with scoops into barges.

165. Do you mean to tell the Government inspector that you do not know that that is called a dredge?—No, certainly not; I call them scoops.

166. You do not know that that thing is called a dredger?—A dredger is what a man goes and dredges after coals with. I know what a dredger is.

167. You do not know that that thing is called a dredger?—No, certainly not.

168. You say you used to fill your water-vessels, and drink the water at the mouth of the creek?—Yes; we used to cook all our victuals in it at sea after having the water aboard for eight or nine weeks.

169. You took the water from the Thames at the mouth of the creek?—Yes, before this sewage came there.

170. You know that all the sewage of London was in that water then?—I do not know about that; we could dip our buckets at low water and fill our buckets with it, and that would be as clear as what is in that bottle now (*referring to a sample produced by Horsley*).

171. You do not remember the Thames being foul before the sewage was brought down?—I do not know anything about the Thames, I only know about Barking Creek; I am not supposed to know about the Thames. Anything you ask me I will tell you what I can, and I will tell you no stories, for I have come here to tell you the truth, and I am doing so.

172. (*The Commissioner.*) Will you listen to this. In this paper which has been printed there are some statements made by some Barking gentlemen, who say that "there are banks within a few hundred yards of "the houses of some of your memorialists composed "of solid sewage, six, eight, and 10 feet deep." Do you know any place in Barking Creek where there is sewage of that depth?—I can assure you that there is a great deal outside the Horse End.

173. That is not in Barking Creek?—It is the entrance.

174. This allegation says that "there is sewage 6, 8, and 10 feet deep?—It is not there.

175. Where is it?—I do not know where it is 10 feet deep.

176. You do not know of any such deposit?—No, but I know there is a great deal of filth there; too much for health. I have had it in my hands when I have been hauling the ropes, when we have been pulling up our anchor.

177. You do not know of any 10 feet depth of sewage?—No, I do not; and I shall not say if I don't. If I did know it I should very soon say so, but there is a great deal out there that ought not to be there.

178. You know nothing of that 10 feet?—No, nor nobody else don't, and that is more.

179. It is also stated in allegation No. 2, "that "there are 11 feet of water less in the Thames;" do you think that is true?—I do not know about the Thames; I am speaking about the mouth of the creek.

180. Do you think there is a bar—that the Thames is blocked by a bar, and that there is 11 feet less water?—There is no bar there; there are two folds of mud on both sides that stop a boat going out of the creek at low water.

(*Mr. Brady.*) He said that formerly, before the sewage was taken there, a barge could get out at low water, whereas now a barge's boat only can get out.

(*Witness.*) That is right.

181. (*The Commissioner.*) Do you think that five years ago a barge could go out of the creek at low water?—Five years ago I dare say she might, but she cannot now, and she could not two years ago.

182. I suppose these conservators of the Thames ought to know all about it?—I do not know anything about their business. I know nothing at all about them, I am sure. I only tell you what I have seen them doing. I have seen them towing up and down measuring the shore this last summer.

183. Do you know anything at all about this irrigation by sewage?—No, I do not.

184. Do you know anything about the state of things at the time when they let the London sewage out into the Thames; have you ever been down there then?—No; I was only down there once in my life; this side I have been down thousands of times.

185. Is there any bad smell comes from those manufactories on the banks of the creek or the Thames?—No, that manufactory at creek's mouth is a very good manufactory; there are lots of cattle about there, and they get as fat as moles.

186. On the grass?—Yes, if it was bad they would very soon die.

187. Near the patent manure-making works?—That is the place I am talking about.

188. The cattle get fat there?—They get as fat as moles, and right in the very marsh, where this is built. If you go and turn in a skinny beast in less than six weeks you can go and have it poleaxed.

189. Did they ever catch whitebait off the mouth of the creek?—Yes they did a good many years back, but not lately.

190. They do not catch any now?—No.

191. (*Mr. Philbrick.*) You are sure of that?—Yes, quite sure.

192. There was some caught last week?—Not at the mouth of the creek.

193. Very near it?—Yes, it might be a score of miles off.

194. You do not call a score of miles very near?—Oh yes, you do. I have been in this very Barking Creek and catched bushels and bushels of fish in a net, but now you cannot go and get one.

195. (*The Commissioner.*) Did you ever lie in a vessel alongside your own quay here?—Yes, plenty of times.

196. Did the sewage of the town of Barking ever annoy you when there have been heavy rains?—No.

197. It never stank?—Only the dung they bring up in barges, that is a complete nuisance.

198. That is landed there?—Yes.

199. Is that a nuisance?—Of course it is, not to me, because I do not live there, but it is to other people.

200. Is there much dung brought up?—Not much.

201. Is there any conveyed by railway?—Yes, a good deal, it lies at times on the quay.

(*A voice.*) It does not lie on the quay at all.

Mr. JOHN QUASH called.

Mr. J. Quash

202. (*The Commissioner.*) Are you a resident in Barking?—Yes.

203. Of what business are you?—I am a smack-owner.

204. Did you sign the memorial of which I hold a copy in my hand?—No.

205. Did you hear me read it?—Yes.

206. Do you know at all whether the main channel of the Thames has been affected to the extent of 11 feet?—I could not say that.

207. Do you know whether there are banks of sewage 8 or 10 feet deep near the houses of any of the memorialists?—I never saw any.

208. Do you know as to the tonnage of vessels that formerly came up, and that now come up to Barking?—I know there were very large vessels that came up, but as to the amount of tonnage or the burthen I cannot speak to.

209. The memorial says that "in former days it "was no uncommon thing for a vessel of 200 tons to "250 tons burthen to be brought up the creek to the "port of Barking; the port is now closed to all such "vessels?"—I should say I have seen a vessel of 200 tons there myself.

210. How many years ago?—I should think the "Mother Goose" was 200 tons which used to trade for Mr. Burrell.

211. How many years ago?—14 perhaps.

212. Would she come up with her full load or full cargo then?—Yes.

213. Do you think you could get a ship of 200 tons up now?—I know I have a vessel of 11 feet draught

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Mr. J. Quash.

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myself, I find a difficulty now more than I did two or three years ago.

214. Is the difficulty at the entrance or all the way up the creek?—Principally at the entrance.

215. You have a bar at the entrance?—Yes, so much so that there is very little water there. I can remember when I went to sea myself we used to take our water from the Thames and go a voyage of eight or 10 weeks with it.

216. For drinking? — Yes. I heard a question asked whether the water at the creek's mouth was impure from the sewage of London before the northern outfall came, possibly it might be; but I do not think it reached so far as the creeks' mouth at that time.

217. It would be diluted?—I can remember about 12 or 14 years ago Mr. Sennaway who used to survey the river used to go with the drift to ascertain how far the ebb ran, and whether the flood would bring it back further than the ebb carried it out to. He was at that work 12 months, but I think the trial was a failure.

218. (*Mr. Brady.*) You mean that it did not come back on the ebb?—Yes, it was brought back, and at times it was carried higher up than it went down.

219. It came further up on rising tides?—It came up further than it went down, the flood on spring tides would float it up further than the ebb would carry it down.

220. Has this change in the state of the water in the creek occurred since the London northern outfall sewer was opened?—The water is much more impure, no question about it.

221. (*Mr. Philbrick.*) Will you give the Commissioner your view as to the obstruction rather than the quality of the water. Have you tried or are you aware of any gentleman in Barking who has tried to bring up a 200 ton ship within the last four or five years?—No.

222. I suppose as a matter of fact the mode of conducting the trade has changed rather, has it not, since the introduction of steam?—No, it has not in the coal trade.

223. Not in the mode of conducting the fishing trade?—Not in respect of large vessels.

224. Is the coal trade still carried on as it used to be?—I think it is carried on more largely now. I do not know about the size of the ships that bring coals into the town of Barking.

225. We know that the coal trade of the port of London has changed very much within the last 10 years, since the introduction of steam colliers and so forth. The coal trade at Barking is carried on much in the same way as it used to be, but you think there is more of it?—It is more in extent, but it comes by smaller vessels. I saw one not more than three weeks back that came there and had to have five barge loads of coal taken out of her before she could be brought to the quay.

226. In Barking?—Yes.

227. How far had she got up?—Some little way within the creek.

228. Do you know of any accumulation in Barking Creek itself?—There is not as much water in that part of the creek as there formerly used to be.

229. The millowners pen it back, do not they; you have the river penned back here from above?—Not more so than it was 20 or 30 years ago.

230. Not more since the paper mills were established?—No, they always had a dam there to work the mill by.

231. This, I think, is called the river Roding?—I think it is the Roding right throughout.

232. Which comes from the upper part of the county of Essex?—Yes.

233. It is rather a sharp river, is it not; that is, it runs rather sharply, does it not?—There are some sharp turns in it.

234. The water in the creek is not penned back by a high tide?—It is always penned back every tide.

235. When the tide is going down fast, when the water is going out of the creek fast, there is a good deal of scour, is there not?—Yes.

236. I mean supposing a little man like me tried to scull up the river in a boat when the tide was going down fast, he would find considerable difficulty in it, would he not?—No; I think the wind would have more power than the tide.

237. If both the wind and the tide were against me I should not manage it, should I?—Probably not.

238. Supposing I had only the tide against me, should I be able to get along then?—Yes, certainly.

239. You have tried the experiment?—I would find a little boy eight or nine years old who would do it.

240. Do you know the "Abdiel"?—No, I have not been towards the town quay for three weeks back.

241. What is the average size of the colliers which supply this town, which come up here?—I could not say.

242. 120 tons?—That would be a large size.

243. (*The Commissioner.*) Do you know anything of the character of the water above the dam; that is above the town?—No.

244. Do you know whether the water is affected by the paper works?—No; I have seen the impurities of the Thames working in the creek on the flowing of the tide.

245. To what height have you traced the floating impurities?—I am speaking of floating on the surface.

246. How far up; as far as the town?—As far as King's bridge.

247. Do the barge-owners or others connected with the trade of Barking take any means to deepen the creek artificially?—I think not.

248. Have they ever done so?—No, not to my knowledge.

249. Do the river Thames conservators dredge the creek that you are aware of?—Not to my knowledge.

250. Or at the mouth of the creek?—No; they might outside the mouth of the creek. I have seen them outside many times.

251. In the river Thames?—In the river itself.

252. But not in the creek?—No, not in the creek.

253. Nor have you seen them attempting to remove the bar that you speak of opposite the mouth of the creek?—No; they have not done so to my knowledge.

254. Do parties throw in solids at any part of the creek, either below Barking or above it that you are aware of. Is there any authority that would prevent them throwing solids in?—Not that I know of.

255. Supposing a person building on the banks of the creek wanted to get rid of his waste materials, is there anything to prevent him throwing them into the creek?—I never knew of such a thing being done.

256. Is the creek much affected by land floods?—Not that I am aware of; in very heavy rain there is a strong current runs down.

257. At low water would that have any effect in deepening the channel?—No, I think it is too well set for that.

258. Have you ever noticed what class of material is thrown out of the mouths of the London sewers?—No, I have never been up, only I have seen it hanging about the mouth of the creek, and coming in on the flood, and there is a very great stench from it.

259. That is material floating on the surface?—Yes.

260. That would not be material which you would say would form a bar?—Certainly not.

261. The material which would form a bar would be of a sandy or solid character; gravelly or sandy?—Or some material that would collect to form a bar.

262. And remain ?—Yes; I cannot say anything about that ; I have not been much out there to prove these facts.

263. Do you know anything of the manure that comes in in barges being a nuisance ?—No.

264. Do you know anything of these banks of mud of 10 or 12 feet in depth that have been spoken of ?—I do not know anything of them.

265. (*Mr. Philbrick.*) Is there a shipping office or registry in this town ?—No.

266. Where do they register them ?—At the port of London.

Mr. William Horsley called ; examined by the Commissioner.

267. Are you a resident in Barking ?—Yes ; I am 73 years old.

268. Have you resided here all your life ?—Yes.

269. Do you hold any office in Barking ?—Yes, I am sanitary inspector.

270. Under the highway board ?—Under the board of guardians.

271. They are the highway authority ?—Yes.

272. Do you do anything else besides inspect ?—I do a little at my business, but very little, because I cannot get it to do.

273. What do they pay you for your sanitary inspection ?—20*l.* a year.

274. How frequently do you report to the vestry ?—Sometimes once a week, sometimes once a fortnight, sometimes once in three weeks, according as I can get the work done.

275. What number of men have you working under you ?—I give notice to the landlords or their agents, that such and such privies are full, such and such cesspools are full, or such and such drainage is stopped, and then they get it done.

276. You have no men—scavengers—of your own ?—I have no men of my own under me.

277. If the tenants do not do the work what happens then ?—Then I have to summon them before the magistrate.

278. The magistrate can fine them ?—Yes, and he can make them clean them out afterwards.

279. Where do the contents of the drains go to ?—The drainage of the cesspools is from the houses.

280. Do your drains end in your own creek ?—In the main sewer.

281. And the main sewer ends where ?—At the town quay in the creek.

282. Does the sewer carry out any sediment that deposits there ?—No, not more than it always did. It does a little ; when there has been much rain then it washes all away what there is.

283. Whatever is in the sewer it washes out into the creek ?—Yes, but it is very seldom that it is choked.

284. Do you know any bank of mud 8 or 10 feet deep in any part of the creek, that is, sewage mud ?—No ; I do not travel much up and down the creek.

285. You do not know of any such bank ?—There may be, but I have never heard of it. I know there is a great deal of filth comes up from the London main sewer.

286. Floating up ?—Yes ; I have seen it floating up.

287. How high have you seen it come ?—It floats up with the tide, and then the eddy sends it in to the little nooks against the quay. Sometimes it goes up to Ilford when the mill gates are open. It has gone up as far as Ilford ; Mr. Shearman, the inspector, has seen it there.

288. How many miles is Ilford up ?—Not more than a couple of miles by water.

(*Mr. Philbrick.*) I am afraid I must have Mr. Shearman here to identify this sewage. You cannot speak to it yourself ?

(*Witness.*) Where else can it come from ?

289. (*Mr. Philbrick.*) From some of you Barking people perhaps ?—On no, it is clear it is not the town people ; I have known the town all my lifetime ; we are pretty clean here, cleaner than you may expect.

290. (*The Commissioner.*) With regard to this manure that we have heard spoken of being landed at the quay, do you ever report that ?—No, because I know it is taken away directly ; it is thrown out of the barges into carts, and taken away directly, and the quay swept.

291. Who by ?—We have a man to look after the quay.

292. Who is it swept by ?—By the men who take the dung away ; by the men who have to load the carts by the order of their master.

293. How many tons do you think will be brought in the course of a week ?—I cannot say ; sometimes more and sometimes less. When they cannot sell it here it goes to Rainham, and they sell it there.

294. Have you had anything to do with the sewage farm that is near here ?—I was there last summer. I was sent for to go where they run this sewage in these troughs. It ran into Mr. Mead's fishpond and killed all his gold fish, and into the water where his horses drink. I told him to stop all the barrel drains under his gateway and let them keep it on their own side.

295. Did he do so ?—He did so.

296. Have you had any complaint of the sewage farm in the town ?—I have not heard since that there have been any more complaints.

297. Have you heard any complaint in the town itself when the wind has been blowing from any particular quarter of a bad smell in the town ?—We have smelt it in the night sometimes, when the wind has been blowing in a particular direction.

298. When was that ?—In many evenings of last summer at the time of the hot weather. The people could not tell where the smell came from, but I smelt it as I was going to Mr. Mead's. I knew the smell directly.

299. Which way was the wind blowing ?—The wind was blowing a little from the south-east ; that blows it into the town, east and south-east.

300. (*Mr. Philbrick.*) Do you know that there is a piece of land which is irrigated with the sewage just by the corner near the pen stocks, where the large sewage reservoir is ; do you know that there is a large piece of ground there which is cultivated and irrigated by the London sewage ?—Do you mean where the outfall of the sewer is ?

301. Yes, where the outfall is ?—I do not know anything about the Thames ; that is out of my district. That is over East Ham way.

302. Perhaps you can tell us this, whether you know that there is a penstock and an open ditch, the sewage of which discharges there into Barking Creek ?—I do not know anything about that.

303. Perhaps you can tell us this, at all events, which would be within your jurisdiction. Does all the sewage of Barking discharge itself into Barking Creek ?—There is no great "all" to discharge into the creek ; not so much as there is at the Thames.

304. Do not run away from me ; I want you to answer my questions ?—There is no more sewage now than there was years ago.

305. I did not ask you that ?—Any question you ask me I will answer if I can.

306. I am quite sure you will do that. The question I am asking you is, does all the sewage of Barking discharge into Barking Creek ?—Yes ; where else can it go to ?

(*Several voices.*) No.

(*Witness.*) It may or it may not ; part runs up the other way.

(*Mr. Brady.*) He does not understand the question.

307. (*Mr. Philbrick.*) What I want to know is this, is there any system of cesspools still in the town ?—Yes, there is.

308. Are there many of those ; are most of the houses drained ?—I should say there are a great many ; there are a great many which run into the sewer.

309. As you are the sanitary inspector, do you report these cesspools when they get offensive ?—

FIRST DAY.

Mr. W. Horsley.

21 June 1869.

Certainly; when they get full I send them a notice to have them emptied, and allow a certain time to empty them.

310. Where is it taken to, is it taken out and put upon the land?—It is taken out, put upon the land, and ploughed in.

311. As to the drains which go into the Barking Creek, do I understand that some of these drains have been cleaned out since you have been inspector of nuisances?—Some of the drainage up Bull Street was cleaned out two or three years ago.

312. Was that on account of the choking with sewage?—It was on account of the sand that had washed off the roads down the gratings; the surveyor had the drains opened and cleaned out.

313. Except that, has the sewerage of the town of Barking ever been cleaned out or flushed artificially since you have been sanitary inspector?—Not the main sewer. It clears itself, it has a good outfall.

314. It has fall enough to clear itself entirely, has it?—It is a 16 or 18 inch barrel drain in the clear.

315. Have you seen Mr. Hope's farm where they put the sewage on the land?—Yes.

316. How far is that, is it two miles from Barking?—Yes, better than that.

317. 2¼ miles?—Yes.

318. Between two and three miles?—Yes, but we can go across some fields and make a short cut of it.

319. I suppose then it is about a mile and a half as the crow flies?—A little more than that.

320. Then we will call it a couple of miles. When the wind sets in that quarter have you ever smelt anything?—That I have, and not only myself, but I may say scores of persons along the road where I live have smelt it, but could not make out where it came from. I have said, "See how the wind is, and that "will tell you where it is coming from."

321. The wind was blowing then from the direction of Mr. Hope's farm?—Yes, it was, and it blew right into the town.

322. I do not know whether you make reports in writing to the board?—Yes, I do, I do not make them by word of mouth, that would not do. If you like I will go and fetch my report book, notice book, and so on; nobody can do it cleaner than I have done it.

(*Mr. Philbrick.*) I have not the least doubt of that. If you will be kind enough to let us see the book we shall be extremely obliged to you.

(*Witness.*) It is in my office; I have got to fill it up, and I allow so many days before I summon them.

(*Mr. Philbrick.*) If you will be kind enough to let me see your book I shall be obliged to you.

(*Witness.*) The reports are always taken to the board. I can show you my notice-book.

(*Mr. Philbrick.*) Perhaps you will allow the Commissioner to see it when we meet again.

322*a*. (*The Commissioner.*) Is there any gentleman present who wishes to make any statement upon any point connected with this inquiry.

(*Mr. Marchant.*) I have smelt the southern outfall a great many times, having lived in Barking ever since the sewage was about; but I have never smelt the farm. The wind from the south-east would not blow that smell into Barking.

322*b*. (*The Commissioner.*) It would be a question whether the stench came from the farm or from the southern outfall.

(*Mr. Marchant.*) Yes, the southern outfall lies about south-east of Barking, the farm lying east of Barking, so that when the wind is east or south-east it must blow it right away from the town of Barking.

(*Mr. Brady.*) You have smelt the southern outfall?

322*c*. (*Mr. Marchant.*) Hundreds of times. I have heard Mr. Seymour say that he has been forced to shut his windows when the wind has blown south-south-east.

323. (*The Commissioner.*) Is that the vicar?—Yes; he has smelt it so bad.

Does any gentleman present wish to offer any observations?

Mr. Crowe.

Mr. Crowe.

I think, sir, you will not be surprised when you are told that there are two large sewers emptying their contents into the river in the vicinity of this town.

(*The Commissioner.*) Allow me to ask you what you are?

(*Mr. Crowe.*) I have a factory at the creek's mouth. I think you will not be surprised to hear when there are two large sewers, one on one side and one on the other, which discharge their contents into the river Thames, that the water is somewhat impure. There can be no question that the water is very impure. At the same time the point before us seems to be whether that creates such a nuisance as to be detrimental to the health of this town of Barking. I am not prepared to say that it does, neither am I prepared to say that it does not, because personally I do not know. I walk down by the side of the creek very often, and sometimes I see that the water is discoloured, and undoubtedly it is discoloured by the stuff which is discharged from the metropolitan sewers. No one can deny that the mortality of this town has been exceedingly high, and especially so during last summer. There can be no doubt that something or other is operating very injuriously upon the health of the inhabitants of this town, but the question for us to solve is, what is the cause of it. I have no doubt at all that the London sewage being discharged into the Thames, as I said before, by one large sewer on one side and by the other on the other of the mouth of this creek, must have something to do with it. But there is another point which I wish to mention, and that is that the town itself is not properly sewered. There is a drain, it is true, going through one or two of the principal streets, but a very large portion of the town is not sewered nor drained at all. If you only open the door of a house you smell the cesspools. Therefore the town itself is in a very bad condition as to the sewering and draining of it. Then again the town has no proper water supply except what is supplied by wells. I believe that one well supplies very pure and good water indeed; so far as my experience goes of that well, and I have known it for some years, I never found the water anything but exceedingly good; but the water is conveyed in a butt, and taken from that butt in pails and sold at so much per pailfull to the inhabitants. They have no water for flushing nor for cleansing except by buying it at so much per pailfull. That is a state of things which I think you will say in our day ought not to exist. There is no question that this town is suffering to a very great extent, not only as far as the mortality of the place is concerned, but also so far as its trade is concerned from the want of a proper authority here to develope the town, and to do away with many nuisances which exist. There is no question that the unloading of manure, which is going on at the town quay in the centre of the town is a thing which operates greatly against the comfort and the health of the inhabitants. There is no reason why it should be so because there is a creek which comes all the way from the river Thames right up to Barking, and plenty of facilities along its course for making a wharf and unloading all the manure required to be brought here further out of the town, but there is nobody here to do it. The town is governed by nobody, and consequently there is nothing done. The roads are allowed to get out of order, and no paths are made. The inhabitants pay rates but get nothing equivalent for the money, and it is high time that there should be some alteration. I, as an individual, would be exceedingly obliged to you if you would put us ratepayers of this place into possession of information by which we can alter this state of things. It seems to me that a Local Board of Health or of Works is wanted here very badly and that such a thing must be had. I have often made up my mind if nobody else would stir in the matter that I would myself write to the Secretary of

State, calling his attention to the great want that there is of a Local Board of Health to take these matters into consideration, and to determine whether the sewage of London is the thing that is causing this high rate of mortality, or whether it arises from other local causes. Some people say that it is Mr. Hope's farm; others say it is the London sewers; others say it is the state of the town. How are we to decide? Somebody is required to take this matter in hand, and determine what it is. As far as the formation of these banks which are alleged to be formed in the creek is concerned I cannot say whether they are there or whether they are not. I have no means of judging. I am a barge-owner, but my barges do not travel up the creek; they travel upon the Thames. I have often heard it said that there is a bank forming in the Thames. I cannot say anything as to that, but this thing I do know, that the mortality of this town of Barking has been and is very high indeed, something fearful. I believe it was something like 50 in the 1,000 during the last summer, and if that is not enough to make the inhabitants bestir themselves and get an alteration, I do not know what is. I am very much pleased at having the opportunity afforded me of saying this much to you. I am not able to define from what cause that high rate of mortality arises, but it is clearly to my mind from some local cause or other, and my opinion is, such cause ought if possible to be prevented.

324. (*The Commissioner.*) What is your business?—I am a chemical manufacturer, and have a factory at the creek's mouth.

325. What number of men do you employ?—Sometimes we employ as many as 50. At this time of year we do not employ as many as that.

326. How many does Mr. Lawes employ?—150 or 200 sometimes.

327. What name would you give your factory?—Chemical works. Mr. Lawes' is a manure factory.

328. What chemicals do you manufacture?—We manufacture ammonia, pitch, and all such things as those.

329. From what?—From the refuse of the gas companies.

330. Is there anything in that manufacture affecting the health of your men?—Not at all, nor do we affect the river in any shape or form.

331. Neither the Thames nor the creek?—Neither the Thames nor the creek.

(*The Commissioner.*) You put a question to me as to what you should do in order to get the inhabitants of Barking to put themselves under proper local government. There was an Act passed in 1866 called the Sanitary Act. If you will look at the 49th section of that Act, you will see that if you choose to memorialize the Secretary of State, an inquiry into the sanitary condition of Barking will be ordered to take place, and if it be found that you are so defective as described—that the inhabitants have cesspools beneath their houses, that they have no proper system of sewers, that you have an excessive rate of mortality, probably attributable to that state of things—you will have due notice given to you to adopt the powers which Parliament has provided under the Local Government Act or under the Sanitary Act, and if the inhabitants will not take steps necessary to improvement the Secretary of State is empowered to send down an engineer to devise works, and to execute them, to levy rates, and to continue levying those rates until the cost of the sewers and other sanitary works has been repaid. The Sanitary Act of 1866 is in force all over England. The inhabitants of Barking ought to know it. It ought to be discussed at the next meeting of the vestry, because it is in force whether you will or not. Any individual resident in a town can bring its machinery into motion, but I would earnestly advise the inhabitants of Barking not to wait till some one applies to the Secretary of State to put the Sanitary Act of 1866 in force, but that they, the Barking ratepayers, should arrange matters amongst themselves, and adopt a system of local government under the Local Government Act, 1858, for they will find that proper sanitary works, devised by themselves, and carried out by themselves will be by far the cheapest mode of proceeding; and though they may have to pay a rate for the necessary works, if those works have the effect of diminishing the fearful mortality which has been spoken of, the humblest ratepayer instead of finding the cost really a tax will find it to be the greatest blessing that he can receive.

(*Mr. Brady.*) Will you kindly give us an adjournment till next Monday? At that time we shall be prepared to give you substantial evidence of the truth of the allegations of the memorial.

(*The Commissioner.*) I wish to suggest that between this and our next sitting, witnesses should be found who took part in preparing the memorial and who can speak positively as to the statements in the several allegations. I do not know who has drawn the memorial, but I think it is quite right and proper that I should ask questions as to the figures in the memorial, for sometimes figures get wrong. You will give the best reply you can.

Adjourned till Thursday, 1st July, at 12 o'clock.

SECOND DAY.

Town Hall, Barking, Thursday, 1st July 1869.

Mr. Lloyd appeared (instructed by Mr. Brady) as counsel for the memorialists.

Mr. EDWARD DEVESON called; examined by Mr. LLOYD.

333. You live at Barking, do you not?—Yes.

334. You are manager for Mr. Burrell, a coal merchant here?—Yes.

335. How long have you been in that position?—26 years.

336. You have known Barking Creek all that time?—Yes; 29 years.

I do not wish to put distinct and specific questions to you more than are necessary. I, however, wish you to tell the Commissioner who is here to make inquiry into the allegations of that memorial your own knowledge and experience of facts, with reference to the state of the creek now, as compared with what it was up to a few years ago.

337–8. (*Mr. Philbrick.*) What is that document in your hand?—Some private memorandum of my own.

(*Mr. Philbrick.*) You had better put it on one side.

339. (*The Commissioner.*) Have you read this memorial, or were you present when I read it?—I was, and I think I understand the nature of it, because I was the party who went round with the petition.

340. Had you anything to do with drawing up the memorial?—I had nothing to do with the wording of it.

341. Who did word it?—I am not able to say.

342. You read it before you went round with it?—Yes.

SECOND DAY.

Mr. E. Deveson.

1 July 1869.

343. You see the second allegation states that information has been obtained from the conservancy, that there is a deposit of mud in the tideway of the Thames (as I understand it) causing a loss of 11 feet of water; do you know anything of that?—Yes.

344. Will you tell me what you know (I assume this means in the low-water tideway of the Thames proper)?—Yes; that mudbank is patent to anybody who likes to walk to the creek's mouth at low water. It is on the Horse End. At one time there was deep water, and our ships used to lie there. Ships too large to come up the creek were anchored there, and our barges used to go and load out of them, and now, through that mudbank, they have to lie much higher up the river Thames.

345. I am afraid we are at cross purposes. Any bank of mud you can see would not be the bank of mud spoken of in this second allegation?—Yes, I think it would.

(*Mr. Lloyd.*) Perhaps it would be better if I put some questions to the witness, and then if you like, afterwards, you can put any that you please.

346. (*Mr. Lloyd to the witness.*) With reference to the alleged formation of a bank of mud at the mouth of the creek, what is it you know; give us the state of your knowledge on that subject?—As I have already stated, a bank of mud has formed since the London sewage first started, which was not there before.

347. Where is that?—A place called the Horse End in the Thames, and to the westward of Barking Creek.

348. Are you able to say from your own personal knowledge that such bank of mud was not there before the commencement of the operations of the Metropolitan Board in pouring out sewage there?—Yes, I am quite certain of that.

349. How is your information derived; how is your knowledge obtained?—By going to the creek's mouth both before and since, and knowing that formerly our ships could lie there and unload, and now they cannot lie there.

350. That is within your own personal knowledge?—Yes.

351. In what way, so far as you are concerned, was your trade carried on before; did you send lighters down to the mouth of the creek and load from vessels lying off there, and then lighter them up the creek?—Some of them. At the time I am speaking of, before this mudbank was formed, our vessels used to lie near enough to the creek's mouth for our barges to reach them at low water going out of the creek, and now we cannot do that.

352. (*The Commissioner.*) Look at this (*handing a plan to the witness*). Here is a map of the locality; will you point out where the bank of mud is?—The bank would be formed somewhere about here (*pointing it out*).

353. Opposite the creek?—No, a little above it, towards London.

354. On this side?—Yes; our ships now, if we unload them at the mouth of the creek, have to lie higher up the river Thames. The consequence is, that our barges are not able to reach the ships till some hours after flood. That is one of the effects.

355. (*Mr. Lloyd.*) That you state from your own personal observation and knowledge?—Yes.

356. What class of ships used to be able to come up the creek?—I will answer it from a memorandum; I have a little memorandum here.

357. (*Mr. Philbrick.*) Will you kindly tell me the source from which you get that memorandum; what did you compile it from, because we shall have to test this?—From my own memoranda that I have in the counting-house. I have a book in which I have entered the name of every vessel from 1843 to the present time. That book is where I got this information from. My memory is not good enough to carry me over all those years, so I have made an extract. The first note is 1848; on the 10th of January a ship called the "Pursuit," Captain Alder, 262 tons, drawing 12 feet of water.

358. (*Mr. Lloyd.*) Did she come up to the head of the creek, and lie by in the basin?—She came up to the town.

359. (*The Commissioner.*) On what tide did she come up?—Spring tide.

360. What date?—The 10th of January 1848.

361. (*Mr. Lloyd.*) Give the next?—The next is the "Peony," Captain Fairney, 298 tons.

362. Any other?—The next is the "Abbotsford;" she brought over 300 tons of coal and drew 14 feet of water. She came up and lay alongside our wharf.

363. Go on?—The next is the 5th of September 1848, the "Hermione," Captain Frazer, 327 tons; the next, 1861, February 11th, the "Bilboa," Captain John Alder, 280 tons, drawing 13 feet 6 inches of water.

364. Those are matters within your own knowledge?—Yes. Now I have a few memorandum for last year; when you met before, there was some allusion made to a ship called the "Abdiel," 200 tons. Her draught of water was only 10 feet 6 inches. The "Severn" brought 246 tons, also drawing 10 feet 6 inches.

365. (*Mr. Philbrick.*) When was that?—Last year; but the "Kitty," which went away only two days since, brings only 137 tons, and she draws 10½ feet of water, so that we must not infer from the tonnage of vessels that they necessarily draw a difference of water. There is a vessel which brings 246 tons, which draws no more water than one which brings 137 tons.

366. (*Mr. Lloyd.*) Are those the ships with the greatest draught of water that have come up since the sewage was poured out there?—Yes, those are the largest we have had up.

367. Are you able to state whether those colliers drawing 13 and 14 feet could possibly come up now?—They will not come now; you may buy the cargoes on the market, but the captains refuse to come to Barking.

368. You know that of your own knowledge?—Yes; they give this reason ——

(*Mr. Philbrick.*) We cannot have the reason.

(*Mr. Lloyd.*) Let us see; do not be quite so captious as that.

(*Mr. Philbrick.*) What a captain says cannot be evidence.

(*Mr. Lloyd.*) In a court of justice it would be evidence.

(*Mr. Philbrick.*) If the captain is here to tell us, well and good.

(*Mr. Lloyd.*) In connexion with that fact he gives the reason, and I never before heard it disputed, that when a fact is stated, and a witness further states something which is a material part of the fact itself, that such may not be given in evidence.

(*The Commissioner.*) If you will allow me, Mr. Lloyd, I will put the question.

(*Mr. Philbrick.*) Very well.

369. (*The Commissioner to the witness.*) Will you state to me what you were going to say; what was the name of the vessel drawing a certain tonnage and carrying a certain weight?—Which one do you allude to?

370. The one they have stopped you about?—It was no particular one. I say I would perhaps go to the market and buy such ships' cargoes that used to come, but the captains will refuse to come now.

371. The captains will not come?—The captains will not come because the insurance offices object to their entering into Barking Creek since there has been so much obstruction. Formerly they used to take the tide and come in as soon as they had water. Now they have to wait till three-quarters flood before there is water over the bar at the creek's mouth.

372. Over the Horse End bar?—No, they do not enter on that side of the creek; the entrance is at the other side of the creek.

373. It is the Horse End mudbank that obstructs the creek's mouth?—Not so much that as the mud of the creek.

374. It is the Horse End we have been speaking about, which is said to have 11 feet of mud ; now we are coming to a different point?—Formerly vessels could take the flood early as soon as there was water and come up the creek and reach our wharf at or about high water, and now they cannot. They are obliged to wait three-quarters flood before there is water enough, and very likely they will ground half way in, and perhaps in a dangerous place, and consequently the captains refuse to come up.

375. (*Mr. Lloyd.*) Has that happened more than once?—It is a general thing now.

376. It is the rule?—Yes; none of the captains of those large vessels will come up now.

377. (*The Commissioner.*) You have been speaking of something that took place in 1848; do you know the date at which the main sewer outfalls commenced to empty into the Thames?—I have not made a note of that. I should say it was four or five years since; certainly since 1848.

378. (*Mr. Lloyd.*) And since 1861; you gave an instance of 1861?—Yes.

379. Any alteration that may have taken place must have been from some other cause, if it existed previously to the opening of the metropolitan outfall sewers?—There was no cause before. There was no hindrance previously that I am aware of; ships used to come up freely.

380. In 1848?—Yes, and since, even in 1861.

381. (*Mr. Lloyd.*) Can you say what you have seen as to the state of the creek itself, whether there is a deposit of mud or not there?—Yes, I have seen plenty of it. I have been a sufferer also from it; I had to go away the year before last for the benefit of my health.

382. That was from the actual deposit of sewage mud in the creek?—I attribute it to the stench arising from the creek.

383. I am speaking of the fact of a deposit; you can speak of the effect afterwards; have you observed in fact that there is a deposit of mud in the creek, which there was not formerly?—Yes.

384. What is the nature of that deposit?—I have not examined it very minutely. I should not like to, but I can see excrement floating on the water. I showed a gentleman that last year when he came down. He came at a capital time. It was floating on the top of the water very nicely. I asked him if he would like to bathe there. He said, No, I should not, indeed.

385. Looking at the creek at low water, you can see that there is a deposit of filth and mud and slime of various kinds?—Yes.

386. Was that formerly the case?—No. But any gentleman that is sceptical on that point may now walk down our quay and see it.

387. Was it so before the London sewage was poured in?—No. Formerly there were some settlings, but they were of a clayey color, which used to come with the backwater after heavy floods. Now it is black.

388. Black slimy mud?—I do not know whether it is mud ; it stinks too bad for mud.

389. It is plain to the eye as well as to the nose that there is sewage deposit there?—Yes.

390. At low water you can see it resting on the banks?—Yes.

391. Have you perceived effects from that of an unpleasant kind?—Yes, I have.

392. Last summer, I believe, it was felt very much?—I think last summer was the worst year here. I attributed it to the hot weather.

393. Still, in the hot weather was there a very considerable stench from that cause?—Yes.

394. Do you remember whether that stench existed at all in hot weather previously?—Not before the great London sewer started; certainly not, nothing of the kind.

395. Was the water in the creek clear water, drinkable water, formerly?—As to drinking, I have seen it drunk, but we, perhaps, might differ in our tastes about that. What I might drink you might not drink. I have seen the water very clear, and seen shrimps alongside our quay, and caught them, but you will not find any now.

396. You are able to say positively, then, that there is a great change in the state of the creek for the worse, both in respect of the silting or filling up, and also in the character of the deposit, and the effects resulting from it?—Quite so.

397. You mentioned that you yourself had been a sufferer last year?—The year before, I think.

398. In what way?—I got into a low way and lost my appetite, and felt generally ill. I was advised to go away for change of air. I had lived alongside this beautiful smell, and I think it affected me, so I was obliged to go away for change of air.

399. Were other persons suffering, I will not say from this stink, but suffering from fever and other disorders?—I am not able to answer that question, because I live near a private wharf. Other people do not live quite so near the water. I am there from morning to night.

400. Generally, in your judgment, is the state of that creek a positive nuisance now?—I take it to be both a nuisance and an abomination.

401. (*The Commissioner.*) Do you know anything of these deposits of sewage within a few hundred yards of any dwellings which are 6, 8, and 10 feet deep?—Yes.

402. In what part of the creek are they?—In the place I mentioned, near the people living at the creek's mouth.

403. Are there deposits of that class and character within the creek?—No; but at and above "Horsend;" they are not so deep within the creek, but there is plenty of mud within the creek.

404. Take the map and show me where those deposits of mud 8 and 10 feet deep are, because this memorial says, "There are banks within a few "hundred yards of the houses of some of your memo-"rialists composed of solid sewage, 6, 8, and 10 feet "deep."—Those are the houses at creek's mouth. This Horse End is within a few hundred yards of where those houses are.

405. You say there are banks of mud 8 and 10 feet deep there?—Yes; I have no hesitation in saying so.

Cross-examined by Mr. PHILBRICK.

406. You say that you have no hesitation in saying that; will you tell me what the reasons are which induce you to say that without hesitation?—I can see them when I go out.

407. Have you ever plumbed or measured any of them?—Not myself.

408. Have you ever seen any person measure them?—No.

409. How do you arrive, then, at what you say without hesitation is the depth of them?—I can judge from my own personal observation. If I look at a house I know whether it is 10 feet high, or 30 feet, or 40 or 50.

410. These are deposits in the bed of the river which are below low-water mark; how do you form your judgment as to the depth of them, and how are you able to answer the questions which the Commissioner put to you "without hesitation"?—I did not make that statement that they were below low-water mark. I never said such a thing.

411. Are they, then, above low-water mark?—No.

412. Are they above it or below it?—They are in the bed of the river Thames, and visible at about three-quarters ebb.

413. Are they above or below low-water mark?—Certainly not below low-water mark, or else they would be out of sight.

414. There are some things which are below low water, and which are still visible. You can see if

SECOND DAY.

Mr. E. Deveson.

1 July 1869.

they are in existence at or about low water. But I understand you that these banks are partly uncovered when the tide is down at its lowest?—Yes, they are uncovered.

415. How much in depth are they uncovered?—I have not measured them; it is not my business to do so. You know that pretty well, I daresay.

416. I want to know what the accuracy of your observation is?—I judge from the general appearance of the bank.

417. That it is 8 or 10 feet deep. I suppose this book from which you took these extracts can be forthcoming; you have taken those out for the purpose of this inquiry?—Yes.

418. Were you present at the meeting before the Commissioner opened the inquiry the last time, the meeting which was held in this room?—Yes.

419. Were you present at the private meeting on Monday night, or the public meeting, when there was a discussion as to what evidence was to be produced before the Commissioner to-day?—I was here at the meeting.

420. Did you make the extracts from the book after the meeting?—No, I made them before. I will swear I made them last Saturday night.

421. What I want to know is this—as far as they go no doubt they are correct, but one would like to see if they are a fair sample of the whole; have you given us all the ships of 200 tons, or about 200 tons, during the last fours years which have come up to Barking since the London sewerage works were completed?—No, certainly not; I think there have been 1,113 ships altogether.

422. Ships of 200 tons and over?—No.

423. Does your register keep a note of the draught of water?—Yes.

424. That the ships draw when at your quay?—No, when they are at sea. They will draw nearly the same in our water, probably a little more.

425. Do you measure it?—No, I do not measure it myself; I take it from the register, and from the captains' books.

426. It is there stated to be a vessel of so much draught?—Yes.

427. You took round (as I understand you to say) this memorial, and obtained several of the signatures?—Yes.

428. You could not tell the Commissioner who prepared the memorial?—No.

429. Who do you believe prepared it?

(*Mr. Lloyd.*) Is that a fair question?

(*Witness.*) I have no idea about it.

430. (*Mr. Philbrick.*) Who did you get it from to take round?—I forget.

431. Do you mean to tell the Commissioner that you really forget that?—I forget.

432. Have you no recollection on the matter?—It was brought to me by three or four people.

433. Whose handwriting is it in?—I am not certain whether it is our vicar's. I do not know who signed the first signature.

434. Whose handwriting is the body of the document in?

(*The Commissioner.*) I should say it is a solicitor's, or that of an engrossing clerk.

435. (*Mr. Philbrick.*) Was it prepared and brought to you for the purpose of your taking it round; were you asked to take it round?—No.

436. How came you to take it round then?—Because I happened to be met in the street; three or four parties met me in the street, and they said, "Deveson, we have so and so, perhaps you will go "round with it," and I said, Yes.

437. You went round in a body?—Yes.

438. Who were they?—Henry Marchant, James Deane, I think, and your humble servant.

439. That is three?—That is three.

440. You did not read it, I understand?—Yes. I never denied that.

441. In the face of the books you kept, and what you must have known, how could you take round a memorial for people to sign, containing this allegation: "In former days it was no uncommon thing for a "vessel of 200 tons to 250 tons burthen to be brought "up the creek to the port of Barking; the port is "now closed to all such vessels." As I understand you, in the year 1868, since the London sewerage works have been in operation, you have had the "Severn," which drew 10 feet 6 inches of water, and had 246 tons of load on board?—No. I think you have misunderstood me. I certainly did not give you the date of 1868 for the "Severn." I have not got the date of that. I refer to it to show that the difference in tonnage between 246 tons and 137 tons with differently built vessels made no difference in the draught of water. That was a fact.

442. At all events you have had within the last two days a vessel up which only had a tonnage of 137 tons, which drew as much water as the 246 tons vessel, the "Severn"?—Yes.

443. Therefore, so far as your knowledge of the shipping which comes to this port of Barking is concerned, it is quite clear that the creek is not closed to vessels of at least 246 tons?—Not to some vessels.

444. Were you aware of this particular allegation in the memorial: "The port is now closed to all such vessels"?—I was not aware of this ship; I am not aware of every ship afloat. There are a great many ships I know nothing about.

445. Do you know how many vessels of 200 tons Mr. Burrell has had up within the last four years?—I do not know.

446. You cannot tell me whether as many as 20 have been up within the last four years—vessels of 200 tons?—No. I only know this one, the "Abdiel."

447. Where is the book you have been reading from?—I have not brought the book. I do not expose my governor's secrets, but I am prepared to swear to my extracts and statements.

448. I cannot take what you as a memorialist and partisan choose to pick out.

(*Mr. Lloyd.*) It is not what you take; it is what the Commissioner will take. He (the witness) says that is a positive statement.

(*Witness.*) I will give my reason for not producing the book. In that book it has been my custom to put down the date, the name of the ship, the captain's name, the quantity of coals they bring, the sort, the price, and the freight, and all the rest, which I am not going to expose in this room (not the price and the freight). That is my only reason for not bringing my book.

449. (*Mr. Philbrick.*) Nobody wants to get at the secrets of your employer; but you may give a complete list of the ships for the last four years of over 200 tons?—I could.

450. That would answer every purpose.

451. (*The Commissioner.*) Permit me to ask one question, because if one ship could get up, 1,000 could get up under similar conditions. (*To the witness.*) At the top of spring tides about what draught of water would you have up the creek, do you think?—Something about 11 feet. But it is the collier captains who object to come.

452. You say you had a vessel drawing 10½ feet, and carrying upwards of 200 tons?—There are three vessels of 11½ feet draft, one of 200, one of 137, and the other 246 tons.

453. Then it is quite clear that at the top of high water of spring tides you could now get a vessel up to Barking Quay carrying 250 tons, if she did not draw more than 10½ feet of water?—Yes.

454. Whether there has been one vessel up or 100 would make no difference?—No; there is no difficulty in coming up now with vessels drawing no more than 10½ feet of water.

455. (*Mr. Philbrick.*) According to the ordinary course of the trade of Barking, of which you apparently know a great deal (as far as the coal part of it is concerned), what has been the average tonnage, during the last 25 or 26 years, of the vessels that have come up?—Before the sewage there was no

"average tonnage;" they came up (as I have already said) drawing 14 feet of water.

456. Is that the greatest draught of water of any vessel that you have had come up?—Yes, the greatest draught that I remember was 14 feet.

457. The only instance you have given us is the "Bilboa."

(*The Commissioner.*) That was 13 feet 6 inches.

(*Witness.*) And the "Abbotsford."

458. (*Mr. Philbrick.*) That is practically 14 feet. Have your employers ever attempted to have a vessel of that draught of water up the creek during the last few years? Has there ever been a specific instance of refusal to come up?—I cannot answer that question.

459. Yes, you can. You can say whether you know of one instance or not?—I do not quite understand you.

460. Those coal vessels' cargoes are bought on the market, I suppose?—Yes.

461. Has there ever been an attempt during the last four years to bring a coal vessel up of more than 11 feet draught of water?—I do not know.

462. You do not remember?—I cannot remember.

463. Can you say there ever has been a vessel, the cargo of which you have bought, which has refused to come?—Yes.

464. Will you give me the name?—I have not the name here. I was not aware that such a question would be put.

465. Can you tell me when it was?—I cannot keep every occurrence that happens in my mind; but I do say we have bought cargoes on the market, and the captains have refused to come up since the London sewage has emptied itself there.

466. How recently do you remember an occurrence of that kind?—Something like two years ago; but I should not like to speak positively.

467. But two years ago you can call such an instance to mind?—Yes.

468. Do you remember how much that vessel carried?—No; because when the captain positively refused to come up I thought it quite useless for me to inquire into any other particulars.

469. You did not buy her?—Yes, we bought her, but we could not make the captain bring the ship to Barking.

470. What happened with that ship, where did she unload?—I do not know; she would be resold on the market.

471. You gave up the bargain?—Yes; there would be an end of it all. The ships' cargoes are bought conditionally; the factor sells the cargoes of the ship if the captain will come up. If a captain will not come up, there is an end of the contract.

472. Has that been the course of the trade as long as you have known it?—Ever since I have known anything about it.

473. Is that the regular course of trade?—That is the regular course of trade.

474. Then if the captain refuses the bargain is off?—Yes.

475. Have there been steamers up the creek?—Yes.

476. Do you remember any last year?—I think you must be joking with me. If you are not joking with me I will say I remember one last week. They are continually coming up—one belonging to the fish company—Hewitt & Co.

477. The company who took over Hewitt's smacks?—Yes.

478. Do you know what size she is?—She is very long. I do not know what her draught of water is.

479. Is she a screw or a paddle?—A screw.

480. Is she a steamship that goes round to the smacks on the fishing grounds?—Yes.

481. And then she comes here to refit?—I am not speaking to one in particular; there are four.

482. That is how the trade is now carried on; the steamer goes round to the smacks on the fishing grounds?—Yes.

483. The steamer would come here, for what purpose; to refit?—Yes, to have her cleaned after discharging her cargo.

484. There are three or four such steamers, you said?—Four, I think.

485. Now one word as to the town of Barking itself. As long as you have known the town, has the sewage of Barking been carried from the houses into the creek?—Yes, part of it I know has; I do not know about the whole of it; I think not the whole. I do not think the town is wholly drained.

486. A part is carried some other way?—There is an outlet into the mill pool.

487 Your house is close to the mill pool?—Not my house, my counting-house, where I am from morning till night; that is why it affected my health.

488. Before the sewage was discharged here (the mill pool) three or four years ago, I suppose you never saw anything like excrement in the river?—I never saw it.

489. What became of it, did it all sink?—I do not know, there is so little goes out here.

490. None comes down from above, I suppose; do you know any other towns on the Roding that drain into this river?—I am not aware of a town, but there is a village.

491. As to the creek itself, your acquaintance with it practically is with the navigation of it?—Yes.

492. Can you tell the Commissioner, taking opposite your counting-house or Burrell's Wharf, what is the shoalest part of the creek between that and Horse End, at the creek's mouth?—You do not expect me to answer that question. I am not an engineer.

493. I did not suppose you were. I have heard you state you were not; but if you have a practical acquaintance with the usual state of the river you can answer me that question?—I cannot.

494. Have you ever been present when any vessel has stuck or grounded at all when trying to get from the river Thames into the creek; have you ever been on board when any vessel which had a difficulty has not been able to get into the creek?—I have never been on board, but I have known several vessels to ground in coming in for want of water; but that, I suppose, is not your meaning.

495. If you saw them ground, well and good, but if you are going to tell us what you have been told by third persons, we do not want that?—I saw them after they were on the ground. I did not see them actually take the ground.

496. You have seen vessels on the ground?—Yes.

497. When was that?—I do not know; I have not made a memorandum of that.

498. Are you aware of the existence of what they call the Shelf in the Thames, opposite the Horse End?—I do not know much of that.

499. You have been talking with captains day by day who have come up the creek from time to time. Do you not know that there was always this shoal or shelf?—You told me just now that I was not to go by hearsay, and I shall not offer you hearsay evidence after that remark; you ask me if I have not heard captains say so-and-so.

500. When it is not evidence in chief; a witness can be cross-examined as to what he has heard; we go by certain rules here. Do you not know that there is a shoal in the Thames called the Shelf?—I have heard of it, and I think I have seen it.

SECOND DAY.

Mr. E. Dereson.

1 July 1869.

Re-examined by Mr. Lloyd.

501. Can the same class of vessels drawing the same number of feet of water come up now that used to come up?—No.

502. You know that of your own knowledge?—Yes.

503. You say that none drawing more than 11 feet of water can come up now, whereas formerly vessels drawing 14 feet of water could come up?—Yes. I say that captains of vessels of 14 feet or 13½, and even of 13 feet, positively refuse to come now when they made no objection formerly.

504. (*The Commissioner.*) Do you know if the creek has ever been dredged between the town basin and the mouth?—I never knew it to be dredged.

505. Are there very heavy land floods occasionally?—They used to come formerly more than now. I think I can explain that.

506. You think the land floods I am speaking of came down more heavily in former times than they do now?—Yes.

507. What has made the alteration, do you imagine?—Doing away with Hainault Forest; formerly, when Hainault Forest existed, there were great obstructions to the watercourses, and the consequence was they would head up till they got a great body of water, and then they would come down with great force; now, since Hainault Forest has been broken up and divided into farms, the watercourses are all clear, and no sooner does a shower fall than the surplus water gets away so that it does not head up and cause those floods that it formerly did.

508. Are you aware whether the land floods have any tendency to deepen the channel?—They clear it.

509. Do you know the date when the London northern outfall commenced to deliver sewage into the Thames?—I am not quite certain; I think it was somewhere about 1864 or 1865.

(*Mr. Philbrick.*) August 1864. I may as well give the exact date.

510. (*The Commissioner.*) Do you know the times and conditions under which the London sewage is liberated?—I have understood that it is let out of the sluices at a certain time after high water.

511. Upon the top of high water?—No, not on the top of high water; I have understood it is something about half ebb.

(*Mr. Lloyd.*) No.

(*Mr. Philbrick.*) About 40 minutes after high water and the ebb has set in.

(*Witness.*) I understood it was later.

512. (*The Commissioner.*) You have understood that it is let out some time upon the ebb?—Yes.

513. Where would it go to if delivered into the Thames upon the ebb?—It would go down the river Thames till the rising tide met it; and then we can see the evidence of the London sewage by hundreds of thousands of corks settling on the shores with grease and oil and all that sort of thing, which you would have some unpleasant knowledge of if you walked across with a pair of white trousers on; you would soon get smeared with something very unpleasant; you know what I mean.

514. The sewage being let out on the ebb, floats down past the creek's mouth and on downwards?—Yes.

515. Do you think that that material which you see floating, and which discolours the water, is that which diminishes the depth of the water, or is it something which you cannot see?—I have no doubt it is the sediment from the sewage.

516. Do you think it is the sediment that floats, or the sediment that sinks?—It must float in the first instance or it would not get into the Thames; afterwards it settles. The greatest sediment takes place at or near high water, when the water is quietest.

517. Why do you jump to the conclusion that the whole of the sewage floats?—I have not made that statement. It must certainly discharge itself into the Thames, but I do not believe it all floats, or else that mud bank would not form at "Horse End."

518. You misunderstand my question; did you ever care at all to see what the sewage consisted of?—No, I never analysed it.

519. You only see that there is a certain filthy scum which rises to the surface with an enormous number of corks?—Yes.

520. And floats along and deposits on the shore between high-water and low-water mark?—Yes.

521. Is it your opinion that there are banks of mud 11 feet deep of that material on the shores of the Thames outside the creek?—There is one outside the creek and there is one inside, near Kingbridge, formed since the London sewage was started, which we knew nothing about before.

522. The shoaling up of the Thames shore where the vessels lay is above the outlet, if I understand your evidence, is nearer to London?—No.

523. You mean it is on the London side of the creek's mouth, but not of the sewer?—Yes.

524. That (*pointing to the map*) is supposed to be the reservoir. I assume the outfall is from that reservoir into the Thames?—Yes.

525. That is "Horse End," and there are Mr. Lawes' patent manure works; this is the bend or bay in which the vessels, as I understood you, formerly lay?—No, here (*pointing to the spot*).

526. Just opposite the outfall?—Just below the outfall.

527. Have you seen that recently?—Yes.

528. Is it not necessarily deeper there than it ever was by the scouring of that sewage?—No. Perhaps just where it shoots itself out it may be.

529. Whereabouts are your offices in Barking?—We are down near the New Malting.

530. You are a mile and a half away by the line of the creek from its mouth?—Yes, I should think so; rather more than that.

531. Are you annoyed in your offices by foul smells from the London sewer?—Yes.

532. Are you quite sure that it is from the London sewer?—I judge it to be from that, because we never perceived it before, till the last three or four years.

533. Do you see these compass marks, "south-south-east;" that is from the northern sewer mouth, in the direction of Barking. Then there is another here, "south-east ¾ east;" that is from Crossness point, verging upon the same point in Barking?—Yes.

534. Are you aware how often the wind blows from those points in the year?—If I had known you would have asked me that question I could have brought you a copy of a memorandum of the wind and weather every day in the year, for I keep an account of the wind and weather every day in the year, as well as other memoranda. But I should not imagine that Crossness would affect me so much as the mud under my nose.

535. I quite agree with you in that; from 1865 to 1869 I have a monthly record showing when the wind blew from those points. In 1865 it blew from those points 35 days in the year, and 330 days in other directions, so that in 1865 you would get the wind blowing over those sewer mouths on 35 days in the year. In 1866, on 22 days it blew from those points towards the town, and on 343 days it blew in other directions. In 1867 there were 24 days when it blew from those points, and 341 days when it blew from other directions. In 1868 it blew from those points on 26 days in the year, and on 339 days in the same year it blew from other directions. In this present year, 1869, it has blown from those points on 12 days, and on 169 days in other directions. That is simply a record of the direction of the wind, so that if you suppose you are poisoned by the wind blowing from the London sewers you may see by the proportion of days in the year when the wind has been from that quarter, and so judge whether it is all due to that or not?—I do not think it is the wind.

536. (*Mr. Lloyd.*) You can distinguish between what comes from the air with the wind, and what comes from underneath?—I do not think the wind affects us so much as the foul sewage deposit in the creek.

537. (*Mr. Philbrick.*) You think it is the mud deposit close to you, as I understand?—Yes.

538. (*The Commissioner.*) Do you know at all what is the condition of Barking itself as regards sewerage and drainage, I mean its sanitary condition. You believe it is the mud deposits in the river upon the banks, between high water and low water, that causes you mischief. But do you know what is the sanitary condition of the population; is the whole of the town sewered?—Not the whole of it; the upper part is not sewered.

539. Are the whole of the houses drained?—I should imagine not.

540. Do you think any of them are properly drained?—Certainly, some of them.

541. Have any of them cesspits and cesspools beneath the yards and floors?—I am not aware of any I think where I live they are drained.

542. Is there any amount of manure brought into this town from London?—Yes, any amount.

543. Brought in by barges?—Yes.

544. And also brought in by railway?—Yes, and brought in by railway.

545. And brought by carts?—Yes, carts and waggons; but not so much as by the barges and the railway.

546. Are the barges unloaded at the town wharf?—At the town quay.

547. Are there ever any foul smells from that manure?—I am not much annoyed by that. I live lower down amongst the London sewage that comes from the creek's mouth; that is the thing that annoys me most.

548. Annoys you individually?—Yes.

549. I assume there would be a foul smell from a vast quantity of manure of the kind brought in?—Yes, very likely; but some people think that smell healthy. It is a matter of opinion.

(*Mr. Lloyd.*) It is stable manure?

550. (*Mr. Philbrick.*) It is London manure?—Yes; and some of our farmers consider that healthy.

551. (*The Commissioner.*) You very rightly and properly say you believe it is that which is near to you, and upon the shore, which causes the nuisance you suffer from; but if you have large masses of manure in a solid state, or a semi-solid state, brought into and through the town and a bad smell proceeds from it, other persons may believe the worst nuisance to them to come from that?—Just so; but it does not annoy me. I live away from it.

552. (*Mr. Lloyd.*) In your judgment is stable manure as offensive as ordinary excrement from waterclosets poured into the Thames?—No, it is not so offensive.

553. That which is placed upon the fields in the shape of stable manure gives out an odour, but it is not offensive?—Not offensive to me.

554. (*The Commissioner.*) Do you know several large works upon the banks of the Thames, or near to it, which may be called nuisance works, or works from which foul smells occasionally may proceed?—Yes. It does not annoy me. I always compare the smell which comes from that to what is called "penny-cake"; that is a powder which the farmers mix up with oilcake to give to calves.

555. You say that does not annoy you?—No.

556. Are you prepared to say that it does not annoy other people?—It may. I cannot say. I am not prepared to deny it or admit it.

557. The smell may be injurious to others?—It may.

558. Gasworks are a great nuisance to some people?—Yes.

559. And to others they are no nuisance?—They are a nuisance to me. When there is any emanation of gas or gas water I certainly have an objection to it.

560. (*Mr. Philbrick.*) Do you know a place called the Barracks?—Yes, Barking Barracks.

561. There are a number of poor houses known by that name?—Yes.

562. How far off are they from where you live, or where you counting-house is?—They are in a line with our counting-house.

563. Is there any drainage from them at all?—No drainage whatever.

564. Have they cesspits then?—They have no cesspools.

565. And no drainage?—And no drainage.

566. How many are there of them?—Eight. I ought to know, because they belong to me; at least I lease them.

567. (*The Commissioner.*) Is there a common privy?—Yes, a common closet.

568. (*Mr. Philbrick.*) But no supply of water laid on?—No; there is no public supply of water in Barking.

Mr. Henry Watts called; examined by Mr. Lloyd. *Mr. H. Watts.*

569. What are you?—A lighterman.

570. Lighterman to Mr. Burrell?—Yes; I navigate Mr. Burrell's barges.

571. How long have you known this creek?—About 12 years.

572. Have you been in the habit of navigating up and down?—Yes, about two or three times a week.

573. You know something about it then?—Yes; I ought to do. I am up and down it night and day.

574. Have you observed any difference in the state of the creek within the last few years?—Yes, a great deal.

575. What is it you have seen?—When I first came down from London loaded with coals, I could run into the creek's mouth about three or four barges' length, so as to get into harbour; if the wind came on to blow hard, I could then come in with my barge. In place of that, now I am obliged to lay my barge in the Thames outside, and if I lie outside (on the shore side of Horse End) my barge lies in a great deal of mud; and when she lies in this mud she sinks right down, and I am obliged to have a rope under her to make her float out of this mud. Two or three years ago I could go out any time of the tide, or I used to lie in the mouth of the creek for a harbour, and if I was bound to London I could go out at low-water time. Now, if I lie in the creek, I catch the ground and cannot get out before the next tide comes.

576. What do you say is the cause of this; what do you think it is from?—I cannot make out what it is from, except it is the London sewer above. I cannot make out what it is else it can be from.

577. Is it since that London sewer came that you have observed this difference; is it since they began to pour the sewage stuff into the Thames?—We had nothing of that kind before this London sewage came there.

578. You have had it since?—We have had it since.

579. Do you find that the smell is very pleasant?—When I let go the anchor my chains are all over night-soil when I come to get my anchor up again.

580. Is it pleasant to handle?—Not very pleasant. I am obliged to wash the chain every time.

581. Used that to be the case?—It never was the case before.

582. You say there is a bed of mud into which the vessel sinks down, and on the rising tide you have to free it with a rope, and when you haul your anchor up it is all fouled with this sewage mess?—Yes; there is a great deal of mud there. I am obliged to have a rope under the barge to free her, by working it backwards and forwards, so as to make her float again.

SECOND DAY.

Mr. H. Watts.

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583. Do you think the creek is filling up?—A great deal in the first reach, where we come in, right away up as far as the powder magazine. We used always to be afloat till we got to the powder magazine; now it is all lying aground, and it makes the barge heel off.

584. Do you remember what the bottom of the creek used to be?—It used to be a hard and sandy bottom, and there was no fear then but that the barge would float. Now, if we run into the creek, or if we ground in the first reach, we are obliged to watch her and free her to see that she does float.

585. And does not stick fast and so sink?—And does not sink.

586. Formerly, when you stepped out of your barge to get on shore, could you go on dry ground then?—Yes, at one time of day.

587. If you stepped out now what would you go into?—Into about five or six feet of mud now.

588. Is it pleasant mud?—Not very pleasant.

Cross-examined by Mr. PHILBRICK.

589. There never was a time that you can recollect, within the last 12 years, when there was not some mud in this creek?—There never was any mud at all, or scarcely any.

590. Which do you mean; there was some mud, was there not, off the town quay?—A little mud, but nothing like what it is now.

591. Do you mean nothing of the same kind, or nothing of the same quantity?—Nothing like it is now.

592. Not so much?—No.

593. You have been talking about your barge; where do you say you have to put a rope under her? When she is lying where?—Just above "Horse End."

594. Is that inside the creek?—Outside the creek.

595. In the river Thames?—Outside the creek, in the river Thames, where we let go the anchor to come into the creek in flood time.

596. How far off the creek's mouth is that; four or five barge lengths?—Yes, somewhere about that; right off Horse End.

597. You lie there when you are light?—We lie there when we are loaded, too; that is where I have to put the rope under the barge to help her to float again.

598. Yours is a dumb barge?—No, a sailing barge.

599. What do you draw when light?—About 18 inches.

600. And when you are loaded?—Four feet.

601. (*The Commissioner.*) You are flat bottomed?—Yes.

602. If you did not work this rope under the bottom your barge would suck down in the mud?—It would suck down. I very nearly sunk two or three times before I had this rope. I have been on the water so many years that I knew what I could do to keep her from sucking down. I have been at "Lock's Dock" and "Deadman's Dock," where I have been sucked down, where there is so much mud that I have been obliged to have chains under the barge. And off the Victualling Office at Deptford, I have been sucked down two or three times.

Mr. J. Honey.

Mr. JOSEPH HONEY called; examined by Mr. LLOYD.

603. You are a shipbuilder?—I am.

604. Where is your yard?—I have three yards in the town of Barking; one at the upper part, one in the middle part, and one at the lower part.

605. Will you describe where your yards are?—I have one close against the town quay, one in the centre, and one in the lower part. The three yards are within the town.

606. I suppose you have been in the habit of having vessels come up to your yard for the purpose of repairs and the like?—Yes.

607. To a considerable extent?—Yes.

608. For many years?—Yes, 25 years I have been in Barking.

609. Since the sewage has been emptied into the Thames have vessels of the same draught of water been able to come up to your yard?—Yes; we never knew of a vessel being stopped through the sewage, or anything of that kind. The vessels could always come up the same as they always had done, only they were delayed at times; they could not get over the creek's mouth before the tide flowed some three feet higher than formerly.

610. (*The Commissioner.*) A vessel coming up to repair would come up light?—Yes; they are all about one burden or draught of water when they are light, and when they again go to sea. There is very little difference.

611. (*Mr. Lloyd.*) You say they cannot come up so well now from some cause?—They cannot get into the creek so early as they used to do.

612. (*The Commissoner.*) To get over Horse End?—To get into the mouth of the creek.

613. (*Mr. Lloyd.*) You know that from your own observation?—Yes.

614. What has been the effect upon your business in that respect?—Our ships are very different now to what they used to be; I have known the time when our vessels could dip water out of the millpool, and take it to sea with them, but now on a flood tide it is more like manure water, or water that runs from a dungheap; you cannot compare it to anything else.

615. Is that since the London sewage has been poured into the Thames?—Yes.

616. It was not so before?—No, I have seen hundreds bathe off my place; now you would not like to put your hand into it.

617. Of course you have opportunities of seeing this day by day?—Yes. I have had 20 men working for me at a time, and I have seen them sitting along the shore and taking their meals, and now on many of those shores there is a foot and half of mud.

618. And of what kind?—A kind of sewage mud.

619. Is there an unpleasant odour from it?—On the flood tide.

620. Can you see that it floats up with the flood?—Yes.

621. You have no difficulty in discerning that?—No; because you see the corks and things come in with the stream.

622. Some of the surplusage of the metropolis coming up?—Yes, I should think nothing else.

623. The colour of it indicates what the quality and condition of it is?—Yes.

624. Were the deposits formerly what you find them now?—No, we could keep our shores clean without the least difficulty; now you might keep on a man night and day to clean them, and then you could not do it.

625. You say your vessels were in the habit of taking in water from the creek?—Yes, and then go off on a 10 weeks' voyage with nothing else to drink.

626. That could not be done now?—No.

627. Have you yourself probed that sewage with a rod to try the depth?—Yes, I did the day before yesterday.

628. Where was that?—At the creek's mouth, and in the creek likewise.

629. What was the result of your observation?—We found three or four feet of mud upon the oar. We had nothing but the sculls of the waterman who rowed us off. I was at the creek's mouth.

630. Was it carefully done to ascertain what the actual vertical depth was?—Yes, I saw a boat out doing so likewise. I heard them calling out the depth of the mud, 3 feet, and 3½, and so on. They had proper staves to take the depth with, with a spike

on the end. Ours was nothing but the blade of the scull; and more than that, we brought in a can full of the sewage, and very nice it is.

631. I believe it is in existence now?—Yes, it is locked up carefully, so that no one can meddle with it.

632. What was the character of the mud on the blade of the oar?—A friend I had with me got some of it on his hand. I complained of it, and he put a little on my nose, and I can assure you it was not at all pleasant; and the worst of it was I could not put my hand overboard to wash it off, for the water was as bad as the mud.

633. Do you know anything about the "Worcester" training ship?—No.

634. There was a training ship off there, was there not?—I do not remember it.

635. The coast-guard vessel?—I know the coast-guard vessel.

636. Where did she use to lie?—Just inside the creek's mouth.

637. Where does she lie now?—Over at Charlton.

638. She was moved over to the other side?—Yes.

639. Do you know for what reason?—No.

640. When was she moved?—I think she has been gone 18 months or two years.

641. Where is that can of sewage mud which you mentioned?—It is at home.

642. Do you believe there is an accumulation going on of this foul deposit?—I do.

643. Which will seriously interfere with the navigation?—Yes; if there is not such a thing, how is it they bring it from London, and that we have to put up with it? If it is not a nuisance there, why do they not keep it to themselves?

644. From your own observation do you believe it is going on accumulating and increasing?—I am certain it is. If you go there on the flood tide you will see plenty of birds there when the London sewer is open; and you will see men on the shore collecting the fat in baskets, who get their living by it. They take it on shore and boil it, and it is taken back to London. I have seen scores of them doing it; baskets and baskets of solid fat are taken off the shore of the Thames.

645. The sewage when it comes out is in a fluid state, and some of the particles are held in suspension and some float?—Yes.

646. The heavier ones will deposit of course?—Yes.

647. In certain distances and at certain times the heavier particles go to the bottom, while the ligher particles float on further, and the fatty matters also continue to float on the surface?—Yes, and are made use of in some way.

648. That is what you have observed?—Yes.

649. Have you ever observed the colour of the London sewage water as it comes into the river Thames at the pumping station?—No.

Cross-examined by Mr. PHILBRICK.

650. About this can of sewage you have spoken of. Was that taken in the river Thames or in the creek?—In the river just on the Horse End, midway between the creek's mouth and the sewer.

651. The London outlet sewer?—Yes.

652. What time of the tide was it taken?—About an hour and a half after flood.

653. As to this practice that they used to follow of filling their casks, and taking the water on a voyage; you are speaking of smacks that used to come up the river Thames before the trade altered?—Yes.

654. Now, in the course of the trade carried on, there is no need for the ships taking water in?—We have no better supply of water now than then.

655. That is a matter independent of the London sewage altogether; that is the neglect of the town authorities?—No question, but if they could do the same now as they did then they would do so, because they would not buy water if they could help it.

656. Do the same class of ships come up, or is not the trade carried on differently now?—No; the same ships come now as used to come, only there are not so many of them.

657. We have understood that the smacks are not in the habit of coming here every time to sell their fish, but steamers go round and take the fish from the smacks on the fishing grounds?—They never did come here no more than they do now.

658. That is occasionally?—Yes, when the voyage is over they come to the town. We used to have 300 or 400 sail out of Barking at one time, but now we have only about 10 or 12.

659. That particular trade of Barking has been decaying?—Not at all decaying; they have gone away because they get nearer to the fishing ground.

660. I mean as regards coming to the town itself; they adopt the system that takes them to another place?—Yes.

661. To a great extent that is a prejudice to the trade of the town?—Yes.

662. How long ago is it since the ships used to take in water from the creek; was that before the paper mills came up above stream?—I cannot say how long ago; I should think not after the paper mills came.

663. Within the last eight or nine years?—I should think not.

(*The Commissioner.*) Do you know when the paper mills came?

664. (*Mr. Philbrick.*) In 1859 or 1860?—About that time.

665. (*The Commissioner.*) What paper mills are they called?—Lloyd's paper mills.

666. (*Mr. Lloyd.*) Where are they?—At Ilford. I do not think we suffer from any sediment from them.

667. (*Mr. Philbrick.*) But they are a contamination to the water?—Yes.

668. How far is your nearest shipbuilding yard from where the Barking sewage drains into the creek?—I should think we are a quarter of a mile below it. [*The sample of the sewage referred to by the witness was here produced.*] (*Witness.*) This was taken in a can (*pointing to the sewage*).

669. (*Mr. Philbrick.*) That has been lying in the can uncovered?—Yes, since Tuesday.

670. (*The Commissioner.*) That has been dipped up from the mud bank?—It was taken off the blade of the scull which was stuck into the mud. It was neither all top nor bottom nor middle, it was some of each; it was as the blade of the oar came up.

671. (*Mr. Philbrick.*) It was taken as a specimen of the deposit?—Yes.

672. You do not represent that as the floating matter?—No.

673. No ships in the river Thames are supplied with the river water now?—No.

674. That system has gone out of use?—Yes, simply because it is impossible to supply ships with river water now.

675. (*The Commissioner.*) Do you know any place within a few hundred yards of any houses of persons in Barking, where you have mud of that kind 10 feet in depth?—You have it, I should think, as near to the people's houses as that at the creek's mouth.

676. You say the mud which you sounded was from 3 feet to 3 feet 6 deep?—That was on Horse End; but they tell me that in the creek's mouth it is from 7½ to 10 feet. I have been there myself, but not to measure it. I have seen the whole of the creek's mouth covered up with this mud or sewage. I have seen a barge of mine sink in, and she has been whale deep in it. Formerly we could produce parties who could tell you that when the boundary people walked along there, a person could walk from the creek

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Mr. J. Honey.

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mouth, from the preventive vessel right along the other side, to mark the boundary. It is impossible to do that now.

677. (*Mr. Philbrick.*) Do you mean that at dead low water a man was able to walk across the creek without a boat where the channel of water ran before the sewage came ?—Yes.

678. You had not a great deal of water then at low water in the creek ?—You might at such times see the whole of the Shelf quite dry.

679. Where is the Shelf ?—The Shelf lies off in the river Thames.

680. Was this accumulation of mud on the inner side of the Shelf ?—Yes.

681. The Shelf is hard, is it not ?—Yes, nothing but a bank of shingle.

Mr. W. Hale.

Mr. William Hale called; examined by Mr. Lloyd.

682. What age are you ?—76.

683. Have you been a smack owner in this town ?—Yes.

684. For how many years ?—For above 30 years.

685. How long have you known Barking ?—I have lived in Barking all my lifetime.

686. Do you remember it very different from what it is now ?—Yes, I have knocked about for 60 years. I have been sailing from Barking since I was nine years old.

687. You have had vessels of your own ?—Yes.

688. And you used to navigate the creek ?—Yes, at all times and at all hours.

689. Has there been any change lately ?—The only change that I know of is the soft soil at the creek's mouth. I have been there myself at low water, rowing a boat there, and you may take your scull and shove it clean out of sight.

690. In the deposit ?—Yes; I have done so.

691. When did you observe that first ?—It was all hard ground before the London sewage came there. We could row a boat at all times of the tide opposite the magazine at low water.

692. Have you observed that mud bank yourself ?—Yes, I have; and I have shoved my scull clean under the stuff.

693. Are you sure that where you found that deposit and that filth it used to be hard ground ?—All hard, dry ground at the mouth of the creek. The run of the water used then to keep it all clean.

694. Did you observe the nature of the stuff you brought up ?—We knew what it was; all the settlings. The ebb tide sets so hard into that bight that all the slush from the London sewer comes into the bight.

695. There is a kind of backwater ?—Yes; it comes from the other side; the tide sets a vessel into that.

696. Then the flood brings it up the creek ?—Yes.

697. Have you observed any disagreeable smell from it ?—Yes. I was in Mr. Dean's dock last week, and it was enough to knock you down the first two hours of the tide. It was a horrid smell.

698. Have you observed that more than once; is it common ?—It is very common now with the first of the flood, and the last two or three hours of the ebb; all the stuff that comes from the London sewer is sure to go into that bight.

699. There it lodges, some floating and some sinking ?—Yes.

700. And then it comes up with the tide ?—Yes.

701. Is the creek in a very different condition from what you remember it before the London sewage was turned into the Thames ?—I do not see anything particular above, but the mouth of the creek is fairly choked with this stuff.

702. The sides of the creek are very different now from what they used to be ?—The mud banks are now growed up a good bit. I think outside the magazine the bank is higher than it used to be

703. The stuff lodges upon the banks of the creek ?—Yes, I expect it does, and it is wonderful soft now; you may take a scull and put it right into it.

Cross-examined by Mr. Philbrick.

704. What I understand you have noticed is something at the mouth of the creek. The creek itself, after you get past the mouth, is pretty much what it used to be ?—Yes, I cannot see much difference.

705. The mud banks being higher, that is where the reeds come down on to the shore ?—Yes, there always was a mud bank on both sides, but the bed of the river generally all the way out was hard ground. When I was a lad, I have walked out on it in the summer season many a time.

706. Do you remember the shoal they call the "Shelf," outside the creek's mouth ?—Yes, and the shoal called the "Ridge."

707. Which was the old passage out from the creek; did you take your ships out between the Shelf and the Ridge ?—Yes.

708. You had one on one side and one on the other, and the channel was between them ?—Yes, there was always a channel between the two; the channel to anchor in was a little between the two.

709. Since you first remember the river at that part has the channel a little altered its course and the shape of the two ridges ?—I cannot say; I see the Ridge is the same, although there is this soft soil.

710. That has come there lately ?—Yes.

711. What you want to get rid of is the soft soil and the silt that is there, and then you think the thing would be pretty right, as far as the navigation is concerned ?—Yes, there is nothing else that I can see stopping the navigation.

Mr. E. Harvey.

Mr. Edward Harvey called; examined by Mr Lloyd.

712. You are a smack-owner, living at Barking ?—Yes.

713. How long have you been here ?—11 years a resident, but I have known Barking for 25 years.

714. And the creek also, I suppose ?—Yes.

715. Have you observed any change since the London sewage was poured into the Thames ?—Yes, a great change.

716. Will you, in your own words, tell the Commissioner what you have observed ?—I have observed the different mud banks outside all grown up, and filling up with silt. I have been out at all times of the tide, and I find there is a great deal of scum brought down the river into the creek on the flood-tide right into the creek; and in sailing through it in a boat I have had it washed on to the boat's deck, so that I have been obliged to wash it off.

717. That is since the London sewage has been poured into the Thames ?—Yes.

718. Nothing of that kind existed before ?—No, I have never seen anything of it before. I have traced it at low water on the first of the flood. It will come with the tide, and go pretty well over into Gallions. I have seen a black mark across the river.

719. That is from the London sewers outfall ?—Yes. Then it meets the tide just below Crow's factory, and goes off and goes pretty well on into Gallions.

720. Does it come into a kind of bight and rest there ?—It comes into a bight, and then the eddy on the flood brings all the refuse down.

721. So that there is a continuous mass of floating matter there ?—Yes.

722. Is this matter, which you speak of, offensive ?—Very indeed; it has been so bad that I could not

row through it. One evening last summer I was out there with a party, and they begged me to row out of it, it was so offensive.

723. (*The Commissioner.*) That was in the Thames? —Yes, just outside Barking Creek.

724. (*Mr. Lloyd.*) Have you ever observed it in the creek itself?—Many times; I see it every day.

725. At low water?—At low water. Where I could formerly sail or row in, in good water, now I could not get near the place for this silt which is 3 or 4 feet deep.

726. You could not get out to step on shore at all? —Not at all. Where I used to land at the coast-guard station, right on to the causeway, you cannot land at all now at low water. You could formerly land on the stones and step ashore.

727. Now you go leg deep into this deposit?—I very nearly lost my dog a little time back. He was trying to get on shore.

728. Did it make the dog sick?—I cannot say that it made him sick, but he could not struggle through the mud for some time.

729. Was the health of Barking affected last year? —I believe so.

(*The Commissioner.*) I may state to you, Mr. Lloyd, that there has been a memorial, or rather a letter, from Barking, asking to have a special inquiry as to the state of health in Barking; and the Home Secretary has promised that if, after he sees my report, it may be considered necessary to make a special inquiry into the health question, such special inquiry will be accorded, but he did not think it necessary to send a medical gentleman down with me on this inquiry.

(*Mr. Lloyd.*) A medical man would make a distinct inquiry if on your report the Home Secretary thought there was any ground for it.

(*The Commissioner.*) If the inhabitants of Barking consider that there is any benefit to be obtained, the health question will be made a special case of inquiry; so that we will avoid going into the health question now.

730. (*Mr. Lloyd.*) I am obliged to you for that information. (*To the witness*) Will you tell me what, in your judgment, the effect will be if this thing continues?—I found on going out yesterday that the whole way out of the creek there is a great deal of silt just clear of the water's edge. Where it is a shoal it is clean, but in the holes you will find a deposit. Likewise on the banks, if you row a boat near the banks there will wash down a nasty black mud.

731–2. Supposing this pouring out of the sewage of London to continue, what, in your opinion, will be the effect on Barking Creek as regards navigation, and the state of the water? — I have seen it in the summer time after the tide fell off just like a black glaze from the settlings.

733. Do you think it is increasing or likely to increase?—I am quite positive of that.

734. And when the new matter is pumped in from the Abbey Mills station, you think it will be worse?— I think it will be increased.

735. You say, from your own observation, that the nuisance has been increasing?—Yes.

736. (*The Commissioner.*) Do you know anything at all of the condition or the depth of the water in the main channel of the Thames at dead low water; whether it has been affected or altered by the deposit of London sewage?—Yes, I believe so between the Ridge and the shore; to what depth I could not tell. There is a great difference; there is a great deal of mud there. I know that where we could lie afloat once with a barge we now lie aground.

737. At low water?—Yes.

738. In the Thames proper?—Yes, from the outfall down to Horse End. Where I could row ashore when the sewer was first opened I could not now get near by a boat's length.

739. Have you any means of knowing whether there is a bar formed across the navigable channel of the Thames, reducing the waterway by 11 feet?—I could not tell to what extent; but there is a great shoal from the shore down to inside, where was our anchorage.

740. Do you know anything of the state of the low-water channel of the river Thames?—Not outside our shoal.

741. You know nothing of it in the river Thames? —Only between the ridge and the shoal.

742. What I mean is, if a vessel going from London, or up to London, at dead low water were passing the entrance to the creek, what would be the depth of water she would have now as compared with what it was formerly?—I never tried it outside.

743. When it is stated in this memorial that there is a loss of 11 feet of water in the channel of the river Thames consequent upon the deposition of London sewage mud, that you say you know nothing about?— There is a great loss, but I never sounded it; but I should say there is 8 or 9 feet, or something of that sort.

744. Do not say there is, if you do not know.—I never sounded it, but I know where we could lie afloat formerly we now lie aground.

745. You are speaking of one thing and I of another? —I know nothing about outside the shoal.

(*Mr. Lloyd.*) The memorial points to that, the shore mud, and not to the main navigable channel of the Thames.

(*The Commissioner.*) The memorial certainly says, "Upon information received from the Thames conservancy there is a diminution of water in the "channel of the river Thames consequent upon such "deposition of sewage mud of no less than from "21 feet to 10 feet at ebb tide, or a loss of 11 feet.

(*Mr. Lloyd.*) It does not say the trough or main channel of the Thames.

(*The witness.*) That is where I say, between the shoal and the ridge.

(*The Commissioner.*) In the channel of the river?

(*The witness.*) It is part of the channel of the river.

746. (*The Commissioner.*) Do you know that there is a loss of 11 feet of water?—I know there is a great loss of water here betwixt high and low water.

(*The Commissioner.*) I am afraid we are at cross purposes.

(*Mr. Lloyd.*) It is a misunderstanding of what the memorial means. It does not mean that the bank of mud is in the mid-channel of the Thames, but in the waterway, towards the shore.

(*The Commissioner.*) As we have the engineer and the secretary of the Thames conservancy present, I will ask them how they understand it, at the proper time.

(*Mr. Lloyd.*) Certainly. It was never intended by the memorialists to state that the mid-channel of the Thames was affected to this extent.

Cross-examined by Mr. Philbrick.

747. Have you any personal knowledge, either by anything you have seen, or anything you have done yourself, as to the extent of any accumulation of mud or silt outside the mouth of the creek?—Yes, between the Ridge and Horse End; between the Ridge and the shoal or Shelf.

748. Show me where it is?—This is the shoal, this is the Ridge, and this is the outfall; all this falls right into the creek, and right away from here, above and below, right down to Horse End is all filled in with deep slime which comes from outside the creek.

749. You say between the Ridge and the shoal, in the course in which the navigation used to be, there has been an accumulation of silt?—A great deal.

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Mr. E. Harvey.

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750. That is the extent of your knowledge of the matter?—Yes, I never sounded outside the shoal, nor across the river Thames at all.

751. Have you ever sounded inside the shoal?—Not except by going in with an oar, or bringing a vessel up, or anything of that sort, when we have let go the anchor. A vessel grounds now where we could ride afloat formerly. I have noticed a difference, where I could lay a vessel ashore to clean her bottom on the hard shore, that is now all slime.

752. You have lived in Barking and known it 25 years. Till quite recently did not the parochial authorities cause the quay and parts of the town where there was any accumulation of filth to be cleansed?—No, not that I know of.

753. Do you mean to say that there was no system of scavenging, or anything of that kind?—Only sweeping it down. They have kept it cleaner lately.

754. There was nothing beyond the ordinary sweeping down of the streets?—The top of the town is paved. There has been a complaint of neglect, but I do not want to go into that now.

755. You were at the town's meeting when they said they would not go into anything affecting the sanitary state of Barking?—No, I was not.

756. Were you one of the persons who joined in the complaint from the inhabitants as to the nuisance arising from the unloading of barges with London muck?—I have complained of it.

757. The barges used to be brought up to the town quay, and used to lie there on a kind of bed?—You can see them to-day.

758. And probably if we could see them we could smell them, too?—No doubt.

759. As to the sewage, is your house near the river?—Yes; I have noticed it more going in and out, and I go in and out every day.

760. Going in and out of the creek?—Yes.

761. That is the substantial matter you speak to?—Yes, and likewise the less draught of water outside.

Re-examined by Mr. Lloyd.

762. Is Barking itself the same, as to its sanitary arrangements, now that it was 10 or 12 years ago?—I think it is improving a little.

763. It is no worse?—They improve.

764. You did not find these smells and this accumulation of filth formerly?—Nothing like it. The closer you get to the creek's mouth the worse it is.

765. That cannot come from Barking itself?—No; and we find a difference on the shore now when we strive to clean the shore down.

J Templeman.

Joseph Templeman called; examined by Mr. Lloyd.

766. What are you?—I have been a fisherman; but I have been minding vessels at the creek's mouth at different times, and at other times I row boats and things out.

767. How long have you known Barking?—51 years I have been in Barking.

768. And you have known the creek all that time?—Yes.

769. And the river Thames opposite to it?—Yes.

770. It has been your business to be a good deal in the creek and at the mouth of it?—Yes, for the last 20 years.

771. You have been a ship keeper?—Yes.

772. Do you remember up to the time when this London sewage was poured into the river what you could do; how could you approach the creek?—With my boat I could go on the shore. If anybody hailed me from the shore, I could row my boat right down to the stones, and I could put my foot on the clean shore, take hold of the boat, and hold her fast. Now, since the sewage has come there, you cannot even row your boat ashore by a long distance, because of the slime and slush. I have formerly laid my boat at the mouth of the creek at low water, on the first start of the tide, when it has been blowing a strong wind, when I have been wanting to get up the creek, and I have put my boat into the mouth of the creek, and took the first start of the tide. Now I have to wait frequently an hour or an hour and a half before I can do that.

773. What is that occasioned by?—All the slush and mud that has grown up at the mouth of the creek.

774. Have you observed anything disagreeable from it?—I have been minding vessels right abreast of the London sewer, and of a morning when I have turned out there has been a terrible smell; and likewise the birds round there are gobbling up the stuff as it comes pouring through the place, and the water at a certain distance is as black as ink, where it never used to be unpleasant.

775. It (floating sewage) comes, as we hear, into a sort of bight by the mouth of the creek, and then it comes up with the flood tide?—Yes; on the latter part of the ebb the water will form a dead eddy, and there it will lie till the flood comes up and meets it, and brings it up into the creek itself.

776. Have you observed any smell from the water in the creek itself?—Yes. A vessel would ground now at low water, where it would lie afloat in former times when you brought it up.

777. Have you ever found your anchor covered when you have brought it up?—Yes, with all manner of muck that comes from the London drainings; guts, and different things, especially on the kedge anchor.

778. We will not go into the particulars of it; it was not pleasant stuff?—No.

779. What do you think is about the depth of that deposit of mud that has formed near the mouth of the creek, by Horse End; two feet?—In different parts more than that. You can put your scull down more than two feet where the stones used to be all dry.

780. That is just before you get into the river Thames, is it?—Yes.

781. Is there a bank of mud in the river Thames?—I do not know that there is. There is the shoal and the Ridge, as they used to be formerly. I do not suppose there is much difference in the main channel, only on the shore there is so much more filth; because, when the true tide runs, it keeps those places open. That is all hard, as it used to be, from the run of the true tide.

782. But when you get near to the mouth of the creek it is very different?—Very different.

Cross-examined by Mr. Philbrick.

783. What you tell us is very clear; there seems to be a sort of dead eddy when the tide is on the ebb, and when the tide is on the flood the rising water catches it, and sends some of it up the creek?—Yes.

784. But where the scour of the river Thames is outside you get some mud upon the Ridge and some mud on the shoal, but you think the body of water in the river Thames keeps the main channel pretty open. There is something on it, but no very great accumulation?—Where the tide runs in the true course outside it runs as it always did. You will see "the Shoal" as clean as can be with the run of the tide, but from this great sewer and inshore, that is where all this mud accumulates from.

785. Where it is a backwater, or where the run of the tide is not so sharp, there it lies?—Yes.

786. How much of it have you noticed where the tide does not carry it away so clearly?—Two feet in some places.

787. You have been in charge of vessels?—Yes.

788. Were the vessels that you were referring to lying in the river Thames or in Barking Creek?—I have minded them when they have got out of the creek's mouth into the Thames as well as in the creek.

789. In both places?—Yes.

790. Where was it the anchor was brought up that you told my learned friend about?—When lying abreast of this place. We have two anchors, one at the head and the other at the stern, the kedge and the bower; on the kedge I have seen all the muck come up when lying close inshore.

791. Where was that?—Right abreast of the big sewer mouth. We have now to take the vessels higher up the river on account of that.

792. You have known the creek for the last few years?—Yes.

793. Do you remember a kind of jetty, or a kind of pier being made into the creek; that wooden erection for the purpose of landing the bricks and so on for these very drainage works?—Yes.

794. While that was out in the creek was there an accumulation behind it?—No. I understand the back-water always carried it away.

795. Behind it was not there an accumulation?—I did not notice it; there was a place where we could lay a vessel very comfortably after the barges went away.

796. So that you do not see any difference in the creek?—No, nothing whatever.

797. It is the mouth of the creek you speak of?—It is the mouth, and up and down the shore from the great London sewer.

798. (*The Commissioner.*) Do you think as large a vessel can go up and down the main channel in the true tideway of the Thames now as ever could?—Yes, I think so; there is what we call "the Shoal," off Gallions, but we see large steamers going up at low-water time take the true channel. They go up the river as they formerly did, but we have this accumulated matter in the mouth of the creek.

799. Between low-water mark and the shore?—Yes.

800. Where you could formerly run a boat's nose and land and walk ashore without mud, now you have from one to two feet of mud?—Yes; not above a month ago I was called to take a man from the shore. I rowed ashore, and I could not take him in for a quarter of an hour or 20 minutes, whereas formerly I have rowed close inshore at low water to a clean beach, but now you cannot.

(*The Commissioner.*) It is not worth while multiplying witnesses to speak to similar facts.

(*Mr. Philbrick.*) I do not think those facts last mentioned are much in controversy between us.

(*The Commissioner.*) That the sewage from the northern side of the metropolis goes into the river at Barking outfall needs no proof.

Mr. Lloyd called Mr. Marchant.

Mr. Marchant stated that he had no further evidence to give in addition to that which he gave at the last meeting.

Mr. WILLIAM HORSLEY called; examined by Mr. LLOYD.

Mr. W. Horsley.

801. Are you the sanitary inspector for Barking?—Yes.

802. Have you observed since the London sewage was poured into the Thames a change in Barking Creek?—Yes, very much, in the water.

803. What have you observed specially?—Great cakes of filth as big as the crown of your hat, some larger and some less, with human excrement floating with it, and sometimes excrement floating by itself.

804. Floating up with the flood tide?—Floating up with the flood tide; and when we have been pumping the water we have noticed it in eddies. When the flood-gates at Barking Mill were open the tide stream has taken it through up towards Ilford.

805. It has gone up and even beyond Barking basin, then?—Yes.

806. Have you observed what the state of the sides and banks of the creek are in that respect?—The banks in that part of the creek, in the basin part, are just the same as usual.

807. I mean as to the deposit of material and stuff down towards the mouth. The banks used to be hard?—The banks used to be harder than they are now.

808. What is it that covers them?—I cannot say anything more than I think it is from the London sewer. The ebb tide leaves all the excrement where it will settle on the shore, and if the wind is on the shore it will keep it there.

(*Mr. Lloyd.*) If we are not to go into the question of the effect on health, that is all I need trouble you with.

(*The Commissioner.*) I leave it entirely with you. If you wish to put a question on it I will not stop you.

809. (*Mr. Lloyd.*) The health of Barking was affected very much last year, was it not?—Yes.

810. There were a great many cases of scarlet fever?—Yes; one or two cases out at Lodge farm, where they run their sewage in those iron troughs on trussels, which are not seven feet from one of the houses.

811. I am asking you about the state of Barking?—That is Barking; but you mean Barking town, perhaps.

812. Yes. Was the state of health bad during that time?—Yes, it was very bad.

(*The Commissioner.*) The question of public health is so complicated, and is also so involved in many other contingencies, that it would be very illogical to conclude that any one thing caused general sickness, even in Barking town.

(*Mr. Lloyd.*) No doubt it is a combination of causes.

(*The Commissioner.*) And an abstruse combination generally.

(*Mr. Lloyd.*) I quite agree with you, sir. It may, however, become necessary to go into a medical or chemical inquiry; but at present you think it is premature?

(*The Commissioner.*) Yes. I have been advised by the proper authorities not to go into the health question, but to confine myself to engineering facts.

(*Mr. Lloyd.*) Very good, sir; I think I will rest there.

Mr. STEPHEN WILLIAM LEACH called; examined by the Commissioner.

Mr. S. W. Leach.

813. You are engineer to the Thames Conservancy Board?—Yes, I am.

814. You have been kind enough to prepare certain tracings which are before me, showing soundings opposite to the Barking sewer's outlet into the Thames?—Yes.

815. Will you open the sheet which more particularly refers to the main channel of the river Thames?—These are copies of surveys that have been made from time to time with reference to this question of a deposit of mud in the river, and they show soundings in the river in the vicinity of the metropolitan northern main outlet sewer and above it. This was the position that the "Talbot" powder vessel formerly occupied (*pointing to it*). When that position was assigned to it by the Thames Conservancy Board, at the request of the War Office, there were some 12 or 13 feet of water, but the vessel has had to be shifted on to the other side of the river Thames on account of silting which has taken place, rendering it impossible for barges to come alongside.

816. That has been between what years?—I think she was moored there somewhere about 1862 or 1863, but Captain Burstal can give the exact date.

817. How far was her berth above the entrance to the main sewer mouth?—About 2,000 feet.

SECOND DAY.

Mr. S. W. Leach.

1 July 1869.

818. It is not half a mile?—No, not quite half a mile.

819. Do you know when the main sewer sluices were first opened at that point?—In 1864 I think it was.

820. And this vessel was moored here before that?—Yes; she had not been there very long, but it was previously to 1864.

821. At what state of the tide are the metropolitan main sewer sluices opened?—The sluices are understood to be opened shortly after high water.

822. And how long do they usually run upon the ebb?—I do not know how long, but some hours upon the ebb tide.

823. During that time I assume it could not have any effect in the way of silting?—Yes, because there is an eddy tide here.

824. When the true tide is running down here you have a back eddy that would drift the silt to this point above?—Yes.

825. There has then been an alteration on this shore of the Thames depreciating the depth of water to a certain extent?—There has.

826. Since the main sewer was opened?—Yes.

827. And these figures in some degree represent the alterations?—Yes. I know for a fact that this part of the river was dredged very extensively by Trinity dredgers (I could bring the men who were employed in it to prove it if necessary), and they would only take clean gravel. They met with nothing then but clean gravel when they were at work, but now there is a general deposit of mud there.

828. Of what date are the blue figures?—The blue figures are 1860.

829. And the red figures?—1867, and the black figures 1864.

830. There is at the "Talbot's" berth there I see a loss of 6 feet?—Nearly seven.

831. That is filling up?—Yes.

832. This bay form of the river tends to drift any silty matters, and to form deposit?—Yes.

833. Have you made any calculation as to the probable quantity of silt that is monthly or annually delivered out from the mouth of this sewer?—No, I have not.

834. You have not attempted to get at any measurement or estimate of it?—No. But in the latter end of 1867 I estimated that the deposit of mud that had then taken place was about 700,000 cubic yards.

835. That had been the increase from what time?—That was from 1864 to 1867.

836. From 1864 to 1867 there had been that increase of about 700,000 cubic yards?—There had been a deposit of about 700,000 cubic yards in the river generally.

837. Is that of a silty character, or is it of a sandy character?—There have been several analyses made of mud taken from where it is evidently deposited, and the results agree very much indeed; about 70 parts out of 100 consist of road drift.

838. That would be the detritus worn off the macadamised roads, and washed along the inverts of the sewers, and poured out into the river at that point?—Yes.

839. (*Mr. Lloyd.*) And the rest was what?—Sewage matter, with a little of lime, of iron, and of alumina.

840. (*The Commissioner.*) Have you reason to believe that if things remain as they are, and if that volume of sewage is continued to be poured out into the Thames at that point, there will be an increase of these injurious shoalings?—I think so.

841. What remedy would you propose for that state of things?—It is so enormous a thing that one is almost afraid to think of it. I should state this, that so far as the navigable channel of the river Thames is concerned I do not apprehend that will be choked up.

842. That will not be affected you think?—No, as the main channel is kept open mechanically in this way: there are so many steamers that make their voyages at all times of the tide, and necessarily many of them come up at low water, or go out at low water, so that the navigable channel is kept open. Any mud is kept in suspension and is carried away, so that I do not apprehend that the main navigable channel of the river Thames would ever be choked up.

843. As engineer to the Thames Conservancy Board, do you object, on their behalf, to the pouring in of this material which, according to your soundings, has been accumulating at a rate of 700,000 cubic yards in the four years you spoke of? Do you think that is a process that ought to be stopped?—I think so.

844. What would it cost the Conservancy Board to dredge that 700,000 cube yards out, and to restore the river to its former state?—I have made an estimate of that. The lowest I can put it at is 1*s.* 9*d.* a cubic yard.

845. Whatever the 1*s.* 9*d.* a cubic yard comes to upon the 700,000 cubic yards would be the cost in your estimation?—Yes.

846. (*Mr. Lloyd.*) That is from the northern outlet?—The northern and the southern, too.

847. Not Abbey Mills?

(*Mr. Philbrick.*) Yes.

848. (*Mr. Lloyd.*) The Low Level sewer has not come in yet?—Whenever the Low Level system comes into operation the deposit will be greater.

(*Mr. Philbrick.*) The Low Level is in operation now, but it is not completed.

(*Mr. Lloyd.*) None comes down.

(*Mr. Philbrick.*) Yes, indeed, Mr. Lloyd.

(*The Commissioner.*) A portion goes in.

(*Mr. Lloyd.*) A very small portion, then, because the Low Level sewer is not completed.

(*Mr. Philbrick.*) From Tower Hill to Abbey Mills the Low Level system is in operation.

(*The Commissioner.*) But the Victoria sewer is in work, as also the Ravensbourn?

(*Mr. Lloyd.*) Yes.

849. (*The Commissioner to the witness.*) Have you, as engineer to the Conservancy Board, received any complaints as to the state of the water of the Thames at any portion of the tide with regard to its purity or its stench, or would the Conservancy Office be the place where such complaints would be made?—They would come to the secretary's office. I should probably have known of them, but I do not recall, at the present moment, any particular complaint that has been made.

850. There have been certain proceedings taken by the Conservancy Board in calling attention to the accumulation of mud. Has not the Conservancy Board also given notice to the Metropolitan Board of Works to alter the present condition of things?—They have not given them notice; but the attention of the Conservancy Board was first called to this deposit of mud, I believe, by a report being brought to the office that a large ship coming up the river had taken the ground on a shoal formed by this mud. They then directed me to have surveys made of the river, so as to ascertain whether that was the fact or not.

851. At what date was that report brought to the office that a large ship had grounded?—In 1867.

852. Did she ground?—I believe not. I believe it must have been a mistake.

853. What took place upon that?—The board then ordered me to make surveys of the river, which I did; and they then communicated to the Metropolitan Board the result of those surveys, and also to the Home Office.

854. Have the Metropolitan Board copies of these soundings you have furnished me with?—I think they have. We gave them free access to all the surveys and everything else we had.

(*Mr. Philbrick.*) We have not had them yet.

(*Witness.*) I think they were furnished in 1867.

(*Mr. Philbrick.*) Some were, but not the later ones. We have not all that is marked on them.

(*Witness.*) I think they were supplied, because Mr. Bazalgette reported on it.

(*Mr. Lloyd to the Commissioner.*) You have not asked him about the part of the Thames near to the mouth of the creek.

(*Witness.*) This is the mouth of the creek.

855. (*The Commissioner.*) Has this Horse End shoal extended since the opening of this main sewer?—Yes, it has, most decidedly.

856. Has it extended by a deposit of hard material or a deposit of soft material, or is the deposit of both kinds?—The deposit is soft in its character, but when analyzed it gives practically the same results as that dredged up elsewhere about here. There is a very large deposit indeed; so much so, that when you look at it at low water it appears to be slipping down, and in fact it does slip down occasionally; as the accumulation increases, its own weight takes it down. In addition to that, there has been a large accumulation formed on the opposite side to the Horse End. I had, in connexion with one of the harbour-masters, specially to report to the board upon this very point, and we found that the available width at low-water spring tides, at the entrance into Barking Creek, was reduced from 40 feet to 18 feet, and, as nearly as we could judge, the depth under water was reduced about a foot by the deposit of mud; we traced that right up the creek, and we found that for a certain distance up the accumulation appeared to be steadily going on. The tide is exceedingly sluggish there, and therefore whatever was held in suspension would be deposited; but as we got considerably higher up the creek it appeared to us that no material deposit had taken place that was traceable to the main sewer outfall.

857. You have heard the evidence of certain barge owners as to the increased difficulty of entering and of navigating the creek; do you agree with that evidence?—I think it is true in this respect, that they must wait longer outside before they can get in, and then, on account of the circuitous nature of the creek, there may be some risk after having waited so long in getting the vessel up to the town quay.

858. Do you know of your own knowledge whether there are accumulations amounting to 11 feet loss of water in the main channel of the river at any point?—No, I know of no such accumulations.

859. Do you know of your own knowledge of any accumulations of mud, 6, 8, and 10 feet deep?—7 feet I do; between seven and eight is the maximum I have detected.

860. At what points?—On both sides.

861. This allegation says that this deposit has taken place within a few hundred yards of the houses of some of the memorialists?—Those houses, as they were explained to me, are these houses (*pointing to the houses towards the creek's mouth*).

862. Not in the town of Barking?—No.

863. But down here?—Yes.

864. Then the allegation may be true to the extent you state. As regards certain houses, not in Barking town itself, but down below, there are accumulations amounting, within your knowledge, to seven feet of mud?—Yes. I should not hesitate to say it must be so on parts of Horse End.

865. (*Mr. Lloyd.*) You know that bight which there is at the mouth of the creek; you have observed how things float there, have you not?—Yes; I have gone along with the floating matter, I may say.

866. There is a large accumulation of that sort of scum, and all sorts of things light enough to float, is there not?—Yes. On one occasion when I was here I noticed almost a little river of black stuff coming out from the outfall sewer; it appeared to me to be perhaps owing to rubbish getting into the sluices and running out into the stream from the sluices not being closely shut down; there was a black line into the stream some distance, and it coloured the water there. It was late in the tide, and it floated all down here. Of course when the flood tide began to make, it carried it up again.

867. And you see on the sides of the creek now a deposit?—Yes, for some distance up. I do not trace that deposit all the way up the creek.

868. At all events, lower down there is an evident deposit?—Yes; there is no question of it at all.

869. (*The Commissioner.*) Is there an accumulation from Crossness to anything like the same extent as the accumulation which is taking place at this Barking northern outfall?—Yes, to at least as great an extent, probably greater.

870. Are there any inhabitants to be affected by the sewage there, or any creek navigation to be inconvenienced by it, as at Barking?—No.

871. That is the reason, I suppose, we have no complaint from that locality?—Probably.

872. Then the Conservancy Board complain of the silting in the Thames from the southern outfall as much as of the northern outfall?—Quite as much.

873. As injuring the main stream of the Thames?—Yes, quite as much.

874. What would have been the effect, in your judgment, of continuing the metropolitan main outfall sewers 10 or 12 miles lower down instead of discharging them at these points from these tanks?—It would have prevented any inconvenience to the navigation, of course, in this part of the river. But it is a question whether it would not have merely shifted the evil to that more distant point of outfall.

875. You think it would have been merely shifting the evil from one point to another?—Yes, except to this extent, that perhaps a better point of outfall might have been selected, where the tide would be more likely to carry away what is in suspension from the shores than here. This is a peculiarly unfavorable part of the river for such outfall sewers.

876. Do you know the report made by Mr. Simpson, Captain Galton, and Mr. Blackwell?—I know it well.

877. Do you know the points of outfall which they selected?—I think they were to have been below Gravesend.

878. Much below Barking?—Yes.

879. Do you think that would have been better than the points at which the sewage is now discharged?—Yes, I think it would.

880. Would the adoption of those sites for the outfalls have tended to free the river Thames from this injurious accumulation of deposit?—Yes.

881. And there would have been a freer scour to carry the sewage seaward?—Yes.

882. Is there any population there (at Mucking Flats or at Higham Creek) to be injured by any accumulation?—No. I think the points were selected with a view to that.

883. Do you know why Barking and Crossness were chosen for the metropolitan outfall sewers instead of their being taken further down the river? Did you pay any attention to the discussions that took place when these spots were selected?—It was discussed very much I remember at the time.

884. You do not remember the circumstances under which the selection was made?—I do not remember the exact circumstances.

(*Mr. Lloyd.*) It was partly with reference to the scheme of ultimately carrying the sewage away for irrigation.

885. (*The Commissioner.*) Do you know anything of the irrigation scheme, the scheme for utilizing sewage?—Yes.

886. Do you know to what extent it has been carried out or been tried?—I am only acquainted with what has been done with respect to the taking a small part of the London sewage to Lodge Farm at Barking.

SECOND DAY.

Mr. S. W. Leach.

1 July 1869.

Cross-examined by Mr. PHILBRICK.

887. You are aware, are you not, that before the plans for these outfall works were definitely approved they were submitted to the Thames Conservancy?—Yes.

888. Did you see them?—Yes.

889. On the part of the conservancy?—Yes.

890. The Admiralty of course also had them submitted to them?—Yes.

891. You reported as follows: "The plans of the "northern outfall having been laid before the Con- "servancy Board, I am directed by them to signify "their approval of the plans for such works, and to "state that the works according to the plans will "not interfere with the navigation of the river "Thames." That is the 21st of December 1860?—Yes.

892. You had before that reported upon the plans to the Conservancy Board?—Very probably.

893. You had seen them?—I had seen them, no doubt.

894. So far as the plans themselves were concerned, there was nothing upon them at that time which would have induced you to call any special attention to the matter?—The works referred to there were simply as to the probable effects an "apron" and "outlet pipes" might have if placed in the river Thames on the northern side, works corresponding to those having been sanctioned on the southern side.

895. Your report only related to the shore form of the northern main sewerage outfall works, as it was known, prior to these works being constructed here, that the sewage of the metropolis had all been discharged into the river Thames at many points above from sewers mouths situate within the metropolitan area?—Yes.

896. Then, of course, it was known that when the works intended to be constructed were in working order, that the whole of that which had formerly gone into the river opposite London on the north shore of the Thames at many points of outfall would be brought to the Barking outfall, and would be there put into the river at this one point?—Yes, but with this modification. It was always understood that there were to be settling reservoirs to prevent sediment going into the Thames. Rightly or wrongly, I know that was the impression at our board, namely, that only the sewage water, after subsidence, would pass out there into the channel of the Thames.

897. You saw the plans of the works, I daresay, and the plan of the reservoir that is now at Barking?—We had no supervision over works inshore. The approval of the Conservancy Board was asked simply with reference to works to be constructed on the river margin.

898. As far as the jurisdiction of the Conservancy Board extended, no doubt it was so?—Yes.

899. The plans showed the apron on the shore and the sluices through which the sewage is now discharged?—Yes, of the works constructed on the margin of the river Thames.

900. As I understand you, the mud or whatever accumulation there has been in that part of the river Thames opposite these sewers is, from an analysis you have had made, composed of about the same constituent elements as sewer mud higher up in the river?—Yes.

901. (*Mr. Lloyd.*) That is 70 per cent. of road grit and 30 per cent. of other material?—Yes.

(*Mr. Philbrick.*) There is no important difference, so far as you are aware of, between the analysis of that mud and of any other river mud?

(*Mr. Lloyd.*) He has not said that; he has said the contrary.

(*Mr. Philbrick.*) I am putting the question in cross-examination.

(*Mr. Lloyd.*) He said the analysis was taken of mud deposited above, and that such mud was due to the sewage.

(*Mr. Philbrick.*) I have not said anything to the contrary of that.

(*Mr. Lloyd.*) You said "mud in any part of the river."

902. (*Mr. Philbrick.*) Is there any material difference between the mud you have spoken of, as being found to contain on analysis 70 per cent. of road grit and 30 per cent. of other matter, and the mud taken from other parts of the river, higher or lower?—There may be a little difference in the constituents, but no material difference; they are pretty nearly the same.

903. That is to say, speaking practically, not speaking as a chemist, the results of analysis, wherever the mud has been taken from, have been substantially the same?—Yes. I will give an instance of it. I think the year before last there was a most extraordinary accumulation of mud on the shores of the river in London itself, so much so that the wharfingers were greatly inconvenienced; their barges would slide down from the front of the wharves upon and over this mud. Many complaints were made to the Conservancy Board about it, and the question was where such mud came from. I had an idea that it came up with the flood tide from these main sewer outfalls. I had several samples taken at Woolwich, Greenwich, and London Bridge, which samples were subjected to analyses, and the results of those analyses were, that the constituents of that mud were almost exactly the same as those of the mud which was collected here at Barking.

904. Tolerably uniform all through?—Yes.

905. Have the Conservancy Board ever had an analysis taken of the mud higher up the river than Westminster?—Yes. I think the highest point at which we have taken mud and subjected it to analysis is Kew.

906. Does the mud there contain the same elements substantially?—It does not differ very much.

907. The quantity of organic matter may be different to the extent of some decimal points, I suppose?—Yes, and there are more living worms and those sort of things in the water; they increase very much the higher you go up.

908. You have been in the office you now hold, I believe, a good many years?—Yes.

909. In this part of the Thames does the course of the river at all vary; first of all, taking the true channel?—It has varied in this respect, that formerly there were considerable shoals in the river, but owing to the operations of the Trinity dredgers, in getting ballast for ships and for other purposes, the general channel of the river has been very much deepened indeed. To that extent an alteration has taken place.

910. There were very extensive dredging operations on the south side. I suppose a great deal was done near Erith?—A great deal.

911. With regard to the "Shelf" and "Ridge" which have been spoken of, putting the sewage question out of sight, have they altered at all in position?—Not that I am aware of.

912. Has there been any dredging on those at all?—No.

913. Those shoals are quite natural to the river, are they not?—Yes; but they are out of the general course of the navigation.

914. Has the deepening of the water on the south side of the river at all influenced the shore on the north side, which is out of the ordinary course of the navigation?—No, I think not.

915. There is a backset or eddy there?—Yes; on the north side of Barking Creek in that bay.

916. It would have occurred to one, that the effect of deepening the south side and bringing a volume of water there would be rather to cause some modification of the shoals on the north side?—Supposing that deepening has been to the extent of 7 or 8 feet——

917. Which I suppose is what it has been?—Suppose it has been 7 or 8 feet, it can have but a very small influence upon the general set of the tide in such a width as that.

918. The width is considerable?—Yes; but the width to which the dredging has been carried is not so very great, therefore it has not been enough to have any influence.

919. Not enough to form a material variation in the contour of the northern shore or in the shoals there?—No.

920. I believe one constant source of care to your board is the prevention of the offence, which is very common indeed, of mud, ashes, or other solids being thrown into the river?—Yes.

921. Especially from the docks?—Yes; mud brought out of the docks we object to.

922. Is that done to any great extent?—I do not think it is now.

923. It has been within the last few years, has it not; there have been several prosecutions, have there not?—Constantly.

924. Weekly almost?—Very frequently.

925. It is generally done at night-time as much as possible, is it not, when they can shoot it out without being seen by the Thames police?—Of course; but there are peculiar measures taken to detect and restrain it.

926. Until you took measures to check it, it was done to a very great extent?—To within the last 8 or 10 years it was carried on to a very great extent.

927. Within the last two or three years have not you had, perhaps, 1,000 or 1,200 such prosecutions?—No, nothing like it.

928. (*The Commissioner.*) When the plans came before the Conservancy Board for these outfall sewers, comprising the sewage tanks, pumping arrangement, and the works to enable the discharge of sewage to be at the top of high water, did you, as their engineer, understand that the clarified water, that is to say, sewage water without its sediment, was alone to pass into the Thames?—Clearly.

929. That was your understanding as their engineer?—Yes, and not mine only, but the general understanding at the Conservancy Board.

930. Is there any written agreement to that effect?—No, I believe not.

931. Then if it had been stated to you, that the entire volume of sewage and sediment was to be passed from these works into the Thames, you would have thought it your duty to have vigorously objected to such an arrangement?—Certainly.

932. You would have considered it necessary to have advised the Conservancy Board to object to such plans?—Yes; but I gave evidence (which is in print) before a commission some years before, where I stated that I did not think Barking Reach was an advantageous place for the sewage to be sent out into the river Thames, because there seemed to be a natural disposition to the formation of shoals in that part of the river which would render that particular reach undesirable.

933. Do you remember certain evidence given by Sir Goldsworthy Gurney before a commission as to his notion how sediment would be worked up a river?—Yes, I remember it very well.

934. Do you think that the sediment you spoke of as having been analyzed, which had been taken from opposite to the wharves in London, had worked up in that way?—Yes. I have no doubt at all it has come up the river from these large main sewer outfalls.

935. It would not come by one tide, but by a series of tides?—Yes.

936. Being first taken down, then carried back, and worked gradually up again, saw-tooth like, as shingle is moved?—Quite so. My opinion was fortified by this. When I had the samples taken of the water at those three points I have mentioned, Woolwich, Greenwich, and London Bridge, it was upon the flood tide; but I also had samples taken upon the ebb tide as well at the same spots, and the result of evaporating that water and measuring the residuum was, that there was nearly double the quantity of sediment upon the flood tide held in suspension than there was on the ebb.

937. I only ask you this question for the sake of putting it on the notes. There is a great difference between neaps and springs in the strength, direction, and general character of the flow of tides, as also in the amount of silt that the tidal water bears; the neaps do not bear so much silt as the springs?—They do not carry it up so far neither.

938. I mean the inflowing neap tide does not bring so much silt as spring tides do?—No; the spring tide runs with greater strength, and scours it off the banks, bed, and shores, and moves it on.

939. Have you any tidal water flowing into the Thames that might be called "bright water," or is all the tidal water charged with silt to a certain extent?—Yes.

940. And the tidal water always has been muddy?—Yes, I think always has been, more or less so.

941. Was it silt of a well-known and defined character which you could trace as coming from the outer banks, from the shores and from the bed of the stream below?—Yes. I do not think there was much silt which deposited. I think what was brought up with the tides, of that silty description which you speak of, went down again.

942. That is to say it oscillated with the water?—Yes.

943. While the silt and sediment you now get from the metropolitan sewers is to a certain extent fixed on the shores?—Yes.

944. Have you any idea what would be the cost to the Metropolitan Board of Works if they were compelled to separate the sediment and to discharge only the clarified water into the Thames?—No; but it would be something enormous.

945. What did you tell me that dredging would cost you?—1*s.* 9*d.* a yard; that is dredging the mud and landing it.

946. Have you formed any idea as to what should be done to prevent the London sewage sediment passing into the Thames?—The only practicable mode that I can see is to carry it altogether further towards the sea.

947. To take the sewer outlets further towards the sea?—Yes.

948. Do you understand sufficient of the irrigation process to know whether that sediment could be utilized upon the land, whether it could be passed through the carriers and floated on to the land, or whether they would have to separate it before using the sewage for irrigation?—I should not like to speak positively upon that; my knowledge is only what I have acquired from reading, and not from my own practical observation.

949. (*Mr. Lloyd.*) You remember it was part of the system which was in contemplation at the time your assent, as it were, was asked to these arrangements, that the sewage was to be utilized by irrigation over the lands that were capable of being irrigated by it, and the residue carried off to the Maplin sands and there utilized?—I cannot say that I was under that impression at the time, but I was clearly under the impression (and I was not the only one under that impression) that the solid matter was to be precipitated and removed, and only the clarified water thrown into the river.

950. You have been at the Lodge Farm, have you not?—No.

951. You do not know, then, what the effect actually is of the irrigation by sewage upon land?—Only from reports I have read of it.

952. If the sewage in bulk, and in its existing condition, can be pumped and be applied usefuily and profitably to irrigate land the question then is solved, is it not?—Yes.

953. (*The Commissioner.*) How many years do you say it required to accumulate these 700,000 cubic yards of deposit in the tideway of the Thames?—About three.

954. At 1*s.* 9*d.* it would come to 61 250*l.*, would it not?—Yes.

955. That would involve an expense of about 20,000*l.* a year?—Yes, that is what I put it at.

(*Mr. Philbrick.*) Representing, at 4 per cent., a capital of half a million.

SECOND DAY.

Capt. E Burstal, R.N.

1 July 1869.

Captain E. Burstal, R.N., examined.

956. (*The Commissioner.*) You are secretary to the Thames Conservancy Board?—I am.

957. How long have you practically known the river Thames?—I first knew it as a youngster in the year 1832. I was at work then for some years on the survey of it with Captain Bullock, and I knew the river very well indeed then for about three or four years, and subsequently surveyed on it from time to time.

958. How long have you been secretary to the Thames Conservancy Board?—Nearly 12 years.

959. I think you made a special survey of the river and carried out some important float experiments during the discussion of the question of the metropolitan main drainage?—Yes. Before the Thames Conservancy Board was formed I was associated with Mr. Simpson, Captain Galton, and Mr. Blackwell.

960. Did you carry on these float experiments for them?—Yes: that is to say, the second set of experiments, but the first set of experiments were at the instance of the First Commissioner of Works, Sir Benjamin Hall. That was in 1856, I think, and the object of those experiments was to verify certain observations made by Mr. Frank Foster, as to the oscillating motion of bodies held in suspension in the river Thames, particularly with reference to the question of the selection of a point of outfall near Barking Creek, and with a view to solving the question whether, if the sewage were discharged into the river at or about the time of high water, the material thrown into the river at that time would ever find its way back, and up to London. The result of those experiments was simply a verification of the experiments previously made by Mr. Frank Foster.

961. (*Mr. Lloyd.*) That it would come back to London?—No; a verification of the experiments of Mr. Foster that it would not go back to London. The result of a fortnight's experiments was, that the material put into the river at high water to-day would at high water in a fortnight's time find itself about five miles further towards the sea. At spring tides it goes further up for a few days, and at neap tides it is taken further down.

962. (*The Commissioner.*) The material would oscillate or play about, and in 14 days it would make that progress seaward of five miles?—That was the result of the experiments.

963. That is material floating upon the surface of the water mid-channel?—No; it was more than on the surface, because the experiment was tried with floats 12 feet long, and submerged 12 feet.

964. In one of the allegations the memorialists say: "On inquiry at the office of the Thames Conservancy, "your memorialists have been informed that the "diminution of water in the channel of the river, "consequent upon such deposition of sewage mud, "is no less than from 21 feet to 10 feet at ebb tide, "or a loss of 11 feet of water." Do you know anything of such a loss of depth of water?—No, I do not know how that statement could have got there; it must have been some misapprehension. I think it arose from this (and who gave the information I do not know, I did not give it.) There is a certain amount of truth in it, and I should like to explain. If you take the river proper outside Barking Creek, and three quarters of a mile above it, at various points a good bit out into the river, from there to about Duval's house you will find there is a very large accumulation of mud taking place inshore, and some little distance from low-water mark. I will instance one place in particular, where the "Talbot" powder hulk was moored in 1862, a quarter of a mile above the creek; there was then some 14 or 15 feet of water at low water, but after these metropolitan sewers had been at work the authorities of the Military Store Department at Woolwich were anxious to get that ship away for two reasons, one was that the mud silted up round her so much that barges which used to go alongside at all times of the tide, where the ship lay in 14 feet of water, could not get alongside at all. The attention of the Conservancy Board was then directed to this, and the particular place examined, and we found that not only there, but at several other points in that neighbourhood, where there used to be 14 and 15 feet, as round the "Talbot," there were not more than 4 or 5 feet. There had been a growing up of 9 or 10 feet of accumulations of mud in this part of the river; and I think that must have been the cause for this statement being made of the silting up in the main channel of the river to the extent of 11 feet.

(*Mr. Lloyd.*) It does not mean the main channel of the river; it means in the tideway.

(*Witness.*) There is no such accumulation as that in the main channel of the river used for ordinary navigation purposes, but for a considerable distance outside low-water mark there has been, and is no doubt still going on, a large accumulation of mud off the sewer outfall, both above it and down to Horse End, at the entrance of Barking Creek. I have tried the depth of the deposit there myself with a long pole, and the trace of the mud on the pole showed a depth of 6 or 7 feet of black mud in that part of the Thames.

965. (*The Commissioner.*) The allegation is true enough as regards the depth of mud, then, but it is incorrect as regards the position in which the mud exists?—Yes. I think it is a misapprehension as far as that is concerned.

966. Have you seen that the editors or writers in some of the London newspapers have taken the view that a bar was formed across the main navigable channel of the Thames?—Yes.

967. That of course, as you explain it, was an incorrect view?—Yes. There is a tracing of a survey made by Captain Bullock in 1832, on a scale of 20 inches to a mile. The first survey made by order of our board was in 1861, which was made without any regard to this sewage question at all, but merely for navigation purposes. We compared the soundings over this ground as made in 1861 with those taken in 1832, and it was difficult to find any difference whatever in them in these 30 years. It was difficult to find any difference in the depths; but when we made a survey reduced to the same datum, in 1867, over this same area we found a considerable difference, as stated.

968. I assume that being accustomed to making these surveys, and knowing what is taking place with regard to the volume of sewage and sludge now daily passing into the river, you would have been very much more surprised if you had not found a difference in the soundings?—Yes. We know by past experience where to find a shoal, because on any part of the river through London you will be sure to find a shelf or shoal outside a sewer outfall; that is the case with every one of them in the river; with small sewers to a small extent, and as you must expect to a much larger extent with these large sewer outfalls.

969. Do you remember what was your understanding with regard to the character of the water to be let into the river when the conservators were consulted about the formation of the northern and southern outfalls?—I think the only question the conservators had put before them to deal with was simply to examine the plans of the works of these outfalls, and say whether the works themselves would be injurious to vessels navigating the river. The scheme of the Metropolitan Board of Works has been carried out under the provisions of an Act of Parliament.

970. Mr. Leach says his impression was, that the sewage water without the sediment was alone to go into the river from these main sewers; was that your impression?—The year before the Conservancy Board was formed, and this thing was being discussed by the First Commissioner of Works, Sir Benjamin Hall, (whether I was right or not I will not profess to say,) I was strongly impressed with the idea that the intention was that this sewage should first of all undergo a subsiding process of some 12 hours, and

that then the water alone should run off in its clarified state into the Thames.

971. And not the whole of the sewage with its detritus has brought down be thrown out into the tide-way of the river, as I assume it is now ?—That is my impression.

972. Is there any sediment abstracted that you are aware of from the main sewers or from these reservoirs? Do the Metropolitan Board of Works, that you are aware of, abstract any of the sediment? —I do not know. The only time I ever saw any was some I saw in the Plumstead marshes. There is a good deal of stuff brought up from the gullies in London.

973. In the City ?—Yes, and in the suburbs, too.

974. Have they any apparatus for dredging sediment out of those reservoirs that you know of ?—I believe not. (*Mr. Lloyd.*) The only thing taken away is what they take to Lodge Farm.

975. (*The Commissioner.*) Do you think the estimate of Mr. Leach's is a moderate one, that in three years there has been an accumulation of silt equivalent to 700,000 cubic yards ?—Mr. Leach and I went carefully together over these figures when the first alarm was raised of a deposit going on in Halfway Reach. The southern and northern outfalls were not thought of at that time; and, comparing the survey made in 1861 with that made in 1836, we found that those two surveys were very nearly alike. The water was a little deeper, in fact, in 1861 than in 1836; but, when we came to the survey of 1867, we found in many places (whether from holes being dredged by the Trinity dredging machine, and these being refilled, or from whatever cause we do not know) a very large silting up had taken place—9 or 10 feet of silt—but never up to a height sufficient to affect the general navigation of the river by vessels. At that time when we saw that such a large accumulation had taken place in those few years (and that must have been within three years after the first outfall, which was opened in 1864), we naturally began to be alarmed, and we said, if it is going on at this rate the river will be choked up in a short time. That was our opinion. If, however, it had gone on at that rate we should have heard a great deal more about it than we have, instead of which, surveys made from time to time show that the accumulation has not gone on at that rate. It seems to have dispersed. We hear no complaints so far as the navigation is concerned. The only complaints we do hear are of mud in suspension being carried up the river and deposited on the shores.

976. If the proposition were put to you as between the Metropolitan Board of Works keeping its sewage silt out of the river, or of subsidising you for dredging it out to the extent of 20,000*l.* a year, which would you, as surveying officer and secretary to the Conservancy Board, prefer ?—I would rather they kept it out of the river altogether, for this reason: supposing they gave us 100,000*l.* a year to dredge this deposit from the river, which, perhaps, would be more than was necessary, we should not get rid of this fact, that all surplus filth held in suspension would for a time remain in suspension; and it would be carried up and down tide after tide, until, from time to time, it would be gradually deposited on the shores; therefore there would be that sort of nuisance which the public would very properly complain of. This time two years many complaints were made of the great quantity of mud at Greenwich, Limehouse Reach, and so on. The river Thames water was in a most turbid state, and mud was deposited on the shore, so that the barges were sliding off from the wharves in all directions. Therefore, I think, whatever amount of money were given for dredging we should never get over the polluting of the water and the fouling of the shores.

977. In your opinion, if Parliament is to take any action in this question one way or the other, it had better stipulate that the Metropolitan Board of Works should keep its sewage and mud out of the river rather than subsidize you for taking out the sediment after it has been put in ?—Either that, or to make them go very much further away down the river.

978. You have paid attention to this matter I know, because I remember the evidence you gave before the Rivers Pollution Inquiry. You stated there that in your opinion the metropolitan outfalls ought to have been carried 10 or 15 miles further seaward, and that even then, if poured into the Thames, the sewage ought not to have been discharged by one outfall, but by several, and over a lengthened area of river frontage ?—Yes.

979. Are you of that opinion still ?—Yes; and I think the sewage ought to be taken to some point where the stream and tides run strongly, and where the currents would constantly act on the discharged sewage directly, and not as in a bay like Barking. This is a very bad place in which to discharge the sewage, as there is not a very strong stream in any part of Halfway Reach to carry it away.

980. That is, assuming the London sewage is to continue to be discharged into the Thames and so wasted ?—Yes.

981. If an arrangement could be carried out, such as that entered into with a certain company which you have heard of, for abstracting the whole of the sewage of the northern and southern outfalls, and taking it by an overground sewer for land irrigation, that of course would accomplish the purpose of preventing the pollution and silting of the river ?—Yes; the effluent water would then go off from the lands irrigated in a comparatively clear and limpid state.

982. (*Mr. Lloyd.*) Have you been at Lodge Farm ? —No, I have not.

983. There you would see the sewage water coming away after it has done its work of fertilization perfectly clear. You know that the ground acts as a clarifier and also as a purifier ?—I know the experiments that have been made at many places on sewage, and I know that the sewage after percolation through soil comes out quite clear.

984. You know that the immediate effect of pouring sewage on to the land is to deodorize it also ?—Yes, so long as it does not get too spongy.

985. (*The Commissioner.*) Do you remember the points to which the sewers were proposed to be carried by Messrs. Simpson, Galton, and Blackwell ?—Yes, I conducted all those experiments.

986. Do you retain those opinions now, namely, that it would have been much better to have taken the sewage lower down the river and more out to sea ?—Yes. The stuff would not have gone up to Gravesend; the ebb tide would have taken it down to Sea Reach, and it would then never have been known more of in the upper waters of the Thames.

Cross-examined by Mr. PHILBRICK.

987. You have spoken of accumulations. I do not know whether the silting up in the river Thames, the existence of which was proved by the survey of 1867, was chiefly found in places where the Trinity dredging operations had been carried on or not ?—I think not. The general effect was to level up the bed of the river to a certain height.

988. That is what I understood; that the general effect was to level it up ?—Yes, and in order that there should be no doubt as to the nature of the material deposited, samples were taken, which were subjected to analysis.

989. Which Mr. Leach has told us about ?—Yes.

990. You say that the general effect observed in 1867 was, that the accumulations had a tendency to level up the bed of the river ?—To level up the bed of the river to a certain height.

991. Which was then kept within a certain limit by the scour of the tide ?—I think, from subsequent observations, that appears to have been the case.

992. I do not know whether you are aware of any soundings or measurements taken in the river since 1867 ?—Yes.

SECOND DAY.

Capt. E. Burstal, R.N.

1 July 1869.

993. Has the level to which the accumulations in 1867 had risen been substantially maintained?—It is only fair to tell you that, from surveys made between 1867 and the present time, 1869, there have not been deposits in the main channel of the river Thames opposite to the sewer outfalls to cause serious alarm as to the general navigation of the river being injured.

994. Supposing, for instance, the estimate of 700,000 cubic yards to be well founded, it would not be fair to say that because in the period of time which produced so much, therefore in so many more years so much more must accumulate?—No; but I think the Commissioner put the question under the impression that Mr. Leach considered that this large accumulation having begun, it must go on at a similar rate.

995. But the effect of the subsequent measurements has been to show that about the same state of things exists now in the bed of the river as in 1867?—Yes.

996. (*Mr. Lloyd.*) That is where there is a tidal scour?—Where the stream has a free course. It must be understood that where the sedimentary deposit will increase would be where there are eddies.

997. In backwater?—In slack water, where the stream is not sufficient to carry it away, as is the case at the entrance of Barking Creek.

(*The Commissioner.*) I have some information here in a return which Mr. Bazalgette has prepared, giving these particulars:—"The area sewered "by the northern outfalls is 50 square miles. The "population sewered is about 2,300,000. The ordinary "daily flow, of 24 hours, of sewage into the Thames "at the outfall at Barking is in round figures about "33,000,000 gallons." Then I have another return from Birmingham, in which we have accurate gaugings and no speculation. In Birmingham there is a population of 360,000. The area sewered is 7,320 acres. The weight of material (granite macadam stone) used per annum to repair the streets and roads over the district sewered by the outlet is about 45,000 tons. The cross-sectional dimensions of the outfall sewers, being two egg-shaped mains, are 5 feet 9 inches, and 4 feet. The dry weather volume of sewage per day is 17,000,000 gallons. The area of land used for the outfall works and space for deposit is 12 acres. The dimensions of each of the depositing tanks which are used is 330 feet by 90 feet, each averaging 6 feet deep. The quantity per annum of grit and sludge removed from these tanks is about 42,000 cubic yards. They are doing at Birmingham now what you gentlemen of the Thames Conservancy imagined the Metropolitan Board of Works would have done when they got leave to establish their main sewer outfall works at Barking, and at Crossness. The area of land usually occupied by that sludge at Birmingham is 7 acres, and it is usually accumulated to a depth of 4 feet. It generally remains on the ground from nine to 12 months. They use lime to prevent its smelling in summer, at a cost of 100*l.* per annum. They sell the semi-dried refuse at 9*d.* a ton, when they can get customers for it. Those are the facts with regard to Birmingham; and if you make a rule of three sum of them with regard to the metropolis (and I think the metropolis would have the benefit of such a calculation), we should see whether your 700,000 tons in three years is in excess of the probable quantity or not.

998. (*Mr. Philbrick to the witness.*) You were aware, taking an interest in the question and having reported upon it, that the matter was very much considered among engineers; for instance, Mr. Bidder, Mr. Hawkesley, and Mr. Bazalgette presented a report about the time?—Yes.

999. And there was Mr. Simpson's, Galton's, and Mr. Blackwell's report?—Yes.

1000. There were different plans proposed from time to time?—Yes. I know Messrs. Simpson, Galton, and Blackwell's plan was to carry the sewage by means of an open conduit, or something of that sort, which would no doubt have had a great many opponents, and properly so, too; but that could have been got over.

1001. Without going into details, there were a great many schemes proposed, and there was a great deal of discussion and consideration among engineers as to what was the most advisable thing to do, and what would be the best sort of works?—I suppose there was, but I had very little to do with it then.

1002. You had more to do with the navigation, I suppose?—I was away in the north of Scotland, but was summoned back for the special purpose of conducting those river float experiments, and then afterwards Captain Galton and Mr. Blackwell were united with Mr. Simpson in the work, and they asked Sir Benjamin Hall to associate me with them, for the purpose of carrying on those float experiments, and that is all I had to do with it.

(*The Commissioner to Mr. Philbrick.*) Have you any witnesses to tender?

(*Mr. Philbrick.*) I shall have a body of evidence to lay before you on another day, but at the present moment I have not any witnesses here.

(*The Commissioner.*) Must we now adjourn the inquiry to receive that evidence?

(*Mr. Philbrick.*) If you please, sir. I may at once say, and I think my learned friend who appears for the memorialists will agree with me in that respect, that you yourself on the former occasion at the request of Mr. Brady, who then represented the memorialists, accorded a postponement in order that they might bring evidence to support the distinct allegations of the memorial. By the evidence which has been put before you to-day the matter has assumed a different shape altogether; one understands better what it is, and the gentlemen who have advised the Metropolitan Board of Works upon this matter, and those who were consulted on the formation and carrying out of this scheme, are all anxious to be witnesses before you, and to explain to you exactly what their views were upon the matter, and how far their views have been realised by subsequent events; besides which we are in a condition to lay before you certain distinct and positive evidence as to what has occurred in the river Thames. Soundings have been taken in the river, and the attention of the Metropolitan Board has been called to it, and it has been most carefully watched, and they think it right, the matter involving interests of enormous magnitude, that the evidence should be laid before you; and every information which can be given to you on the part of the Metropolitan Board of Works, in order to enable you to make a report satisfactory to yourself, they will be most happy to lay before you. For that reason I would ask you to adjourn this inquiry to such a day as will suit your convenience.

(*Mr. Lloyd.*) A portion of that evidence I do not see the relevancy of; what may have been thought about it at one time by engineers has gone by now. The question you are upon has a distinct issue, viz., the effect upon Barking, the inhabitants of Barking, and those living near Barking. That is a question of fact. There can be no doubt about the facts. If any examination has been made, or any soundings taken, or experiments tried, that would displace or alter the facts which have been proved by Mr. Leach and Captain Burstal, and other witnesses, of course it would not only be open to my learned friend, but it would be the duty of the Metropolitan Board of Works to bring forward that evidence; but to bring forward evidence to show that they intended to do what was right, or to show what has prevented them from doing it, or whether somebody thought this would not have happened which has happened, is not material or revelant.

(*Mr. Philbrick.*) I am not going to call evidence before you, or to ask you to receive evidence as to what different gentlemen may have thought, but to tender certain scientific opinions which in the results have been justified. With regard to the bulk of the evidence I intend to place before you, it is this: to disprove in a great measure the exaggerated and

inflated statements of this Barking memorial, and to show that, in point of fact, there is no solid foundation for them. With regard to the evidence given by the gentlemen whose names my friend, Mr. Lloyd, mentioned, I have nothing to say except this, that I desire to supplement certain facts in their evidence, and to put you in possession of certain soundings and other data, taken with the utmost care, in order to see how this matter really stands. It is the wish of the Metropolitan Board of Works, not less than it is probably the wish of the Barking memorialists, that the whole matter should be most thoroughly investigated as to matters of fact; and the benefit of having you sent down by the Home Office to report upon this matter, and to take this evidence, and to make the inquiry, is that we have in you a scientific mind, and you will be enabled to draw proper conclusions from that evidence, having the facts before you. I shall not think it right to trouble you with evidence to prove mere matters of opinion, on which you are the proper person to form a judgment.

(*The Commissioner.*) If we adjourn the inquiry, I beg leave to suggest certain points upon which I ask for definite explanation. The principal point is, whether or not there was in the minds of the engineers to the Metropolitan Board of Works any understanding that clarified sewage water should alone go into the river from those reservoirs, or if, according to their ideas, the Metropolitan Board are now carrying out the stipulated arrangement in its entirety as they understood it; that is one of the most important points. My duty is clearly to ascertain facts in relation to the allegations embodied in this memorial, because it directly imputes injury to Barking town, to Barking Creek, and to the river Thames, owing to the discharge of this metropolitan sewage into the river Thames near Barking. It also states that accumulations of sewage mud have taken place injurious to the trade of Barking, and we have evidence from Mr. Leach and Captain Burstal, that accumulations of mud have taken place in the Thames since the metropolitan sewer outlets have commenced. I have a definite statement from Mr. Leach as to the volume of material, in cubic yards, accumulated in the river within three years; and if you have any further facts to give me in diminution or in modification of that statement, it will be for you to tender them.

(*Mr. Philbrick.*) I have, sir.

(*The Commissioner.*) Because we have also this condition, namely, that if a cost of 20,000*l.* a year is to be incurred to rectify the mischief which has been done, it may be worth while for the Metropolitan Board of Works more seriously to consider the matter in all its bearings.

(*Mr. Philbrick.*) Clearly. If any wrong has been done, or any injury has been inflicted, the question is one which falls within the purview of your inquiry.

(*Mr. Lloyd.*) You wished to have some evidence from the sewage farm. I can tender it to you, if you would like to ask any questions about it. On the last occasion it was said that some nuisance proceeded from the sewage farm itself. I am quite prepared to produce evidence to negative that. In the existing state of the works at the sewage farm, not only cannot there be any such nuisance, but I can prove by numberless witnesses, if necessary, that there is no nuisance caused by sewage irrigation.

(*The Commissioner.*) A statement was made at the last sitting that it was not so much the metropolitan sewage in the river Thames that caused the smell that pervaded Barking as the emanations from the land irrigated.

(*Mr. Lloyd.*) That is an entire mistake, as I can prove by a number of witnesses, and you can also have the evidence of your own senses; in fact you have nothing to do but to go there and judge for yourself, or Mr. Hope will give you any information about it.

(*The Commissioner.*) It is not my intention to go into this sewage irrigation question in detail at present, but I may consider it my duty to make a personal inspection of the sewage farm, and to put myself in communication with the gentlemen connected with it; and if they will let me have such facts as they may be possessed of, I shall feel obliged. It will not however be so much a matter of inquiry connected with this Barking memorial as for my own information.

(*Mr. Lloyd.*) You can make any arrangement for that purpose you please.

(*The Commissioner.*) If you wish to put any question to clear up this statement as to stench from the sewage farm, do so.

Mr. William Hope called; examined by Mr. Lloyd. *Mr. W. Hope.*

1003. You of course have yourself seen what has been going on at Lodge Farm since the time the metropolitan sewage matter was brought upon it?—Yes.

1004. You live in the neighbourhood?—Yes.

1005. You are almost daily there?—Yes, several times a week.

1006. I believe there was a time when from some cause or other, which I need not go into now, some sewage was allowed to remain stagnant in an outside ditch?—Yes; there was an old agricultural ditch divided from one of the sewage carriers by a rotten hedge bank, and there was a very considerable leakage from the sewage carrier into that ditch; it leaked in a state of impurity, not having gone over the earth. That I often represented to the company, but the company being not in a very satisfactory condition took no notice of my representations; they allowed the sewage to stagnate and ferment.

1007. Is that at an end now?—Yes; but after all that was no very great affair. There was only a length of 80 or 100 yards.

1008. Is the sewage generally applied to land for agricultural purposes?—Yes, and the Metropolitan Board of Works in a body (with very few exceptions) came down to the sewage farm about two years ago and went all over it to see how we deodorized the sewage. I think it was on the 29th of June; at all events, the end of June 1867, and there was so little smell that they fancied we had deodorized the sewage before we used it.

1009. In fact, there was nothing offensive in the shape of nuisance from the application?—Nothing whatever.

1010. There were no complaints about it then?—No.

1011. (*The Commissioner.*) Have you a plan showing the extent of the estate irrigated?—We can get it.

1012. (*Mr. Lloyd.*) How many acres is the farm?—220. It is a mere experimental farm. We take about $\frac{1}{300}$th part of the dry weather northern outfall sewage. I do not mean that we take nothing but the dry weather sewage, but the amount we take would represent about $\frac{1}{300}$th part of the dry weather flow of sewage through the Barking outfall.

1013. (*The Commissioner.*) Do you take any sediment?—We take it exactly as we get it, sediment and all. Probably we get more than our due proportion of sediment.

1014. Does it take you any trouble to clean the carriers?—None whatever.

1015. From your experience, do you think the Metropolitan Board of Works, supposing the burden were put upon it by Act of Parliament to utilize its sewage, could do it, and so as to save the ratepayers any extra costs or charges?—I am perfectly certain, from the facts in my possession, and from an experience now of four years of the sewage of London, and from observations of the utilization of sewage at other places, that they could do so, not only without cost to

SECOND DAY.

Mr. W. Hope.

1 July 1869.

the ratepayers of the metropolis, but at a very enormous, almost fabulous profit.

1016. Do you think the Metropolitan Board, as a board, could itself farm and utilize the sewage?—That is another question. They are strongly of opinion that they cannot do so. As you are aware, I made an agreement with them some four or five years since to form a company, and obtain an Act of Parliament to divert the sewage, and intercept it altogether from the Thames, and carry it down to Maplin sands. I fulfilled my part of the bargain, that is, I applied to Parliament at my own expense and obtained an Act at a very immense cost. I was opposed by the Lord Mayor and corporation of London, with unlimited means, and by Baron Liebig and various other great names. The result was a continued struggle down to the very last reading in the House of Lords, and the cost was considerably over 30,000*l.* I also made a bargain with certain persons in the city; but for various reasons it has not been carried out hitherto. They agreed to subscribe the capital and carry out the works. They have not yet done so, and I have endeavoured by various negociations to replace them by another set of persons, and several times I have been on the point of success; but I have been always met by this. The Metropolitan Board of Works have stated on many occasions (some of its leading members have stated it verbally, and the board have stated it in writing in official reports to the ratepayers of London) that the utilization of sewage is not a commercial success, and I have therefore been met by that statement, and what was difficult before became almost impossible.

1017. Is the utilization of sewage a commercial failure?—No, it is not so. It is the very greatest mistake that, perhaps, any public body ever made to say so. They mean to say it has not yet been a financial success. That has nothing to do with commercial success, which is one and the same thing with agricultural success, and it is the most complete agricultural success visible now in the three kingdoms. The first authority on these matters, Mr. John Chalmers Morton, has stated in his paper, the "Agricultural Gazette," that he considers the experimental sewage farm of the company at Barking to be one of the farms best worth seeing at this time in the three kingdoms.

1018. (*Mr. Lloyd.*) Are the results satisfactory as respects produce?—More than satisfactory; better than we anticipated.

1019. The Metropolitan Board of Works are to have a per-centage upon the profit after a certain payment, are they not?—They are to receive a fluctuating per-centage on a sliding scale, which equalizes the proportion they receive to half the profit at a certain point; so that practically they would receive half, because that point would always be exceeded.

1020. (*The Commissioner.*) Do you think that there would be any prospect of such a scheme being carried out if the Metropolitan Board of Works were empowered with their credit to offer the collateral security of the rates for such a purpose; do you think that you could get the money at a low rate of interest on such security, they always holding the deeds of the property in hand as security?—I would undertake with such security to provide the whole of the money at one day's notice.

1021. Upon those, or upon similar terms?—Upon equitable terms of that nature.

1022. I mean if you could have the consent and the security of the board?—I believe the shareholders of the existing company would put the money on the table at 24 hours' notice under those conditions.

1023. (*Mr. Lloyd.*) You mean with a guarantee?—Yes.

1024. (*The Commissioner.*) Do you think it may become the duty of corporations to utilize their sewage as a matter of sanitary precaution, whether it pays them or not?—I think so, unquestionably.

1025. Have you paid much attention to the contamination (pollution) of rivers in England?—To a certain extent. I have watched the cases that have come before the Equity Courts very closely for several years past.

1026. Do you know Birmingham?—I know Birmingham, but I never examined the locality with a view to this question.

1027. What is the crop you would irrigate with sewage, expecting to get the greatest profit from?—My ideas upon that point have undergone considerable modification in consequence of the experience we have had. My view formerly was, that the principal crop, at all events, ought to be Italian rye grass, or some form of grass, and that more money could be obtained from that than any other; but experience has shown us that we can get, in fact, better returns from market garden crops, and even perhaps from root crops. At the same time the great bulk of the sewage must be applied to grass crops, inasmuch as they are the only crops which can benefit by it at certain seasons of the year. At times sewage may unquestionably be applied with advantage to fallow land.

1028. Are you aware that there have been difficulties in sewage irrigation, not in respect of the small produce raised, but from there having been too much of it, and not being able to find a profitable market for it?—Yes, I believe there have. I rather think that was to some extent the case at Worthing, but I fancy that has been the case simply because the crops have been restricted to grass.

1029. Do you think it would be possible, taking London as it is, for the sewage to produce more crops than you would have sale for, under proper management?—Quite impossible.

1030. Do you think you have a market that would absorb and take up the greatest amount of produce you could possibly raise from the utilization of the entire sewage of the metropolis?—I do, for this reason: we could always undersell everybody else. We can produce finer and better vegetables for the London market than can be obtained by any other system of farming.

1031. Have you any idea of the gross area in acres that you would require to utilize the sewage of the whole metropolis?—I think it could be utilized on 40,000 or 50,000 acres.

1032. And that would absorb how many thousand tons of sewage per acre?—2,500 or 3,000 tons an acre per annum on the average.

1033. What is the greatest dressing you have given on your land for Italian rye grass?—4,000 tons per acre per annum.

1034. It has not exceeded that?—Not as yet.

1035. Are you aware that from 9,000 to 12,000, and even up to 15,000 and more, tons per acre have been floated on to land?—Yes.

1036. And that the water has been clarified?—Yes. But I hardly think that would continue over a term of years.

1037. Do you know how many tons of sewage they have floated on to the Edinburgh meadows?—As much as 15,000 to 20,000, I daresay.

1037. Would you be surprised to hear that it was 150,000 tons?—Anything is possible there.

1038. They have passed over the meadows at a rate of from 100,000 to 150,000 tons of sewage per annum.—It must have passed away in a very corrupt state.

1039. They are under no stipulations; they have no restrictions?—They have then, I suppose, a limited area and unlimited sewage.

1040. Do you know that the citizens of Edinburgh upon the opposite side of the city have wasted their sewage deliberately?—I have heard of something with regard to the water of Leith; they have been polluting the water of Leith.

1043. They have drained the water of Leith by an intercepting sewer, and carried the sewage to sea out to low water, beyond the harbour of Leith?—Yes.

1044. Past the Leith Docks?—Yes.

1045. And now it is wasted by being carried into low water?—Yes.

1046. Do you know that they would give that sewage to any person willing to go and take it?—Very likely.

1047. There may then be conditions where utilization of sewage is scarcely profitable?—There may be cases in which a town will actually lose by utilizing its sewage, as, for instance, a town situated in a hollow with valuable building land all round, and where sewage must be pumped to a great height, and conveyed to a great distance.

Cross-examined by Mr. PHILBRICK.

1047. This sewage farm at Barking is an El Dorado?—It is.

1048. It is the only one, is it not; you are not aware of any similar undertaking that pays in this country; you are not aware of any town which utilizes its sewage, where there is a profit derived by persons who supply the sewage, are you?—I do not know as to profit. I do not know of any other place where town sewage is properly used.

1049. If the management of this sewage farm can produce those results I cannot quite understand how it is that the mere difference of the guarantee of the Metropolitan Board of Works should affect the confidence of the shareholders in the success of the undertaking?—It is a question of confidence altogether.

1050. The confidence would be in the board rather than in the management of the undertaking. It would be more a question of the solvency of the ratepayers of the Metropolitan Board of Works than in the management of the undertaking?—If it was the case of a small town, where the sewage could be used on one farm, there would be no want of confidence, but it is a case where soil must be obtained for such an enormous bulk of sewage. However, there are certain other questions which it is unnecessary to go into.

1051. The magnitude of the operations involved would be of that class that it would require a very powerful company to carry them out?—Yes.

1052. (*The Commissioner.*) What was the proposed capital of the company you have spoken of?—2,100,000*l.*

1053. How much of the work has been done?—I think the expenditure has been something like a quarter of a million. Now I have obtained a mode of construction which will knock off, I think, two-thirds of the expense.

1054. I believe a portion of the conduit has been formed?—Yes.

1055. Of what diameter?—10 feet.

1056. What was that to cost per lineal yard?—I think the part that has been constructed has cost upwards of 40,000*l.* a mile, irrespective of works of a still more expensive nature for crossing underneath Barking Creek with a syphon, and connecting with the main outfall of the Metropolitan Board of Works.

1057. Those costly works at the outset, before you have been able to get any area of land upon which to reap any profit, have broken you down as a company, then?—They have been the excuse upon which a section of the shareholders, who for other reasons were unwilling to go on, have decided to suspend operations.

1058. Are the operations suspended now?—Not only suspended but stopped altogether.

1059. And, as regards the Metropolitan Board of Works, is the bargain between the Metropolitan Board of Works and the company at an end?—No; that is a somewhat complicated question.

1060. But you are quite confident if the experiment were permitted to go on; that is, the sewage irrigation works were permitted to be carried out, and you could get the sewage to the land as you have indicated, that there need be no fear of any ultimate financial loss?—None whatever.

1061. Even with an expenditure of two millions and a half of capital?—Less than half would be sufficient, but even with that large expenditure there would be no difficulty.

1062. Would there be any difficulty in getting adjoining farmers to purchase dressings of sewage from you?—The best reply to that is this: that the small surplus which we have available at this moment is already being disposed of to neighbouring farmers.

1063. Are you irrigating at this moment?—Yes.

1064. By engines of your own?—By one small engine of 25-horse power.

1065. Do you pay the Metropolitan Board of Works any royalty for the sewage you take?—No.

1066. And they do not attempt to interfere with you?—No.

Adjourned to Thursday, the 15th of July, at 10 o'clock.

THIRD DAY.

Town Hall, Barking, Thursday, 15th July 1869.

Mr. JOHN MCDOUGALL called; examined by Sir JOHN KARSLAKE.

1067. I believe you are surveyor and assistant to the Metropolitan Board of Works, are you not?—Yes.

1068. And you have been with the board and their predecessors for about 20 years?—Yes, 21 years.

1069. Are you well acquainted with the Barking outfall, the creek, and the neighbourhood?—Yes.

1070. Do you produce plans and sections of the different parts of the river Thames and of the creek?—I do.

1071. Have you got a description of them that you can give to the Commissioner?—Shall I go into the matter of the river Thames first, or the creek?

1072. I think we will take the creek first. Were these soundings and sections made under your own superintendence?—They were taken by myself.

1073. I believe you have several different sections and soundings; I think 9 or 10 altogether?—Yes.

1074. Will you give us first your No. 1?—(*Mr. Lloyd.*) Have you got a copy of your plans and sections, or a tracing of them, that I may look at them as you go on, because I shall not understand your evidence unless I see them?—(*The witness handed a tracing to Mr. Lloyd.*)

1075. (*Sir J. Karslake.*) Will you begin with No. 1, and describe where it is?—It is at the creek's mouth.

1076. Just give us the exact position of it?—We have a plan showing the position (*producing the same*).

1077. Are the corresponding sections marked upon that plan?—Yes.

1078. (*Mr. Lloyd.*) For each section you have a line on the plan?—Yes.

(*The Commissioner.*) Is this evidence intended to disprove some of the special allegations contained in this Barking memorial?

THIRD DAY.

Mr. J. McDougall.

15 July 1869.

(*Sir J. Karslake.*) You wished on the last occasion to have some evidence with reference to this matter, and this evidence will go very materially to disprove (I think) many statements which were made with reference to the soundings of the river Thames, the depth of the mud, and so forth. I think you will find this evidence extremely important for this purpose. (*To the witness.*) Now give us section No. 1, as marked upon the plan.

1079. (*The Commissioner.*) That is across what is known as "Horse End?"—Yes.

1080. (*Sir J. Karslake.*) It is from the foot of "Horse End," across the creek?—Yes, across the mouth of the creek, but in a diagonal direction; the other sections are at right angles. This is a cross-section taken over that part of the plan; that is the creek's mouth.

1081. How far is that into the river?—It is a cross-section at the mouth of the creek, in a line with Lawes' Artificial Manure Works.

1082. Where is "Horse End?"—This is "Horse End."

1083. Your first section is taken across here?—Across in that line, A B.

1084. That point is 1 mile 1,574 yards from Barking Quay?—Yes.

1085. What is the bed of the creek at that place formed of?—The present bed is mud.

1086. Is there anything upon that, any lighter mud?—It is a lightish mud; you can drive a small pole from 3 feet or 3 feet 6 inches in the deepest part, and that is the middle of the creek, and then you get into clay or some harder substance.

1087. What is the average grade of the slopes there?

(*Mr. Lloyd.*) There is only one slope; the other side is nearly vertical.

(*Witness.*) One is 1 in 4, and the other is about 1 in 15; it goes in a diagonal direction.

1088. (*Mr. Lloyd.*) I thought you meant by slopes the banks?—The slope of the banks of the creek. That is 1 in 4, and that is 1 in 15.

1089. But you do not call that a slope?—It is not the slope of the bank, it is the slope of the foreshore.

1090. (*Sir J. Karslake.*) At that point in mid-channel of the creek at spring tides, what was the depth of water as ascertained by you?—Between 20 and 21 feet.

1091. When did you take this sounding?—This month.

1092. All these soundings were taken this month then?—Yes, between the latter end of last month and this month—the latter end of June.

1093. What was the width of the channel at that point?—I have the width at high water.

1094. (*Mr. Lloyd.*) Does this blue line show the height of spring tides as you took it?—The blue line represents spring tides.

1095. And the black line represents Ordnance datum?—Yes.

1096. And the hard black line is "Trinity high water," I suppose, marked in letters "T. H. W.?"—Yes.

1097. (*Sir J. Karslake.*) What is the width of the channel at that point?—250 feet.

1098. Now your next, No. 2, is further up the creek?—Yes.

1099. How far is that section taken from Barking Quay?—It is 8,520 feet from Barking Quay.

1100. (*The Commissioner.*) You gave the other distance as a mile and some yards; therefore it will be more convenient if you give this in the same way?—No. 2 is 1 mile 1,080 yards.

1101. (*Sir J. Karslake.*) How far from the creek's mouth?—I have not the distance from the creek's mouth; I have it from Barking Quay.

1102. Of what is the bed of the creek composed at that point?—There is a little mud there, but the true bed is composed of shingle; the side slopes are mud; the centre of the channel is shingle; it is rough ground.

1103. What is the average of the slopes?—About 1 in 8.

(*Mr. Lloyd.*) On one side, and 1 in 5 on the other apparently.

(*Witness.*) I think they are put down on both sides.

1104. (*Sir J. Karslake.*) What is the depth of the water of No. 2?—20 feet 6 inches.

1105. And is the width of the channel at that point 240 feet?—Yes.

1106. Now No. 3. Where is your next point?—That is at the crossing of the Essex Reclamation Company's sewer or pipe.

1107. That is at a distance of 1 mile 856 yards from Barking Quay?—Yes.

1108. What is the bed of the creek composed of at that point?—It is gravel, chalk, and a little river mud—soft mud.

1109. What is the depth of water there?—It is about 19 feet; 19·1 or 19·2.

1110. What is the width of the channel at that point?—That is about 280 feet.

1111. That is also diagonally?—That is diagonally.

1112. Is that marked upon your plan?—Yes.

1113. Now we will go to No. 3a?—There was an old section taken at that place. I have just been inquiring whether we have here both the old and the new section; I want to compare them; one was taken in 1857 and the other in 1858.

1114. When was the old one taken?—In 1857.

1115. Under your superintendence?—No.

1116. Who can speak to it then?—The surveyor who took that section is dead, but we have his documents and all his books.

1117. It was taken by the instructions of the board?—By the instructions of the engineer, and for the crossing of the creek at that time. It was a trial section for the main drainage works.

1118. Have you got that here?—The section is here.

1119. Let us see it.—Here it is (*producing the same*).

1120. Is that from the office of the Board of Works?—Yes.

(*Mr. Lloyd.*) That is not your own?

(*Witness.*) No.

(*Sir J. Karslake.*) It was taken by the direction of the engineer.

(*Mr. Lloyd.*) That may be, but it may be wrong; however, go on.

1121. (*Sir J. Karslake to the witness.*) Let us have the result from that old section?—The new one shows a great improvement in the creek since the old one was taken.

1122–3. Have you got here the old one with the new one under it?—Yes, the new one is below; that is the old section of the creek.

1124. You say that that shows an improvement since 1858?—It shows a larger sectional area in the creek at that point; considerably so.

1125. This is No. 3a; it is at a distance, I believe, of 1 mile 790 yards below Barking Quay?—Yes, that is right.

1126. What is the bed of the creek composed of?—Coarse gravel and stones.

1127. What are the average slopes of the sides?—About 1 in 6 or in 6½; they are rather irregular; they are not regular slopes; that is only a rough estimate of the slopes merely for description.

1128. What sort of mud are they covered with there?—It is a brownish mud; what I call river mud.

1129. Did you gauge it to try the depth of it?—Yes.

1130. What did you find it to be?—It is from 6 inches to 2 feet in depth.

1131. What is the depth of water in mid-channel, spring tides?—About 19·2 feet; nearly 19 ft. 3 in.

1132. What is the width of the channel?—About 215 feet.

1133. Now let us go to No. 4; that is 1 mile 606 yards below Barking Quay?—Yes.

1134. What is the character of the bed of the creek at that point?—It is shingle and gravel.

1135. Are the sides of the same sort of mud?—Yes.

1136. And the slope is about what?—It is about 1 in 3, and in parts 1 in 4.

1137. What is the depth of the water in mid-channel, spring tides?—19½ feet.

1138. The width of the channel is about 200 feet, is it not?—Yes, about that.

1139. Now No. 5. Is that 1 mile 140 yards from Barking Quay?—Yes.

1140. Is the bed there gravel and chalk?—Yes.

1141. The sides slope about 1 in 5, are they not?—Yes; and the bottom is composed of hard mud, and at one place it is covered with about 6 inches of black mud; that is near the deepest part in the mid-channel.

1142. The depth of water is 18 feet, I believe?—Yes.

1143. And the width about 190 feet?—Yes, 190 feet.

1144. Now we will go to No. 6. That is 1,400 yards from Barking Quay?—Yes.

1145. Is the bed of the creek there shingle and gravel?—Yes.

1146. What are the sides?—The sides slope 1 in 6, and are covered with mud from 6 inches to a foot.

1147. The depth of the water there is 16·8 feet, I believe?—16·8 feet, up to 16 feet 10 inches.

1148. The width is about 160 feet?—Yes.

1149. Now No. 7. Is that about 917 yards from Barking Quay?—Yes.

1150. Is the bed shingle and gravel?—Yes.

1151. The slopes are about 1 in 5?—Yes.

1152. Is that river mud?—It is formed of river mud.

1153. Covered with soft mud?—Covered with soft mud to a depth of about 1 to 2 feet. The depth of water is about 13 feet.

1154. And the width about 160 feet?—Yes.

1155. Now the next, No. 8, is at the upper end of the jute works?—Yes.

1156. Is that shingle and coarse gravel?—Yes, it is, in mid-channel.

1157. Is the slope about 1 in 5?—Yes.

1158. What are the banks there?—There are about 6 inches of mixed mud, clay and black deposit—mixed mud.

1159. That is on one side?—Yes.

1160. The opposite side is about 1 in 1?—Yes.

1161. Composed of river mud?—River mud and clay.

1162. What is the depth there?—13·4 feet.

1163. Is the width 145 feet?—Yes.

1164. Now let us go to No. 9, "Hewitt's Wharf;" that is about 166 yards from Barking Quay, is it not?—Yes.

1165. Is the bed of the creek there gravel and stones?—Yes.

1166. Is the slope also gravel and stones?—It is also gravel and stones, with the exception of a light clay about high water, on the left hand or west side.

1167. That is close to the wharf, is it not?—No, on the opposite side of the wharf, because at the wharf there is the wharf wall.

1168. (*Mr. Philbrick.*) The quay wall?—Yes.

1169. (*Sir J. Karslake.*) The depth is 12 feet 6 inches, I think?—Yes, 12 feet 6 inches.

1170. Those soundings are what you took in the creek itself?—Yes.

1171. In this year?—In June and the beginning of July this year. The part of this section which is tinted red is shingle, and the mud is coloured all along here.

1172. Have you also taken some sections in the river Thames?—I have soundings of the river Thames.

1173. Who did you take them with?—I took them myself.

1174. When?—I took several in 1864, some in 1867, and the others in 1868.

1175. We had better go to those by-and-bye.—I have got some in 1869.

1176. We will defer those for the present. You were engaged for some little time in preparing these different sections?—Yes.

1177. On taking the soundings, did you observe anything at all disagreeable to the smell more than you would observe from ordinary river mud in the creek?—No.

1178. Comparing it with the Medway and other rivers of that description, was there anything more than you ordinarily observe?—The river Medway mud looks far worse, as far as appearance goes.

(*Mr. Lloyd.*) You were asked distinctly as to the smell?

(*Witness.*) I found no smell in Barking Creek mud.

1179. (*Sir J. Karslake.*) As regards the quantity of mud which you find in the creek, would you expect it would be so free from mud as the Thames itself, where there is the action of steamers passing up and down?—Certainly not.

1180. Has that a considerable effect in freeing the river Thames from mud?—The steam traffic on the Thames certainly prevents a large quantity of the mud from depositing—it washes it away; whereas there is no such action in Barking Creek, either by steamers or by storms; it is so protected by the winding course that it assumes, that even the wind does not act much on the water, especially in summer time.

1181. It is protected even from the wind?—Yes.

1182. And that facilitates the deposit of mud on the banks?—I should say so; that is my opinion.

1183. Is the consequence of that that it accumulates on the banks until by its weight it topples over, and at last gets into the course of the river itself?—Sewage deposit has no chance of standing long on those slopes, because by the action of any wind there may be and the water it slips down into the stream and is washed away at or near low water from the creek's mouth.

1184. Before the main drainage works discharged into the Thames at all by the northern outfall, had you to make surveys and take soundings in the Thames in that neighbourhood?—Yes, in the year we opened the main sewerage works, and also a few months before the works were actually opened.

1185. Did you observe the state of the banks in the river Thames, as far as mud was concerned, at that time?—Yes, and I cannot see much difference in the description of the mud there now.

1186. Was there mud there then?—Yes, a very large quantity indeed.

1187. At that time?—At that time.

1188. That was before the metropolitan sewers outfall was opened at all?—That was before the outfall was opened.

1189. Was that the time you took the soundings?—That was the time I took the first soundings—in 1864.

1190. We will come to the soundings by-and-bye, if you please. Whereabouts is "Tripcock"; is that in Barking Reach?—It is called Tripcock, or Barking Reach.

1191. The names are synonymous then?—Yes.

1192. Had you to examine that at that time?—Yes.

1193. How was that part of the river Thames as regards mud?—There was a large quantity of mud there. That is on the Kent side; a very large quantity.

1194. In other places, when you were examining at that time, did you find large deposits of mud in the river?—Yes.

1195. Before that outfall (the northern outfall) was opened at all?—Yes.

1196. Was that mud of a similar character to what you now find in Barking Creek?—Yes. I see little or no difference, as far as I can judge, from the appearance of it.

1197. Were you yourself down the creek at the time that the Essex Reclamation Company's sewage conduit works were going on?—I was backwards and forwards.

THIRD DAY.

Mr. J. McDougall.

15 July 1869.

1198. Describe the coffer dam which was put up there for the purpose of carrying the syphon sewage conduit pipe across the creek?—The coffer dam was first constructed to carry the pipe about half way across which of course necessitated the coffer dam to be constructed a little more than half way across the creek, and when that part of the syphon pipe was laid the other half was constructed.

1199. The othe half of the creek was then blocked wih the coffer dam?—Yes.

1200. Can you tell me whether that coffer dam had the effect of causing a deposit of mud in the creek?—I believe it caused an obstruction to the flow and ebb of the tide. There was a deposit of mud temporarily lodged there, but I believe it is nearly all cleared away by this time.

1201. It is all cleared away from that point?—I do not think there is anything in that that will be injurious to the creek hereafter.

1202. Do you know at all whether since the removal of that coffer dam, and those works have been completed, the mouth of the creek has become deeper than before?—From what I observed last year in trying to get up in a small boat at low water, I should say so. I could not do then what I can do this year.

1203. Do you think there has been a scour since that time and a deepening of the mouth?—I think so.

1204. Have you also made a careful examination of the state of the water in the creek nearer Barking?—Yes, this year.

1205. I think you were up the creek on the 26th of June this year?—Yes.

1206. At that time was the tide out of the creek?—No, the tide was not out, because if it had been we could not have got up in a boat.

1207. Not fully out, you mean?—No, not by a long way, or we could not have got up.

1208. Did you examine the water between the malt-house and the tidal sluice?—We got up the creek that day. I understand your question now.

1209. If you look at your memorandum we shall get on faster?—When we got up to the malt-house we noticed the water in the creek was very dirty and of a brown colour; then the tide was on the turn, the tide was flowing up towards Barking Quay, and the water was of a very dark brown or chocolate colour.

1210. It was forced back by the tide?—Yes, we noticed it first on getting up to the malt-house, but on examining the state of the creek at the basin, I found the dirty water was coming down past the flour mills.

1211. Was the water there of a different character from that which you found in the creek itself lower down?—It did not look so bad above, because after flowing over and through the sluice it caused a froth, and stirred it up, and, when mixed with the water in the creek, it looked worse below the tidal sluice than above.

1212. Did you take particular notice of the shoal in the river Thames, a little below the creek's mouth, in the year 1864?—Yes.

1213. That is what they call "the Shelf," is it not?—Some call it the "Shelf," and others call it the "Shoal."

1214. Is it gravel, sand, clay, and so on?—It is a mixture of clay and gravel; on the top it appears to be clean gravel or shingle.

1215. Do you know whether that is dredged at all?—I believe not. I have never heard of its being dredged.

1216. Then it remains in the same state now as it has been in for many years, as far as you know?—It remains there; whether it is increasing or decreasing I cannot say exactly. I should rather say it is increasing.

1217. Does your business call you up and down the river Thames a good deal, so as to enable you to notice what is going on there?—Yes, for the last few years every summer I have taken soundings.

1218. Have you noticed from time to time mud barges being discharged into the Thames?—Yes, I have.

1219. What operations were going on when you observed that?—One day I was going down the river, and they were cleansing out or dredging the Arsenal Canal; there was a mud barge lying on the foreshore, and they were shovelling the mud out into the river as fast as they could empty the barge.

1220. Have you seen that done at other times?—I have seen the Trinity dredgers off Barking Creek in the same month.

1221. Doing what?—They were throwing the stuff that they dredged up back into the river again. I can give the date, and can call a witness to prove it.

1222. When was that?—In June or July 1868.

1223. About May 1868, I believe?—Yes, and the other was in June or July 1868.

1223*a*. It has been said, but I do not know whether truly or not, that fish in Barking Creek have been poisoned by sewage. According to your experience, does sewage matter have that effect upon fish?—I do not think sewage matter itself has. I think it is the chemicals used at the paper works above. I know as a fact that the main outlet of the Windsor sewers is the best place for catching fish on the Thames. That may appear an extraordinary thing, but I believe it to be the fact.

1224. I believe if you extended your explorations to Richmond you would find the same thing?—I do not know it of Richmond as a fact, but I know it to be the fact, as far as Windsor is concerned.

1225. On the 24th of June in this year did you start from Hewitt's Wharf, at the lower end of Barking basin, and travel along the creek in mid-channel?—I did not, but I got two men to do it.

1226. Did you go with them?—Yes, I started them down the bed of the creek; I walked along the bank. I did not go in the creek, but I saw that the men performed the journey.

1227. From what point to what point; I believe you have got a map showing the points?—Yes, I have them marked on this section.

1228. Show that to the Commissioner.—There is a star marked on the plan (*producing the same*).

1229. Where did the men start from?—They started from the bottom of Barking basin, and walked down to a point just below the Reclamation Works.

1230. You made them walk at low water in the creek?—In the bed of the channel.

1231. You walked on the bank?—Yes.

1232. Were they able, so far as mud was concerned, to get down?—There was no mud whatever.

1233. How long did they take in doing this?—45 minutes, or at the rate of two miles an hour; and only for the depth of water and the tide backing up they could have gone on 1,000 or 1,200 feet feet further.

1234. You have stated that you made soundings in the river Thames?—Yes.

1235. Where did you begin making the soundings; that map has marks on it which correspond with your sections?—Yes.

1236. What was the date of the first soundings you made?—1864.

1237. That was before the metropolitan sewage was discharged from your works into the Thames at all?—Yes.

1238. Where is No. 1?—In Gallions Reach.

1239. How high above the outfall of the main sewer?—About 1,600 or 1,900 feet.

1240. Above the present northern outfall?—Yes.

1241. Have you taken soundings since, from time to time?—Yes.

1242. At the same points?—Yes.

1243. Will you give us what they were in 1864; first of all at No. 1?—I beg pardon, they were not taken so far up in 1864.

1244. Then give us the right place where they were taken in 1864?—They were taken in 1867 up to that place (*pointing to the map*), but in 1864 we did not go so far up.

1245. Tell us where you did take them in 1864?

(*The Commissioner.*) I assume the witness is not going into every detail marked on this plan.

(*Sir J. Karslake.*) We must go into details to some

extent. You have had evidence given as to an amount of about 700,000 cubic yards of increase of mud in the Thames in three years. What we propose to show is by soundings taken from 1864 down to the present time, that it is a perfect fallacy to say that there has been 700,000 cubic yards of increase in this part of the river; we show a decrease. It seems to me most essential evidence with regard to the Thames navigation question which is before you.

(*The Commissioner.*) The Thames conservancy have produced tracings of soundings, and if you had a copy of them you could see whether they are right or wrong.

(*Sir J. Karslake.*) They may be perfectly right as to the moment they were taken. What we propose to produce before you are soundings taken from 1864 down to the present time, which show an increase in some places, and a scour or decrease in other places; and we say there is much less mud now in this reach of the Thames than there was in 1864 or in 1867, and that the increase of 700,000 cubic yards, which is spoken to by the Conservancy Board, in certain parts is an entire mistake, if you spread that over the entire area and see what the scour has been in other parts. It is all very well to say that on certain mud banks there is an increase, but that will be found to be a fallacy when I have laid the evidence before you of all these soundings and call the witnesses who will speak to their accuracy. That no doubt will take some time, but there is no other way of doing it. I believe it will be found that we do not differ much with the Thames conservators in substance. I think we make it rather more than they do, if I am right, as far as the soundings go, at the time they took theirs; but when you come to inquire into the question whether the river Thames within a certain space has been silted up or not, as is said to be the case, you will find these soundings of ours show that such has not been the case, but that there has been a decrease instead of an increase.

(*Mr. Lloyd.*) You were not here on the last occasion, therefore perhaps you will allow me to inform you that the question rather was not whether the main navigated channel of the river Thames had been silted up at all, or any impediment caused to the general waterway for the purposes of navigation, but whether a large bank of mud had not been formed and was still forming in the neighbourhood of this "Horse End" shoal.

(*Sir J. Karslake.*) I am aware that that part of the memorial of the inhabitants of Barking which states that some injury has been caused to the navigation has been entirely disproved.

(*Mr. Lloyd.*) We are not speaking of the same thing. If you are going to show that soundings taken by the engineer and secretary of the Thames conservators are wrong, of course that is worth something, but if you are going to another part of the river Thames to show that the main channel, as a whole, has not been silted up, that is an immaterial issue.

(*Sir J. Karslake.*) I am going to give evidence which will show that the Barking memorial is founded in error, and calculated to raise an erroneous impression.

(*Mr. Lloyd.*) It has been explained before that it was a misapprehension to suppose that there is any statement in the memorial intended to allege that the general waterway or main channel of the river Thames has been obstructed by the deposition of sewage mud. What the memorialists do allege and what they have proved is, that there is a large mud-bank formed opposite the creek at Horse End which prevents vessels entering and so getting up the creek as they used to do; that it extends upwards a considerable distance, and that the deposit consists of an accumulation of street grit and sewage matter to the extent of that large quantity which has been mentioned, namely, 700,000 cubic yards. If there are any means of disproving that, well and good, but the rest is not *ad idem* and not material to the issue.

(*Sir J. Karslake.*) Having read the evidence which was given on the last occasion, and knowing what the evidence I am going to adduce is, I tell the Commissioner that I think the evidence which I now propose to adduce is extremely material.

(*Mr. Lloyd.*) Very well.

(*The Commissioner.*) I should be very sorry to stop such evidence as you may consider to be necessary, but at the same time I have no wish to prolong this inquiry unduly. I may however state, before this gentleman proceeds with his evidence that with regard to soundings taken upon any particular occasion, and which were taken for a special purpose, knowing what is the ordinary conduct of tidal rivers, apart from the question of any admission of mud or silt from the outfall sewers of the Metropolitan Board of Works, I am perfectly sure, with regard to the shores of the Thames between low and high water mark, that the surfaces of the banks of mud are not the same for two consecutive tides. They are always altering, and he would be a very bold man who would swear that such alteration was owing wholly to either one cause or another.

(*Sir J. Karslake.*) What I propose to do is to show what are the facts as regards these soundings, and then applying the evidence which I shall get from this gentleman, I shall call scientific witnesses before you for the purpose of showing that that which is said to be a large bank of mud raised by the sewage from this outfall in the river is not a bank formed by the sewage at all; as that bank will disappear as other banks of mud have disappeared from time to time in this shifting current, and that the deposit which is attributed entirely, or which is suggested up to the present moment to be attributable, to the sewage of the Metropolitan Board is not rightly attributable to the operations of the Board at all. I should have thought that was most important evidence.

(*The Commissioner.*) I do not wish to stop such evidence. If it is considered necessary to convey any such information to the general public, well and good, but I may say that it will convey no information to me.

(*Sir J. Karslake.*) I shall be perfectly willing to do this if you like. I will assume that these soundings which I am going to put in are correctly taken; and then, assuming that these soundings are correctly taken, I will apply the evidence of the scientific witnesses as to the result to be arrived at from the facts founded upon those soundings.

(*The Commissioner.*) I may state that Mr. Leach's evidence went to this on the last occasion. That soundings had been taken over this reach of the river Thames, at an interval of 30 years previous to the opening of the metropolitan main sewers outfalls, and that during all this time little or no alteration in the hard bottom or beach of the Thames had taken place; but that since the opening of the main sewers outfalls there have been large accumulations of mud in places defined and marked on these tracings to the extent of 10 or 11 feet. If the soundings of this gentleman can show that there is no such accumulation, then it becomes a dispute as to accuracy, or otherwise, between the soundings taken by the Thames conservators and soundings taken by the Metropolitan Board of Works.

(*Sir J. Karslake.*) I think you will find there is no dispute on that point, only I believe that we bring down the soundings to a much later period than the Thames Conservancy do.

(*The Commissioner.*) Mr. Leach will speak to his own soundings subsequently. I am only anxious to save time.

(*Sir J. Karslake.*) At the same time this inquiry is of very great importance, not only to the general public, but also to the ratepayers of the metropolis, who are now taxed to a very considerable extent for these main sewerage works.

(*Mr. Lloyd.*) They need not be taxed at all. It is their own fault if they are.

(*Sir J. Karslake.*) I say it is not their own fault by any means.

(*The Commissioner.*) I am quite willing to let the inquiry go on, having given and received these explanations.

(*Sir J. Karslake.*) I am obliged to you, sir. In the exercise of my discretion I am anxious that this evidence should be laid before you and before the public.

THIRD DAY.

Mr. J. McDougall.

15 July 1869.

I will assume the accuracy of these soundings as given to Mr. Bazalgette and others. Of course I will prove them afterwards, if you think it necessary. I will give the scientific opinions on the soundings, or I will prove the soundings at once. I will take whichever course you think is most convenient.

(*The Commissoner.*) I do not think it will lead to any good purpose to continue detailed verbal evidence as to plans and sections. If this plan is put in it can be compared with Mr. Leach's soundings, and if any differences exist such can be ascertained in that way; but if you still think it necessary to continue the verbal evidence from this gentleman's mouth I will not interfere further, but let him give such evidence as far as you may wish.

(*Sir J. Karslake.*) I am quite willing to take that course. (*To the witness.*) Will you give us your earliest sounding in 1864, and the place where that sounding was taken?

(*Mr. Lloyd.*) We should have Mr. Leach's plan before us to see whether the soundings are identical in position.

(*The Commissioner.*) Mr. Leach's plan is very full of figures, and the soundings are over the same ground. They have been taken at intervals, and are recorded in blue, red, and black figures; but it will be impossible in this room, upon this table, and before this company, to go into a comparative examination of these plans and these numerous figures.

(*Mr. Lloyd.*) I quite agree.

(*The Commissioner.*) It would be most confusing.

(*Sir J. Karslake.*) When this witness has proved these soundings, the rest of the evidence with regard to them will be given by Mr. Bazalgette and other scientific witnesses, and you will get on your notes from them what the result of them is.

(*The Commissioner.*) I only wished to make these explanations in order to avoid as much as possible an accumulation of minute details from this gentleman's verbal evidence, which I do not see my way to subsequently making available.

(*Sir J. Karslake.*) Although it may not appear available at the present moment, I think it is evidence which is essential, because it is the foundation of other evidence which I am going to lay before you for the purpose of showing that these charges which are made against the Metropolitan Board of Works of having silted up the Thames, and injured the navigation, and so forth, are unfounded.

(*The Commissioner.*) Very well, then, we will go on with it.

(*Sir J. Karslake.*) I will take it as short as we can; but the soundings to which this gentleman will speak are data from which other gentlemen who have not sounded the river themselves are going to speak scientifically, and give their opinions upon the question.

(*Mr. Lloyd.*) Let me ask you whether duplicates of these plans have been supplied to the Thames conservators so as to enable them to look at them?

(*Sir J. Karslake.*) I do not know anything about the Thames conservators, or whether the plans have been sent to them or not.

(*The Commissioner.*) How long, as far as concerns yourself, will this inquiry take? You cannot get through it to-day, I suppose?

(*Sir J. Karslake.*) No.

(*The Commissioner.*) I propose, if this inquiry goes on beyond to-day, that our future meetings shall be in London and not here.

(*Mr. Lloyd.*) If there is an interval, these plans ought to be submitted to Mr. Leach and Captain Burstal to look at.

(*Sir J. Karslake.*) I cannot understand what the objection you are making is. A charge is made by the Barking memorialists that we have caused the town of Barking to become a sink of filth, and they say that, as far as they themselves are concerned, they are utterly innocent of having made a bad smell in Barking at all.

(*Mr. Lloyd.*) No, we never said that.

(*Sir J. Karslake.*) And, moreover, that we have silted up the Thames and destroyed or injured the navigation; and then you say, "Have the Thames conservators seen these plans?" I do not suppose they have, but they will have a fair opportunity in the course of this investigation of seeing them. If instead of discussing this matter I were allowed to go on with the case on behalf of the metropolitan board, I think you will find that probably the conservators will not disagree with the plans. I believe, so far as the plans of the Thames conservators are before us, they will be admitted to be accurate, or nearly accurate. But I am going to a further question, for the purpose of giving evidence which I believe to be most essential.

(*Mr. Lloyd.*) What I mean is this, that we do not allege that the navigable waterway of the Thames, as a navigable river, has been seriously interfered with at all. The allegation is, that there is a mud bank formed near Barking, a bank formed at or near "Horse End," and on the shore of the Thames above, as to the accuracy of which allegation I do not believe there can be the slightest doubt.

(*Sir J. Karslake.*) Perhaps even you may doubt it as soon as you have heard the evidence.

(*Mr. Lloyd.*) You say you do not disagree with Mr. Leach's soundings. If you are going upon another question altogether, as to whether the navigable way of the Thames has been interfered with, we do not state that it has. You may take that as admitted.

(*Sir J. Karslake.*) I am not going upon that alone by any means. I am going to the further question, whether what you say has been the increase of deposit in the river is attributable to the works in connexion with the metropolitan main sewerage.

(*Mr. Lloyd.*) Then we need not have the soundings, we may admit the soundings.

(*Sir J. Karslake.*) If you admit the soundings you need not cross-examine upon them.

(*Mr. Lloyd.*) You say ours are not incorrect; and also that there is no difference between them.

1246. (*Sir J. Karslake to the witness.*) Give us No. 1 of 1864?—1864 brings us down to No. 13.

1247. Does the plan which is before the Commissioner show where No. 1 of 1864 is?—No. 1 of 1864 is No. 13 now. We have extended our soundings since then, as soon as we found out that the Thames conservators had taken their soundings.

1248. I want to know, by reference to this plan, what your No. 1 of 1864 is?—No. 13.

1249. What is No. 2?—We have no No. 2. No. 13 on this plan was the highest section that was taken of the river in 1864. We extended them in 1867, 1868, and 1869, but not in 1864.

1250. No. 13 was the highest up?—Yes.

1251. What was the lowest down?—We have them a long way down.

1252. How far down?—Down to No. 68, near Rainham Creek; but I am only prepared to speak to the neighbourhood of Barking Creek, not having finished this year's soundings.

1253. How many sections have you got for 1864 in the neighbourhood of Barking Creek?—Here is the first in 1864 (*producing the same*). The hard black line is 1869. There are four different series of sections.

1254. Is the black line 1864?—The black dotted line is 1864, the red dotted line is 1867, the blue dotted line 1868, and the black hard line 1869.

1255. Are those accurate?—I believe so; as accurate as I could take them.

1256. When you had finished those sections you took them to Mr. Bazalgette?—Yes.

1257. Just give me the map which you say those sections refer to; how far down do those go?—They go altogether near to Rainham Creek.

1258. I mean these?—They go half way between Barking Creek and Crossness.

1259. What time in 1869 did you take your last soundings?—In May and June.

1260. And you are going on with them now, I believe?—Yes.

1261. In 1868, when were your soundings taken?—They were taken in May, June, and July.

1262. And in 1867 about the same time again?—Yes.

Cross-examined by Mr. LLOYD.

1263. First, about the creek. There are back sluices just above Barking Quay which flush into the creek from the mills above?—Yes.

1264. There is a scour goes on there?—Yes, at the flour mills below.

1265. That will keep the bottom of the channel tolerably free, I suppose, from deposit?—When the tide will be out.

1266. Then the scour of the backwater tells, of course?—Yes.

1267. Did you examine the sides on that occasion, when you walked down the creek, as you say, with the men?—They walked.

1268. Did they walk straight down the middle?—They walked along the middle.

1269. They did not get into any of those pools?—They got 3 or 4 feet down in some places where there was a pool; they did not deviate their course.

1270. Did they try to land?—They tried to land when they wanted to get out.

1271. Did they try to get on shore at any part of the way while they were getting down?—No.

1272. Did you try to get to them?—No.

1273. It would have been rather important if you had ascertained what depth of mud there was between you when they were walking down—they walking down the middle, and you walking along on the bank?—Yes, but we tried the depth of mud when the tide was up; we took the depth with the poles.

1274. You did not try it when they (the men) were walking down?—No.

1275. Do you think they could have got to you if they had tried?—Yes.

1276. But in what state would they have been in?—They would have been rather muddy, no doubt, and they would have been in the same state 20 years ago.

1277. That is not the question?—I have known the creek 20 years, and I have seen very little difference in it.

1278. You said you took some soundings of the mud itself; what did you take them with?—With a pole.

1279. What sort of a pole?—A long pole; a round pole with an iron ring and a spike on the top of it. We did not take it with a jumping-pole, which is a thing which would not go down at all.

1280. Are you sure you got to the bottom of it?—It went as far as the men could drive it.

1281. And when you took it up again it was all nice and clean, I suppose?—There was nothing different to what I found in the river years ago.

1282. I daresay not, opposite the creek?—It was the same as it was years ago.

1283. Did you apply your nose to it at all?—Yes.

1284. It did not smell at all badly?—No, not particularly.

1285. Perhaps your olfactory nerves are not very sensitive?—Very likely not.

1286. What was the character of it, slimy or greasy?—A kind of loamy clay—a loam with very fine sand.

1287. Of a light colour?—Well, I think I have described it already.

1288. Was it a light colour?—Some of it was light and some of it dark, and some of it was what I call mixed mud.

1289. I mean where you took the soundings and drew up your pole, was it of a light colour?—In some places it was a light colour; in some places it was mixed mud.

1290. And some dark, you say—black?—We found in one place six inches of dark mud, as I have described.

1291. What sort of mud was it?—Black mud, the same as you get out of ditches even inland, in which you find the same sort of mud.

1292. Where the ditches are stagnant you get the same sort of thing?—All the marsh ditches are stagnant to a certain extent, except when the water is let out at low water.

1293. Did you ever try the effect of endeavouring to come up the creek with a billy-boy, or a large barge?—No, I have not tried that.

1294. Do you know whether there is a mud-bank formed opposite to the mouth of the creek at "Horse End?" Is there or is there not?—I have not found one, not a bank of mud.

1295. Do you mean to say there is not?—Not a bank of mud.

1296. Nor any deposit of mud there?—There is a deposit of mud there, and so there is above and below.

1297. I am asking you a simple question.—There is mud there.

1298. What is the depth of that deposit?—3 feet 6 inches is the deepest I could get.

1299. Do you mean to say that the notion of there being 6 or 7 feet deposit is inaccurate?—It depends upon the appliances you use for getting down; but in an ordinary place, after getting down 3 feet, or 3 feet 6 inches, you get into hard clay or hard soil.

1300. Not at this particular place?—Yes, at this particular place.

1301. Just point out on the map what place you are speaking of exactly. I am speaking of the Horse End, the bank at the end there?—I do not know what you are referring to. I suppose there is the foreshore.

1302. There is no mud bank?—There is the foreshore.

1303. There is no deposit of mud off the mouth of the creek at Horse End, is there?—It is all mud-bank there, like the rest of the river.

1304. You will undertake to say from your personal knowledge that there is no difference in that respect now from what there was years ago; do you mean to say that?—I cannot see any difference myself.

1305. Do you undertake to say that there is not?—I give you my opinion.

1306. But I want the fact from you. Is it or is it not in the same state as it was in seven years ago, or ten years ago?—I think my sections show that there is a decrease of mud there from what there was in 1864.

1307. Will you show me any section that you took off Horse End in 1864?—It is on these sections, Nos. 21 and 22.

1308. Show it to us on the map itself. Where is it?

(*The Commissioner.*) You have not figured the soundings on this section?

(*Witness.*) We have a large section with the figures on.

1309. (*Mr. Lloyd.*) That gives me no information. I want to know where it is with reference to Horse End. Here is Horse End on this side. (*To the witness.*) Do you understand where it is?—Yes, there it is (*pointing it out on the plan*).

1310. Where do you say it is?—There it is.

1311. No, no, that is not the place?—Perhaps that is the tail; that is what I know as the Horse End.

1312. Will you undertake to say that you ever yourself took a single sounding opposite Barking Creek mouth in 1864; let me know the fact?—The nearest to it is just at the upper corner of Mr. Lawes' works.

1313. That is not it. I want to know whether you will undertake to say that you yourself took any soundings whatever at the mouth of Barking Creek, by the Horse End?—You will find, if you look at this plan, that the section goes across the mouth of the creek.

1314. That is opposite Mr. Lawes' works?—No, I did not take one at this point (*pointing to the plan*).

1315. You have taken it in a diagonal line?—This year I have.

1316. In 1864, did you take any soundings across the creek at all?—Not across the creek.

1317. Where did you take any, in the river?—Across the Thames.

THIRD DAY.
Mr. J. McDougall.
15 July 1869.

1318. Where?—From here to here (*pointing to the plan*).

1319. Have you ever taken soundings in 1864 or at any other time off Horse End?—I have.

1320. When?—In 1864, 1867, 1868, and 1869.

1321. Show us which they are?—Do you want the position of them?

1322. I want to know the exact position of the parts where you sounded?—If you cannot see them on the plan I must take you to the ground to show you the places.

1323. Did you go up as far as this, do you mean?—That is the corner of Horse End. I went right across the Thames.

1324. What is this black figure here?—That was taken in 1864.

1325. Did you take it?—Yes.

1326. And the next one?—Yes.

1327. And the next?—Yes.

1328. On what occasion and for what purpose did you take those?—To know the character of the river Thames, before we discharged our sewage into it.

1329. You were instructed by the Metropolitan Board to do that?—Yes.

1330. And this is the line of soundings you took across the river at that point?—Yes.

1331. What do these red figures represent?—The soundings that were taken in 1867.

1332. You did not come up so far as the 1864 soundings then?—It depended upon the state of the tide at the time they were taken.

1333. These red figures all represent what you took in 1866?—No, 1864 and 1867.

1334. Which is the nearest point that you have ever come to this Horse End at any period?—We came there every time.

1335. You call this the Horse End?—That is called Horse End, so far as I know.

1336. Have you seen the soundings that were taken by Mr. Leach?—I saw a tracing of them at one time.

1337. I mean those which were proved on the last occasion?—I just had a sight of them.

1338. Have you taken any soundings in the same places in which those soundings were taken?—I believe all my soundings are taken on his line of soundings.

1339. Just show us by comparison between the two how that is; put them together and let us see whether you have gone over the same ground?

(*The Commissioner.*) I am afraid, Mr. Lloyd, we cannot enter into this portion of the question here; there is no convenience for doing it.

(*Mr. Lloyd.*) Perhaps I may just ask my learned friend, Is it intended to impeach the accuracy of the soundings taken by the engineer and secretary of the Thames Conservancy Board?

(*Sir J. Karslake.*) I believe I may say substantially not.

(*The Witness.*) I believe we agree remarkably well.

(*Sir J. Karslake.*) Perhaps I may be allowed to suggest this as the most convenient course. This gentleman has stated where he took these soundings and that he submitted them to Mr. Bazalgette, who assumes them to be correct. I would suggest that the result of those soundings shall be given by Mr. Bazalgette, who is prepared to go at length into the subject.

(*Mr. Lloyd.*) That will do for me. I want to know whether this witness is able to speak from his own personal observation of the state of the mud deposit which has formed opposite Barking Creek at Horse End. If he will answer me that question it will save a great deal of trouble.

(*Sir J. Karslake.*) When you say, "What is the state of the mud deposit," I do not know what you mean. If you mean what is the state of the section at the nearest point to that on the section of 1864, this gentleman will give it you.

1340. (*Mr. Lloyd to the witness.*) Are you able to say from your own personal inspection that there has been no accumulation of mud whatever at Horse End, opposite Barking Creek, since 1864?—When I was down at the outfall works in 1863 and 1864, I noticed that the creek was in as bad a condition then as it is now, because I had occasion many times to go to the works at Crossness and at Barking, and in a certain state of the tide it was impossible to get a small boat to pass up there.

1341. I am asking you a plain question. I want to see how far you are prepared to assert that there has been no material change in the state of that mud bank since 1864?—I believe from what I have observed, that last year and the year before there was a certain accumulation of deposit there which has now altogether, or nearly altogether, disappeared, which I attribute to——

1342. Never mind your attributing; let us get the facts first. When do you say that disappeared?—I did not say that it has disappeared; I only say that from my observation, I do not think it is as bad as it was.

1343. Is that from your ocular observation merely?—From my observation, and trying to get a boat into the creek. As to the soundings in the creek I have not any taken previous to these.

1344. (*The Commissioner.*) Look at this plan; you see that is Barking Creek; that is Horse End point. Have you soundings in that direction?—Yes, up to about low water.

1345. Opposite that land which I presume belongs to the Metropolitan Board of Works?—Yes.

1346. Do you know where the powder barge lay?—Yes, about 1,400 feet above the outfall sewer mouth.

1347. Do you know whether or not there has been an accumulation of mud between Horse End point and this part of the reach (*referring to the plan*)?—In 1864 I had no soundings taken of that, but in 1867, when Mr. Leach sent us a tracing, or some document showing 7 feet 6 inches of deposit, I could not find 7 feet 6 inches of deposit there. I should like to see that section.

(*The Commissioner.*) I can submit these tracings which Mr. Leach has handed in to the representatives of the Metropolitan Board after this meeting, and then they can be examined and compared with any soundings which they may like to test them by.

(*Sir J. Karslake.*) What are those?

(*The Commissioner.*) I have here tracings made by Mr. Leach from his map of soundings made in the special years named on the plans; they are marked in different coloured figures. The line of section is marked on the plan, and they can be compared, if anything is to arise upon them, with the soundings upon the plans which this witness is bringing forward.

(*Sir J. Karslake.*) I believe Mr. Bazalgette has already done that.

(*The Commissioner.*) On the last occasion there was distinct evidence given by Mr. Leach, that in this portion of the river above the main sewer's outlet a large accumulation of mud has taken place since the opening of those sluices, and that for many years previously that shore had remained in one condition without accumulation; but that an accumulation of mud has taken place in the backwater formed by the tide above the mouth of the main sewer, and to such an extent that they have had to remove a vessel which was moored there to another place, because barges could not get to it; in fact, it grounded in deep mud, where previously it floated.

1348. (*Mr. Lloyd to the witness.*) What is your special function, what are you?—Surveyor to the Metropolitan Board of Works.

1349. The only surveyor to the Metropolitan Board of Works?—I am one of them.

1350. How long have you been so?—In two days I shall complete my 21 years.

1351. Surveyor in what sense; do I understand that you have been accustomed to sound the river Thames and the like; is that your special function?—No.

1352. You are not an engineer?—I am a surveyor.

1353. What experience have you had with respect to rivers previously?—I had not had much experience in rivers before I came to the Metropolitan Board of Works, but I had experience in railway works and other engineering works.

1354. I should like to know your method of proceeding in sounding. Did you merely take a pole and probe in that way? Is that your way of taking soundings?—If you will allow me I shall be very happy indeed to explain it to you.

1355. I shall be very glad if you will.—The soundings are taken by a pole marked in feet and inches. The level of the water is obtained at the time with a gauge so as to get the rise and fall of the tide. We generally do it at the fall of the tide, as it is getting on towards low water; these soundings are taken on sectional lines in a straight line across the river.

1356. That I understand, but how do you put the pole down; who does it?—The man who takes the soundings.

1357. Do you see whether he has got to the bottom; do you take care to be sure of that?—I cannot see that at all times when I am taking my observations, but I have sufficient confidence in the men, and I believe from the general character of the soundings, as they having agreed with the Thames Conservancy soundings, that therefore they are right.

1358. (*The Commissioner.*) When you are taking soundings to ascertain the depth to the surface mud, you do not drive the pole down?—No; I first of all get the depth of the water to the top of the mud, and then I drive the pole into the mud.

1359. How do you ascertain the surface of the mud?—When the pole touches it we can judge what the character of it is. We take soundings within an hour or two of low water, and when there is but very little current.

1360. The mud is of a very soft character, you say?—Yes, we can soon tell when it is hard.

1361. Could you tell the depth of the mud within 6 inches?—I think I could within one inch.

1362. Do you rely on the touch of the end of your pole to know when you are on the surface of the mud?—Yes, I do rely on that.

1363. Do you know what mode the conservators adopt?—I believe from what I have seen of them that they do it in a similar way. They use long poles.

1364. I think they will tell you that their mode of sounding is very different to that. Now, as to this No. 3 A section that you showed us, where there was a considerable difference in the sections shown, do you know whether or not there had been any excavations at that point? Do you think the water itself had altered the creek so much at that point?—(3 A) being so very close to where the Essex Reclamation Company's works are being carried out, I could not say.

1365. Then there may have been some excavation causing an alteration?—Yes; but I could not say.

1366. You saw certain mud barges discharging into the river Thames in June or July. Do you know whether that was with the sanction of the Thames conservators, or not?—I should say not.

1367. Then if they were discharging mud it was done by some person who did it improperly, and against the byelaws?—I have no doubt of that at all.

1368. You spoke about sewage not injuring fish; do you know of your own knowledge whether the sewage of the metropolis has any effect upon the fish in this part of the Thames?—I do not.

1369. Then if any persons who deal in fish declare that the water, in the state in which it now is, killed them, I suppose you would have no means of contradicting them?—I say that I think sewage is not so injurious as it is supposed to be.

1370. That is your opinion?—Yes, that is my opinion from what I know.

Re-examined by Sir J. KARSLAKE.

1371. Do you know, as a fact, one way or the other, that the sewage which is discharged now is of the same character as that which used to be discharged throughout the Thames formerly?—Yes; I should think it is just the same sort of sewage.

1372. Do you know the effect of it upon fish higher up the Thames?—I never saw fish in the Thames higher up. I never saw fish in the Thames about London before the sewage was brought down here; I have heard of fish being taken occasionally.

1373. I mean above London. I want to know whether the sewage which is now turned into the river there (Richmond) is of the same character as that which is now turned into the Thames at the outfall at Barking?—I do not think that there is any difference.

1374. At all events, you say there are other matters which do considerable injury to fish, although, in your judgment, sewage does not?—Sewage is not so fatal to fish as the chemical stuff that is sent in.

1375. You knew this Barking Creek well in 1864, before the metropolitan outfall sewer was opened?—Yes.

1376. Had you known it for years before that?—Yes; I have known it for the last 13 years particularly.

1377. In your judgment, from what you know of it at any time (since you have known it), could you have walked down from the banks free from mud, so as to join people who were walking in the bed of the creek?—No, far from it. We never could get to a boat at half tide.

1378. I think I understood you to say that you have known Barking Creek for 20 years or more?—Yes; I have been particularly acquainted with it for the last 13 years.

1379. As to "Horse End;" when did you first know of the Horse End as a point in the river?—I should say for the last 20 years.

1380. Have you had it under your notice from time to time for the last 20 years?—Not particularly till about 1864, when I took the soundings.

1381. I understood you to say that in 1864 you wanted to cross for some special purpose or other near that point?—Frequently we could not get to the boat. I could not get a boat up the creek at low water.

(*Mr. Lloyd.*) At the Horse End?

1382. (*Sir J. Karslake.*) Whether mud on it has increased or not, did it present to the eye a similar appearance, or a very much similar appearance, to what it does now?—There is in some respects a very different appearance now, because the reed beds are washing away, which makes the foreshore appear longer.

1383. The reed beds have washed away in some degree, which makes the foreshore longer, you say?—Yes.

1384. You state that as a fact?—Yes; I have a plan showing it.

1385. Has Horse End been a point of land coming out in the way we see it now ever since you have known it?—No; it was rather flat at first. It has worn down to a point. There is an Ordnance survey in 1848 and 1849, which shows that it was much more flat.

1386. You say it has become more pointed at the end, but that in other respects, judging from the eye, it is very much the same as when you first knew it?—Yes: but there was an Ordnance survey about 1864, which shows it.

1387. What is the nearest point across the Thames at which you took that section?—That is the Horsend. There was one taken here in 1864.

1388. That is where the river bank comes?—Yes.

1389. What is this No. 22?—That is in 1867 and 1868.

1390. And No. 23?—The same.

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Mr. J. McDougall.

15 July 1869.

1391. That would be from the point of the Horse End?—Yes.

1392. Then I may take it that that is the nearest to the Horse End that was taken in 1864?—Yes.

(*Mr. Lloyd.*) He did not take it.

(*The Commissioner.*) There is evidence that the Horse End shoal has lengthened, as also that it was formerly flatter.

1393. (*Sir J. Karslake.*) He says if you look at the Ordnance map of 1848 it was much flatter, but that now it has come more to a point.

1394. Now let us see these sections of 1864.

(*Mr. Lloyd.*) They were not taken by him.

1395. (*Sir J. Karslake.*) The black dotted line is the one of 1864?—Yes.

1396. And the red dotted line the one of 1867?—Yes.

1397. And the blue dotted line the one of 1868?—Yes.

1398. And the hard line the one of 1869?—Yes.

1399. There are two of 1867 and 1868?—Nos. 22 and 23 were not taken in 1864 at all. No. 24 was.

1400. Show me 22 and 23 taken in 1867 and 1868?—Here they are (*pointing them out*).

1401. No. 22 is about the middle of the Horse End shoal?—Yes.

(*Mr. Lloyd.*) No, it is not.

1402. (*Sir J. Karslake.*) Those were taken in 1867, 1868, and 1869?—Yes.

1403. You say the red dotted line shows 1867, the blue dotted line 1868, and the hard line 1869?—Yes.

1404. So that there has been some slight shifting?—Nothing very material. There is no material difference.

1405. (*The Commissioner.*) Which is high-water line?—That (*pointing it out*).

1406. Then you are giving evidence as regards something below low-water line?—This is a section from the Ordnance datum. The Ordnance datum is about 8 feet lower than my datum.

(*The Commissioner.*) There is no allegation in the memorial, you now say, which is intended to show that there is any accumulation of mud seriously affecting the river Thames below low-water mark.

(*Mr. Lloyd.*) Just so.

(*The Commissioner.*) The Thames conservators tell me that they have no evidence to show any serious accumulation of deposit in the river Thames below low water.

1407. (*Sir J. Karslake.*) Just let me understand your mode of sounding. You told the Commissioner how you sounded. Have you found from an examination of the conservators soundings that yours and theirs agree?—As far as I have seen their soundings. But I have not seen any of their soundings since 1867.

1408. In 1867 you were sounding, and the conservators were also sounding?—Yes.

1409. Did you compare yours with theirs after you had taken your soundings?—Yes, with a copy we had of theirs.

1410. Did you find that they agreed?—Pretty nearly.

1411. (*The Commissioner.*) Your soundings both for the bottom and for the top were taken with a pole?—Yes, with a pole.

1412. (*Sir J. Karslake.*) What has been your chief duty during the last 20 years you have been engaged for the board?—I have been engaged in making surveys and taking levels; preparing plans and surveys for the main drainage works, and other works.

1413. During those 20 years the Metropolitan Board has been in the habit of acting upon the plans and surveys so taken by you?—Yes.

1414. And have you had to compare your plans with plans taken by other engineers and persons engaged on similar works?—I have prepared plans for the engineer, who examines them and approves of them.

1415. And acts upon them?—Yes.

1416. Is that Mr. Bazalgette?—Yes, and his staff of assistants.

1417. (*The Commissioner.*) Is not river surveying a specialty; does it not require special practice and special knowledge to take soundings?—Yes, it certainly does.

1418. It is a very different order of surveying to surveying for town sewerage works?—Yes, it is. Greater care is necessary to fix the position of the soundings taken.

Mr. Joseph William Bazalgette called; examined by Mr. Philbrick.

Mr. J. W. Bazalgette.

1419. You are engineer-in-chief to the Metropolitan Board of Works?—I am.

1420. And have been so since its formation?—Yes.

1421. Since you have been with the board has the last witness, Mr. McDougall, been an assistant surveyor?—Yes.

1422. Has he from time to time surveyed under your direction?—He has. He is a very careful surveyor. He is a man whom we always put to do work that we want to have very carefully carried out.

1423. From time to time, as occasion has arisen, with regard to surveys of the river, have they always been entrusted to the care of Mr. McDougall?—He has taken them.

1424. As far as the results which he has arrived at have come under your notice, have you had confidence in his calculations and work?—Yes, perfect confidence.

1425. Where there has been any check of it by comparing it with the work of other surveyors, either of the Thames conservators or other public departments, has it been to confirm your confidence in Mr. McDougall?—He has always been found to be very accurate.

1426. Have you, as engineer-in-chief to the Metropolitan Board, had your attention called to the allegations contained in this memorial from persons in Barking?—I have.

1427. Have you considered this allegation, with reference to "The present dangerous condition of the "river Thames, dangerous alike to navigation and "to the health of the inhabitants of the parish of "Barking, and of all the populous and industrious "towns below London, consequent upon the concentrated discharge of sewage through the main outfall "sewers of the Metropolitan Board of Works?"—I have.

1428. Knowing the metropolitan system of drainage, is that averment in the memorial consistent with the truth?—It is entirely imaginary, and contrary to the fact.

1429. Now we will come to the matter a little more in detail. With regard to the discharge of sewage from the northern outfall in Barking Reach before the design was adopted by the Metropolitan Board of Works, and which has been since carried into effect, was the matter one of great consideration?—It was.

1430. And were various eminent leading engineers, and other gentlemen who devoted their time and attention to the matter, consulted upon it?—They were.

1431. Was the present scheme finally adopted, after the maturest deliberation and the best judgment which could be brought to bear upon the matter?—After very mature deliberation, extending over some years, and very full discussion upon it.

1432. Were several series of experiments with floats and so forth, originated and carried out under your direction, with a view to see how far the scheme would work if carried out?—Yes; particularly with reference to the point of discharge into the river. A series of experiments on that subject was made by Captain Burstal and myself.

1433. Was the result of those experiments one of the matters which was taken into consideration by you and those gentlemen who were consulted before deciding upon adopting the present scheme?—They (the experiments) were very carefully studied.

1434. The northern main outfall sewer was permanently opened in August 1864?—Yes.

1435. The southern main outfall sewer was opened in April 1865?—Yes.

1436. We have heard from Captain Burstal that, prior to any of the works being constructed at all, the plans which had been prepared were submitted to the conservators of the Thames?—They were.

1437. At that time were you aware of any undertaking, or was any representation made, that only clarified sewage water would be discharged into the river?—Certainly not; on the contrary, Mr. Bidder, Mr. Hawkesley, and I, in the final report upon that subject, distinctly pointed out that we did not consider it necessary to recommend that anything of that kind should be done. We thought it would be objectionable.

1438. That was a matter, I believe, which was specially considered?—It was. There was no such statement as that to which your question refers. On the contrary, there was a statement that we did not recommend any such process.

(*Mr. Lloyd.*) That is not the question you were asked. You were asked as to a statement by others, not by you.

(*Sir J. Karslake.*) You had better let us examine in chief first. You may cross-examine afterwards.

(*Mr. Lloyd.*) He answers, not your question, but something else which you did not ask. You asked him whether there was any statement made by other people.

(*Mr. Philbrick.*) Indeed I did not. I will put my own questions, if you please.

(*Witness.*) I can answer it very fully. There was no statement from anyone, so far as my recollection goes, having reference to that matter at all. There was no discussion upon it, and no suggestion of that kind from anyone that I know of.

1439. (*Mr. Philbrick.*) In adopting the final design, and in making the final report, had you the benefit of the advice and assistance of Mr. Bidder and Mr. Hawkesley?—I had.

1440. Prior to the works being carried out, and the system being ultimately adopted, was your report, entering into all those questions, printed and circulated?—It was.

1441. Were the schemes which had been put before you, and the various plans which had been suggested, embodied in that report, and did you give your reasons for selecting and adopting the final plan which was decided on?—Yes.

1442. Besides the sanction of the conservators being given to those plans, as Captain Burstal has stated, were they also submitted to the Lords Commissioners of the Admiralty, and did they receive the sanction of the Secretary of the Admiralty on behalf of the Admiralty?

(*Mr. Lloyd.*) That would only be as regards encroachments on the river. It would have nothing to do with the sewage to be afterwards poured in.

(*Witness.*) They were also submitted to the Admiralty, and we received the sanction of the Admiralty to them, with one condition; namely, that the discharge of sewage should not commence to take place until one hour after the time of high water.

1443. (*Mr. Philbrick.*) Therefore, in imposing that condition the Admiralty were perfectly well aware that it was intended to discharge the London sewage into the river Thames?—They were, the whole thing having been matter of public discussion, and it was a matter of public notoriety in addition.

1444. (*Mr. Lloyd.*) What was?—The whole thing had been matter of discussion for years; it was a matter of public notoriety.

1445. (*Mr. Philbrick.*) It was discussed both in Parliament and in the press?—Yes, very fully, indeed. I think there never was a subject more fully discussed than that.

1446. I believe the condition imposed upon you by the Admiralty has been adhered to, and the discharge of sewage does not take place till about an hour after high water?—It does not.

1447. How long do the sluice gates continue open?—The discharge commences about an hour after high water, and continues till about half-tide.

1448. That would last, more or less, for two hours?—About two hours.

1449. During the first portion of the two hours, what is the efflux from the openings?—During the first portion of the two hours there is a larger flow than at any other period. The first rush comes off and gradually decreases until the sewage reservoir is emptied, and then there is nothing more than the ordinary flow of sewage.

1450. And then the sluice gates are closed?—Yes.

1451. Tell me about what is the velocity with which the sewage flows along the sewer from Abbey Mills down to the point of discharge?—It varies. Taking it at the minimum, it is a little more than a mile an hour, increasing up to a mile and a half an hour.

1452. I need scarcely ask you, except for the purpose of having it upon the notes, is the velocity of the water in the Thames at the moment the sewage discharge first commences greater than the velocity of the sewage as it comes down the sewer into the reservoir?—It is. I should follow that up by saying, that the velocity of the flow of the Thames at a strong ebb, in the centre, is about three miles an hour, and in the line which the discharged sewage takes it is probably about two miles an hour.

1453. Does the sewage, as it flows out of the sewer, discharge itself diagonally across the river?—It does, until it gets into the main stream.

1454. What effect (if any) upon it has the stream or current which comes down Barking Creek; that is, from the river Roding?—It helps to drive the sewage further into the centre of the river Thames.

1455. (*Mr. Lloyd.*) Will you repeat that?—The stream of the river Roding ebbing at the time of the discharge of the metropolitan sewage from the Barking sewer outfall helps to drive the sewage further into the river Thames.

1456. (*Mr Philbrick.*) Was that one of the matters which was considered as a useful auxiliary at the time when the point of discharge was selected?—I do not know whether it was considered so, but it is so.

1457. It does so act?—It does so act.

1458. With regard to what sewage flows from the point of discharge, is there any substantial diffe-rence, to your knowledge, between that and sewage which was formerly discharged into the Thames at the 101 sewer mouths in London which have been intercepted by the new main sewers formed by the Metropolitan Board?—I do not quite understand your question.

1459. Is there any difference between the character of the sewage as now discharged by the board at the Barking outfall and that which used to be discharged at the numerous smaller sewer mouths into the river Thames at London?—The character of the sewage is no doubt much the same, but the mode of discharge is vastly different.

1460. The difference, then, is in the mode of discharge?—Yes. It is as well perhaps to show what that is. Formerly, at the 101 sewer outlets which you speak of, the sewage was principally discharged into the river at the time of low water when there was very little river water with which to dilute it, when the rising tide carried the sewage up the river. Now it is discharged at a lower point, where there is a very much larger river sectional area, and when that sectional area is full of tidal water, when there is a strong ebb tide going out to sea, so that the difference in the mode of discharge is as different as light from darkness.

1461. Does the volume of river water in the sectional area of the Thames at the point of discharge, in your judgment, secure an advantage in the method of discharge?—Yes, an enormous advantage. There is immediate and extreme dilution of the sewage and outward flow.

1462. With regard to the heavier deposit which we have heard something of, the road detritus and so forth, so far as that goes down the street and road gullies it gets into the sewers?—No; we as far as possible prevent road

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Mr. J. W. Bazalgette.

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grit getting into the sewers. It goes into the gullies, but at the gullies we fix catch-pits, which arrest that solid deposit and prevent its going into the sewers; and it is our clear interest to do that from this fact, that if sediment gets into the sewers it costs us 1*l.* per cubic yard to get it out, whereas if we get it out of the catch-pits it only costs us 2*s.* 6*d.* a yard. It does happen that some mud and grit escapes out of those gullies, and there are some places where gullies are not fixed, and we get some deposit into the sewers of that hard road stuff. We have to take it out of the sewers, and it is quite evident that if the flow of the current down the sewer is sufficient to carry it into the reservoir, the flow being from a mile to a mile and a half an hour, nothing that is brought down with that velocity can deposit in the river Thames, where it is subjected to a greater flow.

1463. As a matter of fact, is there a continual item of charge for work done in clearing the road detritus and other similar substances which we have heard described from gulleys and sewers?—Yes. There is an item in the accounts every year for taking out that road detritus.

1464. To what extent?—I cannot tell the extent. It is however a large amount. We endeavour to curtail it as much as possible by the arrangements I speak of, but we have not perfected them yet.

1465. You have told us that you have had soundings and cross-sections of the river Thames taken in the neighbourhood of the main sewer outfalls. You are aware, I daresay, of the survey and sections which were taken in 1864, before any sewage discharge commenced from the works of the board?—I am.

1466. In consequence of communications from the Thames conservators was great care exercised in taking those sections accurately?—Yes.

1467. Mr. Leach tells us that between 1864 and 1867 there has been an increase of mud in the river Thames, amounting to about 700,000 cubic yards?—Yes. Mr. Leach furnished me with his soundings taken at two points coloured blue on the little map which I have in my hand, the first of those commencing about a quarter of a mile above Barking Creek, and extending to Barking Creek, and the other commencing about half a mile above Crossness Point, and extending to about a mile below it in all, taking a length of the river of $1\frac{3}{4}$ miles.

1468. Putting the two together?—The two put together, representing a little above Barking Creek and a good bit below Crossness Point. Those sections were taken between 1861 and 1867; some in 1861 and some in 1867. I assume that Mr. Leach, in giving his evidence, stated what the increase of mud had been, without taking into consideration the decrease also. As the Commissioner stated, everyone knows that the bed of a tidal river is continually shifting from point to point with almost every tide. Therefore, I say, that the only fair way of looking at the condition of the river Thames is to see if the mud has merely shifted from one point to another during any particular period, and if so to deduct where it has gone away from where it has accumulated, and then to take the balance as the accumulation during that period. Taking those points, and deducting the portions which have deepened from those which have accumulated I find from Mr. Leach's own soundings only a nett increase of about 400,000 cubic yards.

1469. As against 700,000 cubic yards?—Yes.

1470. 700,000 cubic yards would be the absolute, and 400,000 cubic yards the nett?—Yes, but I should say, first, with regard to those two quantities, the soundings that I took in 1864 and 1867 do not differ very materially from that result; but I also took soundings of a more complete portion of the river. At the same time I took soundings from a quarter of a mile above, or a little above Barking Reach, down to a quarter of a mile below Crossness Point, and I found from those soundings, although I did not disagree from Mr. Leach, that taking the whole length, which is, perhaps, the fairer way of looking at it, the total increase between those periods of 1864 and 1867 was only 60,000 cubic yards. If you take those two points there is an accumulation of 400,000 cubic yards, but, if you take the whole Reach between the points of discharge, it is reduced to about 60,000 cubic yards.

1471. Then 60,000 cubic yards would represent the total absolute increase in the year?—No, the nett increase between 1864 and 1867.

1472. That is taking it, not between the two points of the river which Mr. Leach has described, but taking it where he began, and continuing it down to below the Crossness Point of discharge?—Yes; that is to say, not exactly where he began. It is a little lower down. It is a little further down out of that bay, where it is stated there is so large an amount of accumulation of mud. My 60,000 cubic yards does not include the whole of this, but the 400,000 includes that worst part.

1473. Would that include the whole of the part opposite the Horse End, opposite where Barking Creek discharges; would it include the whole of that part?—My comparison with Mr. Leach's soundings, from which I get a nett increase of 400,000 cubic yards, includes the whole of that.

1474. Your 60,000 cubic yards includes the whole of that also?—No; it begins not quite so high up the river, and, therefore, does not include the whole of it. It begins a little above our sewage reservoir, but it does not include the whole of that bay above.

1475. It does include, as I understand, the whole up to a point higher up than the sewage reservoir, and, therefore, includes the part immediately in front of where Barking Creek discharges?—Yes, it does.

1476. It includes what we have been talking of here as the "Horse End," and the "Shelf," or "Shoal?"—Yes.

(*Mr. Lloyd.*) He has said the contrary.

(*Witness.*) No; I say it does include the Horse End and the Shelf, Shoals——

1477. (*Mr. Lloyd.*) You said it does not include the whole of the bay above that point?—No; but it does include the Horse End and the Shelf. I then made another series of soundings over the same ground in 1868. It has come to my knowledge, as it seems to have come to the knowledge of the Thames conservators, that a very remarkable change had taken place after 1867.

1478. (*Mr. Philbrick.*) As I understand, the figures from which the 60,000 cube yards which you have spoken of is arrived at are a comparison as between 1864 and 1867?—They are.

1479. You have not brought the 1868 comparison in?—No. The Thames Conservancy soundings are a comparison between 1861 and 1867. Mine are a comparison, as nearly as possible, over the same ground, and then over different ground between 1864 and 1867.

1480. You say that between 1867 and 1868 everybody who had turned his attention to the subject became aware that there was a remarkable change in that part of the river Thames?—Yes. I had careful soundings taken over that ground again, and I found, taking the same system of calculating for the increase and the decrease, that between 1867 and 1868, over the ground sounded by Mr. Leach, there was a total scour of 816,000 cubic yards, leaving that portion of the river with 400,000 cubic yards less in it than in 1864, when our main sewage outfalls were opened. I apprehend Mr. Leach can hardly have taken the soundings and worked the thing out so carefully as I have done, or he would not have talked about 20,000*l.* per annum as the estimated cost for dredging sewage deposit.

1481. That was on the assumption that there was a continual increment to the extent that Mr. Leach mentioned?—However the fact is, taking those two points from above Barking Creek (including the whole of that bay, and also taking in Crossness) from a quarter of a mile above the point of discharge to three-quarters of a mile below, there is now in that part of the river Thames 400,000 cubic yards less of mud deposit than there was at the period when the metropolitan main drainage works were first opened. I have worked it out in the same way in comparing the

soundings of 1864 and 1867, and I find that, whereas over that ground there had been an accumulation of 60,000 cubic yards, there has since been a decrease of 541,000 cubic yards; therefore, the result is that, taking the whole of Barking Reach from a quarter of a mile above the Barking outfall to a quarter of a mile below the Crossness outfall, there are now 480,000 cubic yards less of deposit in this part of the river than at the time of the opening of the main drainage works.

1482. Having directed your attention to the subject of this alternate accumulation, scour and shift, what do you attribute the difference in the river to?—There are a great many things to which it may be attributed, but I am unable to say which of those causes it may be most from. I should say that one great reason has been upland floods in the river with particular winds in particular states of the tide, or some of those other causes which occasionally affect the scour and accumulations in the river Thames. I have not studied the subject sufficiently to determine that point, but it is possible that the Thames embankment, and the mud that was washed into the river from that part of the river for the time being, may have had something to do with the accumulations. There are many reasons that one's mind reverts to that may have had that tendency. However, I am clear on the fact that there was a gradual accumulation of mud up to 1867, although always shifting from time to time, and that there has been a very large decrease between 1867 and 1868. Perhaps it would be as well to go to that point above Barking Creek, where there has been an accumulation of, I think it has been said, from 8 to 10 or 12 feet of mud, or something of that kind, where the "Talbot" powder magazine lay. In the first place I say, looking at Mr. Leach's soundings, and comparing 1861 and 1867, they show an increase, not of 10 or 12 feet, but of 7 feet 6 only, which is a very large increase.

1483. That is the maximum?—If you will look at the plan of the river Thames there, you will see that the ebb tide, in coming down the river, striking that point, would run across here at this point, and would not come into that bay. Therefore, according to all the laws of nature, that bay never had a strong scour in it, and always was liable to accumulate mud deposit. Further than that, it is not a bay available for navigation. That is proved by the Thames Conservancy having recently allowed the Chartered Gas Company to carry a pier right across that bay, so constructed as to be an obstruction to navigation, and which will also tend to accumulate more deposit in that mud bay, for the new pier forms a sort of groin in the river. I say that mud bay will fill up now more rapidly than it has ever done before, and that vessels berthing and lying there will have a tendency to produce that effect. I further say the best thing that could be done for the river would be to warp that bay up, or make an embankment, which would give a better current round that reach of the river, and help to keep a deep channel by scouring it down. I also say that the works of the Metropolitan Board can have no effect whatever upon that shore; that the discharge taking place upon the ebb tide commencing one hour after high water, and going on to half tide, can have no possible effect upon that bay.

1484. In arriving at the opinion you have just expressed, have you had regard to a series of experiments as to how far the London sewage will be carried down, or any matter which floated in the river would be carried down, assuming that it was started on the ebb tide?—I know as a matter of fact, which is better than any experiment, that the metropolitan sewage is carried down, and that by the time you get from half a mile to three-quarters of a mile below the outfall at Barking you cannot trace it in the river water; it is gone, it is so dispersed and diluted, that you can see nothing of it.

1485. With regard to the particular conformation of Barking Creek and the outfall into the Thames, it has been stated that there is an accumulation of mud just at the mouth?—There is. There is a small amount of mud accumulation. There is a little bar at the mouth of the Barking river; it is a mud bar, just such a bar as you ordinarily meet with at the mouths of rivers, which spread out wide; but that bar only extends over a very short distance indeed, because just outside, on what they call the Shelf, it is hard; and about a quarter of a mile up you get to hard ground again.

1486. Free from mud deposit?—Yes; and therefore whatever may have been the cause of that bar, there may be a great many things totally unconnected with the sewage of the metropolis (as I believe to be the case) that may have occasioned that bar; at any rate it is so small in extent that half the time that will be spent in this inquiry would have taken the whole thing away.

1487. (*The Commissioner.*) You mean half the money?—Half the money, and less, I daresay.

(*Mr. Philbrick.*) With regard to the allegation that the condition of the river Thames is dangerous to the health of the inhabitants of Barking and of all the populous and industrious towns below London?

(*Mr. Lloyd.*) We were precluded from going into that inquiry; we could have brought a great deal of evidence upon that.

(*Sir J. Karslake.*) We have not precluded you.

(*Mr. Lloyd.*) You have not, but the Commissioner intimated to us that the health question was not a matter into which he would go at present.

(*The Commissioner.*) What is the question?

1487*a*. (*Mr. Philbrick.*) The question is this, with regard to the averment in the memorial about the dangerous condition of the river Thames to the health of the inhabitants of Barking. I am going to ask Mr. Bazalgette if he can say from his experience that such statement is consistent with the facts of the case?

(*The Witness.*) The creek at Barking town is in a very bad state.

(*Mr. Lloyd.*) We were stopped from going into that inquiry.

(*The Witness.*) Allow me to state that no sewage from the Barking outfall on the Thames gets into Barking Creek; the water near the outfall is perfectly clear and free from sewage; the mud on the banks of Barking Creek is ordinary river mud, and the green stuff growing on the banks is of a fresh healthy description, and not such as would be contaminated by sewage, nor can it be so. If the tide is running out from Barking Creek it is impossible that the metropolitan sewage can force its way up against the tide. By the time the tide has turned the sewage has got three-quarters of a mile down the river, and is lost to sight.

1488. Is it diluted so as to be untraceable?—Yes, and it then has to go still further down the river some eight or 10 miles, and has to come back again: and if it can come back again in the form of sewage it is very odd to me.

1489. With regard to the condition of the river Thames water, looking at the water itself, or at the nature of the deposit, and comparing the Thames water at the mouth of Barking Creek, where it discharges, with the creek water which you find at the town quay, which is the purer water?—The further you get down the creek from Barking town, the purer the water is.

1490. Have you seen the water near the town quay to-day?—Yes.

1491. And in the creek?—Yes, both.

1492. Which was the purer?—The water which was in the creek below was far purer.

1493. At low water, near Barking town, was there an open sewer discharging?—There was.

1494. Was the mud which lay near the town quay black and offensive?—Yes, it was.

(*Mr. Lloyd.*) We have had evidence that there was no smell in the town at all.

1495. (*Mr. Philbrick.*) Was there a barge lying there loaded with manure?—There was.

1496. Was there an offensive odour in that part of the town?—There was; but from local circumstances, and not at all coming from our sewage works.

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1497. Are there a number of people in the constant employment of the Metropolitan Board, who must reside with their families at or near the main sewer outfall and attend to the works?—There are; and you may see children running about over the large sewage reservoir.

(*The Commissioner.*) If you are going into the question of health, I must again remind you that the question was put to the Home Secretary in the House of Commons, and a request made to him that he would send a medical officer and a barrister to sit with me on this inquiry. He declined to do so, but stated that if any question subsequent to my report arose with regard to health, and which necessitated a special inquiry, he would send down a medical commission to make that special inquiry. I have decided, therefore, not to go into the health question.

1498. (*Mr. Philbrick.*) Very well, if that be so I will not pursue that part of the inquiry. (*To the witness.*) Now I will take you to this part of the memorial; it is stated that "there are banks within a "few hundred yards of the houses of some of the "memorialists composed of solid sewage, 6, 8, and 10 "feet deep." Are there any banks anywhere composed of solid sewage at all?—None whatever.

1499. Are there banks of anything at all 6, 8, and 10 feet deep, within a few hundred yards of any houses near Barking Creek?—I have not probed the depth of the mud-banks at the sides of the creek, but it is like any other ordinary river with mud-banks, and it would be just the same if there were not a house within a hundred miles.

1500. Is there, as far as your knowledge and experience goes of the matter, any material difference between these mud-banks and mud-banks in other parts of the creek above, which could not possibly be affected by the metropolitan sewage discharge?—They are in character precisely the same.

1501. (*The Commissioner.*) Do you know the tidal portion of the river Lee?—Yes.

1502. Is that portion of the river Lee which is within tidal influence, do you think, cleaner or dirtier than this Barking river?—I should say dirtier.

1503. Is there as much mud on the shores of the Lee as on this river?—I do not know whether the Lee is as deep in mud, but there is the same kind of mud on the shores of the Lee.

1504. (*Mr. Philbrick.*) The same class of mud?—Yes.

1505. (*The Commissioner.*) As far as the question of mud goes, do you not find mud on all tidal creeks?—Yes, and on many parts of the foreshore of the river Thames. I have also seen precisely the same character of mud even on parts of the sea coast.

Examined by the COMMISSIONER.

1506. There have been several official inquiries, and several reports on the Metropolitan main sewerage questions?—There have.

1507. There was one report by Mr. Simpson, Capt. Galton, and Mr. Blackwell?—Yes, there was.

1508. The point of discharge which they recommended was considerably lower down the Thames?—It was; and the cost of carrying out those proposed works would have been 10,000,000*l.* to 12,000,000*l.*

1509. There is also a detailed report in a Blue Book upon the character of the river Thames sewage and mud by Messrs. Hofmann and Witt. I am speaking of the well-known Blue Book which preceded the report of the referees, Messrs. Bidder, Hawksley, and yourself, which settled the question of the Metropolitan sewerage as carried out?—Yes.

1510. The outfalls proposed by Messrs. Simpson, Galton, and Blackwell were some 18 miles on one side and 16 miles on the other, I think, lower down the river Thames?—Yes.

1511. And such works must necessarily have been at a very much larger cost?—Yes.

1512. In settling upon the present sites for the main sewers outlets, did it enter into the calculation of the Metropolitan Board that the sewage to be discharged on both sides of the Thames must ultimately be utilized; had they that contingency under consideration?—At that time they did not know what ultimately might be found the best to be done with reference to a utilization of the sewage, but they thought the best arrangement would be to carry out effectually the sanitary question for the Metropolis, and to place the sewage in such a position that, if commercially valuable, it might be utilized hereafter.

1513. I think the Metropolitan Board made certain examinations of sewage farms—Carlisle, Edinburgh, and other places—where systems of sewage irrigation had been adopted, to see what effect town sewage had when applied to land for agricultural uses?—Not till subsequently. I think sewage irrigation at that time was not so much developed as it has been since. You probably refer to a committee of the board which went round to examine into the subject. That was some considerable time afterwards.

1514. In determining the present sites for the metropolitan main sewerage outlet works, and in fixing the sizes of the sewage reservoirs and their character, did you at all contemplate abstracting the sewage sediment before passing the clarified water into the Thames?—No, never.

1515. Do you remember whether the covering of those sewage reservoirs was a part of your original design, or was that forced upon you?—It was part of the original design.

1516. Do you think it is a proper plan to cover large sewage reservoirs over?—I do.

1517. Supposing for a moment restrictions were put upon you not to send sewage sediment into the Thames, would you be able to abstract such sediment from these covered reservoirs easily?—Before I can answer that question, I must know what kind of process would be enforced upon us.

1518. Your engine power now is adapted for the lift from low water; or rather, from the main sewer inverts into your reservoirs sufficient for the discharge upon the turn of the tide. I suppose you have only engine power sufficient to cope with this work you are doing, namely, the carrying out of the regulations imposed upon you by Parliament?—We have only engine power for the low level sewer. The high level and the middle level sewers are discharged by gravitation.

1519. I mean you have only engine power for the work you have now to do at the main outlet sewers?—That is all.

1520. Is any of your engine power in duplicate?—We have a certain amount of reserve power, so that in case of an engine breaking down, or being under repair, we may be enabled to avail ourselves of it.

1521. Then you have a certain amount of surplus power?—Yes, at Barking; but we have no spare power of this sort at Crossness.

1522. Your engines pump all the sewage and all the sediment?—They pump all the sewage.

1523. They pump everything that comes?—Yes.

1524. Have you any means of knowing what proportion of sediment is contained in the sewage that is passed into the Thames?—No; it has, however, been analysed and computed by chemists. I do not remember what it is, but the sediment is very small in proportion to the liquid.

1525. Do you imagine that your catch-pits in your street gullies intercept any considerable portion of the detritus from the macadamised roads in London?—A great deal of it, and if we could only get that system more completely carried out, we should do it to a still larger extent.

1526. I suppose you have no idea of the annual amount of macadam stone ground to powder and mud on the streets in London?—It is very large, no doubt.

1527. You have no idea what it is?—No, I have not. I know that in our report, that is, the report of

Mr. Bidder, Mr. Hawksley, and myself, we computed what the annual total solid matter in the sewage was, and we found it to be about half the quantity that is annually deposited in the docks.

1528. (*Sir J. Karslake.*) What solid matter; that which is ejected from the sewers?—Yes. We made a computation of the whole of the solid matter.

1529. (*The Commissioner.*) Your board entered into some arrangement with a company on the northern side to take the sewage in its entirety and carry it down a considerable distance and utilize it?—Yes.

1530. Does that arrangement hold good?—Yes.

1531. It is in force now?—It is. We are bound by that arrangement, I take it, under Act of Parliament.

1532. Would they have the sewage delivered to them, sediment and all, just as pumped from the main sewers?—They would.

1533. If they carried out their contract to completion, as far as the northern outfall is concerned, the river Thames would be free from this pollution and from any accumulation of this portion of sewage deposit?—It would. When you say free from accumulation I mean it would be free from sewage going into the river. I say there is no accumulation of sewage deposit.

1534. You say that the sewage, and all contained in the sewage, is dispersed and lost?—Certainly.

1535. I suppose that you say the river Thames never was and never will be free from a certain amount of sediment in the tidal water which the currents stir up?—As long as the tide is ebbing and flowing in the Thames, and washing some hundreds of miles of siltings, and unprotected banks, so long will there be a large amount of sediment mixing in the waters of the river; and it is within my own knowledge and observation that several of the siltings of the river are washing away in some places and the sand and mud banks are extending in other parts, and all that deposit is moving in the river; and some of it is of a far heavier and more tenacious character than sewage mud.

1536. That sort of alteration always has taken place, the shifting of silt with the tides and land floods, and I assume always will take place?—No doubt, unless we can have the river Thames embanked on both sides above and below London.

1537. Do you know of your own knowledge whether your embankments below Westminster and above, on the southern side, have had any effect in that part of the river in preventing deposit?—I have not made sections in those places, but I have no doubt that the embankment must have had a beneficial effect.

1538. You have taken no soundings to ascertain that?—No.

1539. But you have removed or enclosed the muddy foreshores?—Yes, we have removed the muddy foreshores, and necessarily improved the scour of the tides.

1540. Does the low-water line leave the face of the embankment walls at any point?—Not at present. I see Captain Burstal nod his head; therefore it may do so at some points unknown to me.

1541. I hold in my hand the main drainage report of Mr. Bidder, Mr. Hawksley, and Mr. Bazalgette; will you look at this part of the report? It would appear that the consideration of sewage sediment was discussed by you?—We there consider the question as to what has been done at Leicester and other places, and, with reference to this sewage reservoir, we wind up by saying: "We have, therefore, no hesitation in stating "our decided conviction that shoals will not be created "by the admission of sewage water into the river "Thames in the manner proposed." There is another passage as to the process: "We do not, however, "believe this process to be needed for the prevention "of injury to the Thames, or to the health of the "population residing on its banks, and we certainly "do not recommend it for adoption."

1542. That is the liming process?—Yes, the process we had been describing, "because, when pro-"duced in large quantities, the precipitated matter is "unsaleable, and must be removed at considerable "expense."

1543. It further says: "An objection has been made "that the admission of sewage water into the river "(Thames) will be liable to create shoals in the navi-"gable channel. It is scarcely worth while to argue "this point, because the sewage matter emitted from "the large sewers in London does not produce shoals, "nor, in fact, can it, especially when, as in the case "before us the detritus of the roads will be detained "and removed before the water is allowed to pass "into the reservoir."

1544. (*The Commissioner.*) Does that mean that it will be removed from the gullies as you have described?—It does; or if it gets into the sewers from the gullies, then from the sewers, I am still strongly of the same opinion that I then expressed, and I entertain a still stronger view, that it is exceedingly difficult, if not impossible mechanically, to separate the solid matter of the sewage from the liquid.

1545. Have you ever seen the depositing tanks at Birmingham?—No, I have not; but I have seen a great variety of modes of filtration and precipitation.

1546. They are under an injunction at Birmingham not to send sediment from the sewers into the river Tame; nothing is to go into the river but clarified water, after the sediment has been removed. The dry weather sewage, to the amount of about 17,000,000 gallons a day, is passed into open tanks; and out of which the water flows over a long weir lip, leaving the sediment. I have a return from the surveyor, showing that the weight of macadam stone they put upon the macadamized roads of Birmingham amounts to about 45,000 tons per annum, and that the amount of sediment intercepted by those tanks amounts to about 42,000 tons per annum. You do not think you have anything equivalent to that in London?—I have no idea. I have not gone into those figures, but I have always understood, with reference to those works at Birmingham, that they have entailed upon the corporation great difficulty, and that they have now reverted to irrigation to get rid of the difficulty.

1547. They have entailed a large cost; they have a large acreage covered with useless deposit, which is the cause of great nuisance. They are attempting to carry out the irrigation system. They have tried the experiment on a small scale, but still there is the great fact, that the deposit is measured and measureable, and it nearly amounts in the gross to the weight of the macadam put upon the streets in Birmingham?—Then it occurs to me it would be highly objectionable for us, supposing it is so large a quantity, to accumulate that at Barking and carry it away, when it is carried now by nature to the sea.

(*Sir J. Karslake.*) Might I ask you, as a matter of information, whether at Birmingham, that which is caught in those pits or tanks at the outlet is road and street detritus, or whether it is general sewage?

(*The Commissioner.*) It is the wearing of the macadamised roads and streets, the analysis proves that; and at the parts of the tanks where the sewage enters, a great portion of the material is so clean that they can take it out and use it as sand, the sludge and floculent matter separating and flowing further away. It is the same at the sewage outfall tanks in Blackburn.

Cross-examined by Mr. Lloyd.

1548. What is the average amount of sewage that is poured into the Thames from the outfall at Barking day by day?

(*Sir J. Karslake.*) About 32,743,000 cubic feet.

1549. (*Mr. Lloyd.*) And that contains of course the ordinary matter which is found in sewage, the excreta of the metropolis, the soluble washings of the roads, subsoil, or spring-water, rain water, and the water which is brought into the metropolis by the water companies of London, and the like; that is

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what it contains?—Yes; but it does not contain the whole of the detritus from the streets and roads.

1550. That is to say, except so much as is intercepted by catchpits in the gullies?—No; the great bulk of it is taken away before it ever reaches the gullies.

1551. In what way?—By dust contractors and road sweepers. That is how the great bulk of metropolitan street mud goes away. It is penal to pass any road sweepings into the gullies. Whenever anyone is caught doing that he is brought before the magistrate and fined.

1552. Nevertheless you find a great deal does go down into the sewer?—No, we do not, as the great bulk is intercepted, swept off the surface, and taken away. Then the next sifting, if I may so call it, goes into the gulley catchpits, then what overflows from them gets into the sewers, but is taken out of them. A very small proportion, therefore, only finds its way to our outfall and into the Thames.

1553. You think it is a small proportion only of the detritus of the metropolitan streets and roads that gets into the Thames?—Yes.

1554. Do you happen to know, from any analysis, or from any other investigation or examination that has been made, what is the proportion of street grit found in that deposit which was spoken to by Mr. Leach and Captain Burstal?—I do not know of my own knowledge anything about it, but I have seen the gritty portion of the mud, which is sometimes called street grit, which I do not believe to be street grit at all. I believe it to be ordinary river sand, such as we take out of the river. We specify in London, in building, that the sand to be used shall be river sand. There is abundance of that, and it is very like road sweepings when they have been washed.

1555. Supposing there were a certain per-centage, say 60 or 70 per cent. of that which is deposited in the river Thames mud banks in places where the soundings made by Mr. Leach and Captain Burstal indicate, you think it is a mistake to suppose that that comes from the street sweepings of London?—Do you mean where the "Talbot" lay?

1556. Yes.—I say it could not proceed from the northern metropolitan sewage reservoir. I say it is impossible.

1557. You say it is physically impossible?—I do.

1558. Therefore, if it is in fact grit, such as would be obtained from the detritus of the granite of the macadamized streets and roads in London, you would account for it in some other way. I want to know how would you account for such material being there?—I say at once, there is a great deal of grit in the river Thames.

(*Sir J. Karslake.*) What is the proportion you put?

(*Mr. Lloyd.*) I forget what the exact proportion is, but I am putting the hypothetical proportion of 60 or 70 per cent.

(*Witness.*) I am putting it as strong as I can. I believe there is no metropolitan street or road grit from the northern outfall sewer goes into that mud bank at all.

1559. None whatever?—None whatever. It must force its way up against the ebb tide to enable it to do so, or it must go down 12 miles below Barking, floating all the way and not depositing, and then it must come back again, contrary to the tidal experiments of Captain Burstal and myself, above Barking, and have such an affection for that particular bank that it must deposit there.

1560. You yourself admitted to some extent that this bay, which forms a backwater, might bring back the material without its floating down?—No, I do not admit that.

1561. May it not as a fact do so?—No.

1562. You think it impossible?—I do.

1563. Will you tell me why you say, mechanically or hydrostatically, that is impossible?—Because I cannot imagine it possible that a heavy body can, from some law which I have never yet heard of, force its way up against the tide.

1564. Supposing there is a set of the current, a backwater and reflux, why may not it come back?—Because there is no such set from the northern outfall.

1565. You say there is none?—I do.

1566. That is a fact we may differ about?—No; we cannot differ about it, at least as far as I am concerned it is a fact. I have traced it as it goes down the river in the manner shown on this plan, and it does not go up the river.

1567. You say there is no backwater, and no eddy there, which could by reflux bring it back?—Not from our outfall. I say the current from the reservoir is itself sufficient to counteract a backwater which probably does exist in that bay above our point of outfall, but, as a matter of fact, the sewage gets into the tidal way of the river, and goes down the river.

1568. Supposing the fact to be so, and upon an analysis of that deposit which is formed in that bight and above you found a certain proportion of street grit, and a certain other proportion of sewage matter, can you explain how that comes to be there, assuming it to be so?—I do not admit that it is the fact; I dispute its being so. But I further say if it is so, it must come from some other source.

1569. You have not tested whether it is so as a matter of fact; you have not analysed it?—No.

1570. There has been evidence given expressly to the effect that there is a certain per-centage of street grit in this deposit, and that the rest is sewage matter; supposing that is uncontradicted, how would you explain the fact of its getting there?—I should be unable to explain it. I would repeat that the contrary is so clear a fact, that anyone here may satisfy himself of it; namely, that the sewage from Barking outfall does go with the ebb tide down the river Thames and not up the river.

1571. Supposing it to be ascertained as a fact also by actual analysis, that on the foreshore much higher up, and even above bridge, above London Bridge at all events——

(*Sir J. Karslake.*) Kew.

1572. (*Mr. Lloyd.*) No, London Bridge (anybody knows what above bridge means in London; we do not speak of Kew; we mean London itself). Supposing it to be the fact that there is a deposit in London which has been analyzed, and found to be of exactly the same character as that deposited on this foreshore, now what would you attribute that to, or would you deny that fact?—No, I believe that is the fact. I believe the mud found at Barking Creek, and that found at London Bridge and at Westminister, and all up the river, is of the same character.

1573. Supposing that upon analysis it is found to be in certain proportions street sweepings, grit from roads, and sewage matter of precisely the same character as that which has accumulated opposite to Barking Creek, or a little above it, how would you account for that?—I am quite unable to account for it.

1574. There are certain mechanical laws which it is not difficult to understand. I suppose matter in suspension deposits itself at different stages, according to the velocity of the stream or tide and the gravity of the matter suspended?—Yes.

1575. A brickbat will settle first, or a paving stone?—Yes.

1576. And lighter things will float longer?—Yes.

1577. They are kept in suspension for a considerable time?—Yes.

1578. And when you get to the lightest they will float, and float a very long time?—Yes.

1579. Particularly if in a strong current?—Yes.

1580. Those are all facts which we need not dispute about; but that which is held in suspension, though in minute particles, is some time or other deposited, is it not?—Yes.

1581. It does not go oscillating for ever backwards and forwards, but it goes at last to the bottom?—If it has a greater specific gravity than the water, and supposing other laws do not come into action, under which that body is dispersed.

1582. I will suppose for a moment that there is a considerable quantity of heavy matter that comes down and is discharged at the outfall, some of it will deposit itself earlier, and some later. Do you mean that none of that which goes down and is held in suspension, and goes down with the tide, will come back again with the reflux of the tide?—I think it will not.

1583. Upon what mechanical law or principle do you say that? Supposing it is of such relative gravity, that taking the effect of the current and other circumstances into account, it has not had time or has not been in a condition to deposit itself before the tide turns, will it not come back again?—No.

1584. Why not?—Experiments made by Captain Burstal and myself show, that if the sewage is a solid body, or can be treated as a body, which floats in the river and oscillates with the tide, at each high water it comes back a mile lower down the river than the point at which it started.

1585. Grant all that?—Then it cannot come back to the same point again.

1586. We have got this fact: there are lighter matters which float a longer time than others. The law being that the heavier matters deposit themselves first?—Yes.

1587. Do you mean to say that at the point of the outfall some heavy matters will not deposit there; are there none heavy enough to deposit themselves immediately after the discharge?—I think not.

1588. Do you know as a fact whether brickbats have not been actually pumped up, and have gone along the troughs of the conduits on to the farm at Barking?—Never to my knowledge.

1589. Will you undertake to say as a fact that it is not so, that pieces of brick, or what are called brickbats, have not actually been pumped up and have been swept along with the sewage?—I will not undertake to say it is not a fact, but I think it is not.

1590. You think no such heavy material as that is carried to the outfall, do you?—I think not.

1591. You suppose that it is all so light that it will necessarily float away to sea?—I think that brickbats and all other heavy materials are deposited in the outfall sewer before they reach the river.

1592. That is as to the heavy matter. Then there is a great deal of light matter, grease and floculent matter?—That being subject to a greater scour is kept in suspension till it is dispersed by decomposition or carried away to sea eventually.

1593. That will float as scum on the surface. Is that necessarily carried off to sea, or may some of it not come back, do you think?—I think it is carried off to sea, but really it is a matter of theory and imagination. However, I tell you as a fact that when the sewage gets three-quarters of a mile below the point of the outfall I have lost it. I cannot trace it any further. I suppose, in theory, it goes 8, or 10, or 12 miles lower down the river, and I assume, as a matter of theory, if it is not deposited, or dispersed or destroyed, it comes back again within a mile of the outfall, and goes back again, and keeps on getting further and further down, till it ultimately gets to the sea.

1594. Supposing the fact to be ascertained and proved to demonstration that there is a great accumulation of surface matter that floats, and that is found accumulating continually more and more at this bight that we have spoken of, and supposing it is proved to demonstration that people actually get their living by taking off the sewage grease in great quantities which comes down there at this very place, would that alter your view at all?—In what respect?

1595. That it goes off to sea and never comes back again?—I think it does go off to sea.

1596. Supposing persons actually get their living by collecting the grease that comes out from that sewer opposite Barking and selling it, what would you say then?—They possibly and very probably may do that. Grease is one of those things which will stick wherever it touches. I have known a six-inch pipe to be filled up with grease because it has the property of sticking wherever it touches.

1597. I am speaking of that which is floating on the river until it is deposited on the banks; where do you suppose it comes from. The Thames does not grow grease?—No; but a great many factories on the Thames send out grease into the river.

1598. The sewage sends none then?—I daresay it does send some.

1599. Do you know as a fact, or have you ever observed, what has been stated is seen in this bight about Barking Reach; that there are corks, ginger beer bottles, and all sorts of things, which are sometimes kept in a state of agitation, and are sometimes at rest?—I think it is very probable that corks may float for a short time in certain states of the tide, just at the mouth of Barking Creek.

1600. If you found a bed of them which covered the surface, what does that indicate to you?—At that particular point that there has been an eddy that has washed those corks into that bight.

1601. I thought so; that an eddy has had the effect of bringing them there?—Yes.

1602. May not that same eddy and backwater bring back something heavier than those corks?—Those corks are carried away eventually. You do not get a great accumulation of corks there. They may accumulate there for a time, and then with a different state of the river current away they go.

1603. Supposing they happen not to be corks, but something heavier, they would rest there for a time and would then deposit themselves?—You get the same process. They rest there for a time, and are washed away eventually.

1604. If they rest there and are heavy, they will deposit themselves there, will they not?—No; in one state of the tide they may remain there, in another state of the tide they will be washed away. I am stating what I have observed over and over again, and what I know to be a fact. I am not speaking merely with reference to this particular case. I say there are many places where there is a little bight, and where there is an eddy, which at certain states of the tide will draw in things of that kind, and then that they are subsequently washed away.

1605. Supposing there is an eddy, and they are drawn in and sank, they will not be washed away then?—At that particular place they are not sunk but are washed away.

1606. Supposing they happen not to be corks, but something heavier, which will sink, and supposing they have time to sink there, why are they not to remain?—Because in a different state of the tide the flood water current comes from the Roding and carries them out.

1607. Even if they were deposited in the meantime the current would carry them away, would it?—It is the fact that they are not deposited there.

1608. If it is asserted and proved that a portion of the 600,000 or 700,000 cube yards of grit and mud deposit spoken of, and which you do not contravene as a fact, is actually sewage matter, you say that must arise from some other cause?—What point are you speaking of now?

1609. From a little above the Barking outfall, down towards Horse End?—I say that nothing from the main sewer outfall goes above the outfall at all.

1610. Therefore, if it is sewage matter, it must come from somewhere else?—Yes.

1611. Were you here on the last occasion?—No; but I have read the evidence which was given.

1612. Did you smell the evidence which we had produced on the last occasion?

(*Sir J. Karslake.*) It reproduced itself at the quay to-day.

(*Witness.*) I smelt it at Barking Quay to-day, but not at the end of Barking Creek.

THIRD DAY.

Mr. J. W. Bazalgette.

15 July 1869.

1613. (*Mr. Lloyd.*) This sample of mud was, however, taken at the mouth of the creek, at Horse End?—If you stir up alluvial deposit of any kind it will smell very strong. If you go to the Maplin sands and dig six inches deep, it will smell exceedingly strong.

1614. I should have liked you to have smelt this?—That is no evidence of sewage.

1615. None whatever?—No.

1616. On the seaside at Worthing or anywhere else, you would expect to find the same sort of thing?—No, I should not; but where there is alluvial deposit, or what are called "slob-lands," (and I have had a great deal to do with embanking slob-lands,) entirely away from habitations, they (the mud) smell very strong indeed.

1617. They do not smell as this did?—Yes, they do.

1618. Not of organic matter?—No.

1619. But this did, I assure you. If that is organic matter which is deposited there, of which we had so pleasant a sample before, can you account for that organic matter being deposited there?—I say it is not organic matter.

1620. We will have it analyzed if you like. If it is organic matter, then it must have come, not from the mere deposit of alluvial soil, but from sewage, must it not? If it is upon experiment and test found to be organic matter, how would you then account for it?—Taken from where?

1621. Taken from that place which I have mentioned to you, opposite the mouth of the creek off Horse End, where the deposit of what we say is sewage matter is most visible?—I think there is no deposit of organic matter there.

1622. If upon analysis there is found to be organic matter in the deposit, how would you account for it?—I do not know. I cannot account for it.

1623. Did you read that portion of the evidence which stated, that when the men dipped their oars into the mud and drew them up again, the offensive smell was such that they could not endure it?—I have tried the experiment of dipping an oar in and drawing it out again, and I say from my observation of it that it is precisely the same as any other river mud.

1624. Where did you try it?—At the mouth of Barking Creek.

1625. Did it come up black, slimy mud?—Ordinary river mud.

1626. Which river are you speaking of?—Any muddy river.

1627. Take the Lee, for example, which is a fair sample, or the Mole, or the Wandle; do you say if you dip an oar in there you bring up slimy, offensive mud?—The Wandle happens to be a very pure stream.

1628. Take, if you like, the Lee?—The mud at the mouth of the Lee is very much of the same character.

1629. And stinks in the same way?—Yes, if you disturb it.

1630. I suppose the nose is no safe indication of what the matter is; it must be analyzed and tested; I want to know exactly when the last soundings were taken by the authority of the metropolitan board?—They are being taken this year.

1631. I mean those which we are considering. I do not care about the channel of the river Thames one jot. You may go up and down from London Bridge to Gravesend if you like. I do not care about that. I mean as to the part where it is stated that this deposit and accumulation has taken place. When were your last soundings made?—Our last soundings which were taken in the bay above Barking Creek, where the Chartered Gasworks are now carrying out their pier, were taken in 1868.

1632. You have made soundings since then?—Yes. We are making them now. We are keeping a record.

1633. In the same spot?—Yes.

1634. Do you dispute the accuracy of those soundings which appear on that tracing of the Conservancy Board?—I believe the soundings sent to me by the Conservancy Board to be correct.

1635. What is your theory, accounting for that accumulation of mud which appears to have taken place within that area?—I do not pretend to give the cause.

1636. But you do not dispute the effect?—I say there was an accumulation of mud up to 1867, and that that disappeared in 1868.

1637. Has it gone now altogether?—It has altogether gone. There is less deposit in the river at this moment than there was then.

1638. I am not speaking of the whole area of the river; I am speaking of this particular part?—I beg your pardon. I say there is an accumulation in that particular bay where I should have expected that there would be an accumulation. The river is wider at that point than at any other part near. It is out of the tideway, and, further than that, there are works being constructed in that part of the river Thames which must increase the silting up which is going on in that bay.

1639. Do you attribute the whole of this accumulation to that pier of the Chartered Gasworks?—No; but it is very much increased by that.

1640. When was that put up?—I suppose about a year ago.

1641. Was it completed a year ago?—No. It is not completed yet; it is going on now.

1642. How much of it was constructed in the river a year ago?—I do not know. I suppose there was not much constructed then; but there were barges lying there bringing materials. The works had commenced.

1643. You attribute the accumulation to that?—Yes, partially.

1644. Do you attribute the character or quality of the mud to that also?—The quality of it is the same as in any other part of the river.

1645. Supposing it not to be so, would you attribute anything to the Chartered Gasworks, as altering the quality of the mud deposit?—No, I should not.

1646. We have had some evidence about the dredging barges discharging their mud into the river; do you attribute a great deal of this accumulation to that?—I do not know. It is impossible for me to say what the cause of it is, but it is a part of the river at which I should expect accumulations of mud to take place.

1647. Accumulations of any kind?—Yes.

1648. Do not those accumulations take place by the deposit of matters which has been held in suspension in the water?—Yes.

1649. The matter held in suspension is there deposited?—Yes.

1650. What the character of deposit would be would depend on what was the matter that was held in suspension?—No doubt.

1651. Therefore, if the sewage matter coming out there is held in suspension, and deposited there, that would account for what we see. Do you state that you never heard of any suggestion about separating the solid matter from the London sewage before it entered into the Thames?—That is so to the best of my belief.

1652. But was there not in your knowledge a scheme for deviating the sewage water altogether from the river, and was it not contemplated that this was merely a temporary and provisional arrangement to be superseded afterwards?—I say, certainly not.

1653. Do not be too hasty, because I must call your attention to certain facts and documents. Do you mean to say it was not in contemplation at the time when this scheme was sanctioned of pouring the London sewage into the river at Barking, that hereafter the sewage would be diverted from the river Thames and be applied to agricultural purposes by irrigation?—No. I said in my evidence in chief that it was placed at a position where it might be rendered available for such a purpose; but that was no part of our scheme.

1654. I beg your pardon. You are a little too hasty. I have got Sir John Thwaite's evidence which he gave before the Committee before me. This is what he says: "We have always entertained the hope that "the sewage might be profitably applied to agricultural "purposes from the very commencement."—That is so, but that does not controvert what I say. Allow me to explain, if you please. We have taken this view from the commencement, and consistently. We have felt it was our duty first to divert the sewage from that

portion of the river near the metropolis, where if suffered to remain it might be injurious, and to get rid of it in such a way that it would not be injurious, and we have always been ready to encourage any commercial body who should be prepared to take that sewage and apply it to agricultural purposes.

1655. What encouragement have you given them?—We have given the Essex Reclamation Company a good deal of assistance.

1656. In what way?—In carrying out their works. We have also given them the sewage for a certain number of years, and prevented anyone interfering with them. If they could carry out their works and complete them we should be very pleased to see them do so.

1657. You are aware of course that they entered into a sub-contract with the International and Financial Company to take up this concern, and to carry it out, are you not?—I am aware of nothing of that kind, except what I may have read in the newspapers of the day, or from hearsay.

1658. But you know that when the original idea was started of emptying the London sewage into the Thames, an Act of Parliament was obtained, by virtue of which a sewage utilization company was formed?—After the completion of our works such a company was started.

1659. You had not begun to pour sewage into the Thames at all before then?—I think we had.

1660. I beg your pardon. Documents will show you that you had done nothing of the kind.

(*Mr. Philbrick.*) The Metropolitan Sewage and Essex Reclamation Act was passed in 1865.

(*Witness.*) Our outfalls were opened in 1864.

1661. (*Mr. Lloyd.*) But not the whole of them?—No, not the whole of them. The great bulk of them were permanently opened in 1864.

1662. That Act of 1865 was a completion of arrangements made previously, and this is the agreement scheduled to the Act.

(*Mr. Philbrick.*) The first Act was passed in 1865, and the second Act was passed in 1866. There were these two Acts.

1663. (*Mr. Lloyd.*) The agreement is dated 24th February 1865, and is set out as a schedule to the Act of 1865. I will call your attention to a few words in it. This agreement is made between the Metropolitan Board of Works and Messrs. Napier and Hope:—"That by the 'Metropolis Management Act, "'1865,' it was enacted, among other things, that the "board should make such sewers and works as they "might think necessary for preventing all or any "part of the sewage within the metropolis from "flowing or passing into the river Thames in or near "the metropolis, and that all sewers and works made "by the board should vest in them;" and so on. And it gives power to the board to construct and place, either above or underground, such reservoirs, sluices, engines, and other works as might be necessary, and might cause the sewage and refuse from such sewers to be sold or disposed of as they might see fit, but so as not to create a nuisance. Then it goes on to recite certain other matters, and among the other matters this: "That the board, with a view to the better "execution of the powers and duties conferred and "imposed on them by the said Acts, advertised for "tenders or proposals to be made to them by persons "desirous of contracting for deodorizing or otherwise "treating the sewage conveyed by the main outfall "sewers of the metropolis, so as to render the same "innocuous, or for removing or disposing of such "sewage with a view to its application to agricultural "or other purposes." Then it further recites: "That "in consequence of the advertisement aforesaid, Mes-"sieurs Napier and Hope made a tender or proposal "to the board for a contract to be entered into by "them for treating the sewage conveyed by the "northern main outfall sewers as follows, that is to "say, for collecting and transmitting the same for fer-"tilization of lands lying to the east of the metropolis, "and for conveying the surplus thereof into the sea;" and so on. "And whereas it appeared to the board" (now this is the agreement) "that the objects of the "works proposed by Messrs. Napier and Hope were "(1) to divert the sewage from the Thames; (2) to "render it innocuous by its application to growing "crops; (3) to realize the greatest money value of "the manure contained in it." Then it recites that Messrs. Napier and Hope had applied for an Act of Parliament to form a company to take up that contract, and execute those works. Having read that to you, I want to know whether it was not in the contemplation of the Metropolitan Board of Works that this discharge of sewage into the Thames was provisional only, and that the sewage was ultimately to be diverted from the Thames, and applied in the way there mentioned?—At that time it was clearly in contemplation to allow Messrs. Napier and Hope to take the sewage and apply it as there described.

1664. And for them was substituted a company authorized by Act of Parliament to construct those sewage irrigation works?—Yes.

1665. They were superseded, as it were, by that company?—Yes.

1666. That sewage irrigation company exists, I believe, at present; do you know that?—I do not.

1667. Have the Metropolitan Board taken any pains to call upon this company to fulfil their contract, or do anything in the way of diverting their sewage from the river Thames?—I am not aware that they have.

1668. You do not think, I suppose, it matters one farthing whether they do or not?—I think it does.

1669. Will you explain why, if the Metropolitan Board of Works thought it so important that the London sewage should be diverted from the river Thames and applied to the purpose of the fertilization of land, they have thought fit to take no steps in this direction?—I do not say they have taken no steps, that would not come within my province; and therefore I say I do not know whether they have or not.

1670. At present the ratepayers of the metropolis are pretty heavily taxed for these main sewerage works, are they not?—They are taxed for them, certainly.

1671. Supposing it were necessary to have a system of dredging to remove any deposited matter which comes from the metropolitan outfall sewers, they would be taxed still more for that, would they not?—No, certainly not.

1672. They would not! How so?—There is no sewage deposit coming from them, therefore they cannot be taxed for taking nothing away.

1673. But supposing it shall be found necessary to dredge for the purpose of removing sewage deposit, the expense of that would fall upon the ratepayers, would it not?—No doubt.

1674. You think it a mistake to suppose that it will be necessary to dredge?—I say broadly, that Barking Reach from above Barking outfall sewer to below Crossness outfall sewer is in a better condition since the main drainage works have been opened than before.

1675. That is, taking the average of the river between the navigable waterway and the shore?—I take the whole of the bed of the river Thames from high-water mark.

1676. Do you mean to say that though the river itself may have been deepened, and certain mud deposits, or banks, or shoals may have been carried away by the greater scour from above, that has had any effect upon the mud bank which is formed, and the deposit which is made between the tidal waterway of the channel and the shores?—I have taken a broad view of the whole question. I have taken a debtor and creditor account, and I say that the river Thames, taking the whole waterway of the river, has improved between 1864 and the present period (1869).

1677. What advantage is it to the inhabitants of Barking and the neighbourhood, that the waterway of the river Thames on the Kent side should have been deepened when there is a great accumulation of mud taking place on the other side? What advantage is that debtor and creditor account of yours to them?—It has been deepened on their side as well.

THIRD DAY.

Mr. J. W. Bazalgette.

15 July 1869.

1678. Where?—In a number of places, which I can point out on the sections. If you wish me to go into details, I can show them on the plan.

1679. Has it removed this mud deposit above Barking Creek which is spoken of, and which you admit to exist?—That is out of their reach altogether. It is above the point of the main sewers outfall, and has nothing to do with it.

1680. Has that mud deposit, spoken of by Mr. Leach and Captain Burstal, which they have analyzed, and found to contain street grit and sewage matter, been removed at all by the scour of the bed and main channel of the river Thames?—No. The Thames conservators have rendered it impossible that that ever can be removed, by allowing a pier to be placed there.

1681. It is, then, all the Chartered Gas Company's pier, according to your theory?—Yes, that renders it now impossible that any tide can wash the accumulation away; it renders it also unimportant, because that part of the waterway of the Thames cannot be used for the purpose of navigation.

1682. Supposing it affects the health, supposing it contains sewage matter, how will it be then?—I can only tell you I do not think that it does.

1683. Have you tried it?—Yes; I have taken samples of the deposit, and examined it.

1684. When?—Within the last month.

1685. Have you any analyses of it?—No. I have not got any analyses, but you can have them, I daresay.

1686. Your theory is, that nothing which the Metropolitan Board of Works has done has in the least degree prejudiced the navigation of the Thames, or affected the foreshore of Barking or Barking Creek, or done anything whatever that is injurious, but, on the contrary, they have rather improved the navigation of the Thames?—I say in my belief the operations of the Metropolitan Board have not injured any of those things at all.

1687. Did you ever hear of a river being polluted?—Yes. I think the Thames was very much polluted before these main sewerage works were carried out.

1688. Sewage matter poured into the river has a tendency to pollute it, has it not?—Yes.

1689. And the sewage matter of 3,500,000 of people pouring into the channel, even although it is a tidal river as large as the Thames, has some effect, has it not?—It has, no doubt.

1690. You do not mean to say that it would not be better to divert this sewage from the Thames?—No, I do not say so at all.

1691. You think then that it would be better?—I should like to see all the metropolitan sewage applied to a profitable use.

1692. And not merely as a question of profitable use, but also of getting rid of a possible nuisance?—No; I think at the present time it is no nuisance. It is carried into the river, and so diluted that there is now no nuisance in the river.

1693. That is your theory?—Yes.

1694. I think you said that the Barking memorial is all a tissue of imaginary statements?—I think it is the most poetic thing I ever read.

1695. You think that even the health of the inhabitants has not suffered; you say that expressly?—I do.

1696. Have you taken pains to inform yourself whether the health of the inhabitants has suffered?

(*The Commissioner.*) I must again stop you now.

(*Mr. Philbrick.*) I was prevented from going into the health question.

1697. (*Mr. Lloyd.*) I am not going into that at all, but Mr. Bazalgette makes a reckless assertion, and I want to ascertain the value of his assertion. He said the memorial was all a tissue of falsehoods, including the allegation that the health of the inhabitants had suffered. I want to know how he can possibly know that that is false?—I have stated that I do not think it could possibly affect the health of the inhabitants of Barking, because I find that the water of the river Thames at the mouth of the creek is purer than the water is at Barking Quay.

1698. You say it is impossible that the tidal water in the river Thames can bring up sewage into Barking Creek?—I do. The sewage discharged at the time when we discharge it cannot be brought back and up Barking Creek.

1699. There is one point I just want to ask you about, because I did not quite follow you. You said that the velocity of the current into which the sewage is discharged is greater than the velocity with which it comes in?—Yes.

1700. Supposing that that is so, what is the effect of it? One is slower than the other, is it not?—Undoubtedly.

1701. When you see one water joining another stream which runs less rapidly than a stream which has come into it, what is the effect?—It forms part of that stream.

1702. Do you mean to say that they blend immediately?—Yes.

Re-examined by Sir J. KARSLAKE.

1703. You do not alter your evidence on that point, although Mr. Lloyd laughs and others laugh as well?—No; they blend in one stream, but the smaller stream, coming in at a greater velocity, has very little effect on the larger stream.

1704. You still adhere to your statement, that in your judgment it is impossible that any sewage discharged into the Thames from the northern outfall finds it way up to Barking Quay?—I do.

1705. In the event of its being proved that organic matter is found at Barking Quay, do you think it within the bounds of possibility that that organic matter may have originally come from Barking town?—No doubt about it; I saw it floating in the creek to-day.

1706. Now let us go to the case of Messrs. Napier and Hope. So far as you are concerned have you in any way interfered with Messrs. Napier and Hope?

(*Mr. Lloyd.*) They have nothing to do with it; it is now a company.

(*Sir J. Karslake.*) They must have some interest in it; I suppose they are members of the company?

(*Mr. Lloyd.*) They were superseded by the company altogether.

(*Sir. J. Karslake.*) I call them Napier & Hope.

(*Mr. Lloyd.*) It is the Sewage Company.

1707. (*Sir J. Karslake.*) Let me know about the Sewage Company. Have you yourself, as engineer of the Metropolitan Board of Works, ever put any difficulties in the way of this sewage company?—On the contrary, I gave evidence in their favor before the Parliamentary Committee.

1708. And Sir John Thwaites did so, too, I believe?—Yes. I have assisted them in every possible way with their works, and I should be very pleased to see them succeed.

1709. So far as you know, have the Metropolitan Board, as a body, thrown cold water on their scheme?—On the contrary.

1710. Do you know of any single instance in which the Metropolitan Board, as a body, have expressed any opinion as to this company not being a financial success?—I am quite sure that, as a body, it is a matter of great disappointment to the board that they (the company) have not more effectually carried out their operations. The board would have done anything that they legally could to have made it a commercial success.

1711. Does the Metropolitan Board consist of a great many individuals?—It does.

1712. Do you know, as a matter of fact, whether some of those individuals entertain the opinion that the sewage utilization scheme is not a financial success?—No doubt they do.

1713. And express it?—Yes.

1714. If so, they merely express their opinion as individuals ?—Yes.

1715. As far as you know, have they ever expressed it, as a body or as a board ?—As a body they have not; but members of the board may have expressed their individual opinions as unfavourable.

1716. With respect to the facilities that have been given to the Sewage Utilization Company, they have already formed, or very nearly formed, a junction with your works, have they not ?—They have formed a junction between their model farm and our sewer outfall works.

1717. The Act of Parliament speaks for itself. But at the time that you conceived the plan of carrying the main sewer outfall into the Thames you were permitted by Parliament to do so ?—We were.

1718. So far as the Essex Reclamation Company are concerned, if they take your sewage, have they a right under the Act of Parliament to give up that concession on any day that they choose to do so ?— I think they have.

1719. In that event, is there anything to prevent the sewage being again diverted into the Thames ?—No.

1720. Some part of it would always have to be so ?—Yes; under any circumstances. There are three culverts 9 feet 6 inches in diameter, and their main culvert is only 10 feet in diameter, so that it is quite clear that there must be times when the sewage company could not take the whole of the metropolitan flood water sewage.

1721. Would it be taken during all times of the year, or are there times in the year when the Essex Reclamation Company could not take the whole ?—In times of rain they could not take the whole of the sewage.

1722. Supposing they carried out the contract, and took only such part as you were bound to give them, you would still have to discharge some sewage into the Thames ?—Yes.

1723. Your arrangement with the company would not alter the scheme or the necessity of preserving the outfalls into the Thames ?—No.

1724. I believe Mr. Hope's farm, which is an experimental farm, has always had the sewage which has been required for it without any payment at all ?—Yes.

1725. With reference to the smell of mud on the pole; did you detect anything different from ordinary river mud in the smell of the mud that was taken up on that pole ?—Ordinary mud, or the mud which is found in an estuary, commonly called "slob," has precisely the same appearance and smell.

1726. As to bringing the metropolitan sewage down to this point in the Thames, have you yourself watched the flow of sewage at the time when it has been let out from the nearest outfall ?—Many times.

1727. You have followed it down until you have lost the track of it ?—I have.

1728. About how far from the mouth of the sewer is it that you have lost the track of it ?—From half a mile to three-quarters of a mile.

1729. (*The Commissioner.*) Which outfall ?—Either of them.

1730. (*Sir J. Karslake.*) I am at present speaking particularly of the northern outfall. You have watched the sewage matter passing down into the Thames ?—I have.

1731. You have tracked it by sight for half a mile ?—Yes.

1732. As regards the experiments. Were experiments made by you and Captain Burstal as to the return of matters which were let out from the sewer ? I am not speaking of bricks and pigs of iron that find their way on to the sewage farm, but ordinary sewage matter. You have watched it, and have made experiments to ascertain how far it returns ?—No; we have made experiments to find how far a float put into the river would return by the next tide, the float being a solid body which cannot be dispersed.

1732*a*. As I understand you, that float after having been discharged from the sewer would come back again on the return tide, how far ?—On the average it would go to within one mile of the point of discharge.

1733. That is under conditions less favourable than sewage matter ?—Clearly; the motion of a solid float may be a matter of theory; but sewage matter does not return in that way in the form of sewage; other laws come into play and it is dispersed, deodorized, and annihilated.

1734. It is broken up and so completely mixed with so large a volume of river water as to be annihilated ?—Yes.

1735. Having regard to those experiments, and what you yourself have seen, do you believe it possible that sewage which is sent out from the northern outfall and goes down as far as the tide will carry it, then, unlike the float, having a particular affinity to this mud bank above, comes back and lies there for the rest of its natural life ?—It does not seem to me to be likely.

1736. Have you ever seen this bed of corks that my learned friend speaks about at the mouth of the creek ?—Never.

1737. You have never happened to have witnessed that bed of corks floating about ?—No; but you constantly see beds of corks wherever there is a sewer discharging into a river; you see the corks floating around, but they get carried away eventually.

1738. I think you say that in your judgment in all these banks which are formed in the Thames there is a great quantity of sand ?—There is.

1739. As distinguished from road detritus ?—Yes, there is a great deal of Thames sand mixed with the mud.

1740. My friend asked you whether it was possible that a river should be polluted by sewers pouring sewage into it. In your judgment, before this main outlet sewer was formed by the Metropolitan Board of Works, was the river Thames considerably polluted by letting out the sewage at low water throughout London ?—It was notoriously in such a bad state as to be almost intolerable.

1741. My friend asked you a question about this detritus. As I understand, your great object is to save yourselves expense, by catching all the detritus you can from the roads and streets in those catchpits before it reaches the main sewers ?—Yes. There are large contracts with every parish or district board in the metropolis, which contracts bind the contractors to sweep the streets, particularly after rain, and they collect and deposit the road detritus in carts, and carry it away, and it is used by them for the manufacture of bricks and other things of that sort.

1742. Are there penalties attached to the offence of allowing this detritus to wash into the sewers ?—There are. We offer rewards to the police and others whenever they can detect persons sweeping street or road detritus into the sewers, and they get a part of the reward.

1743. Precautions are taken by putting straw and things of that kind over the gullies to prevent road and street detritus going in ?—Yes.

1744. Is it in London, as far as you can judge, reduced to a minimum ?—Not yet.

1745. If the road and street detritus is washed into the sewers do you use means from time to time to clear it out before it gets into the river ?—We do.

1746. In different parts of the sewers ?—Yes.

1747. Does it deposit in the sewers ?—It does.

1748. In your judgment, even supposing a certain quantity of detritus gets into the sewers, is it, comparatively speaking, a small proportion even of this which finds its way into the river ?—A very small proportion.

THIRD DAY.

Mr. J. W. Bazalgette.

15 July 1869.

1749. Nothing to be compared with the 42,000 tons of Birmingham ?—No.

1750. It can hardly be said that if street detritus gets into the Thames it can have any effect upon health ?—No, I should think not.

1751. You say you are still engaged on the survey for 1869 ?—We are making another survey this year.

1752. The evidence that has been given is however given by those engaged in making the surveys as far as they have gone ?—Yes.

1753. (*Mr. Lloyd.*) What quantity do you intercept of this detritus, because I suppose you keep some record of the quantity ?—I should not be able to get that without referring to all the different district boards. There are 45 different jurisdictions within the metropolitan area.

Mr. J. Hawkshaw.

Mr. JOHN HAWKSHAW called ; examined by Sir J. KARSLAKE.

1754. I believe originally you looked at this question when you were asked to go into it with a view to navigation and health, did you not ?—Yes.

1755. First of all, as to the question of detritus. In your opinion, having regard to what you have heard and what you know as to the mode of intercepting the detritus as far as possible, and having regard to the size of the metropolitan main sewer outfalls, is it the case that the detritus from the sewers makes that mud bank which is said to exist above the outfall, or that it contributes to it to any extent ?—I think it must be to a very small extent at all events, if at all.

1756. You have had your attention called to soundings in the river Thames ?—Yes.

1757. You have heard the evidence of Mr. Bazalgette founded on those soundings ?—Yes.

1758. In your judgment is it a fair way of putting it, to say that a certain accumulation has been formed in one place, without taking into consideration that credit should be taken for the scour over a certain reach of the river ?—No. I think, as regards the Thames, the only way of dealing with the question is to take soundings over the whole of a given reach, and then by examination of those soundings to see what the effect upon that reach has been. I cannot imagine any other mode of arriving at a conclusion worthy of consideration as regards any effect upon the navigation of the Thames.

1759. (*Mr. Lloyd.*) You are speaking of the navigation of the Thames now ?—Yes.

1760. (*Sir J. Karslake.*) Having regard to the shifting character of the banks in the Thames, do you think it is at all improbable that those mud banks which have grown up higher, as they say, in the dead water will by-and-by disappear or be diminished to a considerable extent by the alteration of the set of the tide ?—I think it likely that they will diminish in certain places ; but if you are referring to the particular mud bank which I understand to be the subject of this inquiry, I do not think it is likely that that will be diminished, from the fact of there being something in the nature of a groin put right across it.

1761. In your judgment is that which you call a groin likely to cause an accumulation, and to increase it ?—I am quite confident that the completion of the Chartered Gas Company's pier will increase the mud deposit at that particular bend of the river.

1762. Wholly irrespective of any question about sewage or detritus ?—Certainly.

1763. (*Mr. Lloyd.*) If that increase of deposited matter happened to be sewage it would aggravate the mischief ?—No doubt, whatever it comes from it must increase it.

1764. (*Sir J. Karslake.*) Were you consulted at all with regard to this outfall ?—I was consulted to this extent, that I happened to be one of the old commissioners of sewers up to the time that the whole of these works were transferred to the Metropolitan Board of Works, and the plan which has been acted on since was at that time matured to a very considerable extent. It has not been varied very much since that period.

1765. Did that plan receive your general consideration at that time ?—Yes.

1766. In your judgment is there any better position, having regard to all questions, than that in which the outfall now empties itself into the Thames ?—I think there is no better position, if you take the question of cost into consideration.

1767. I suppose the cost of carrying it down much further, say 15 or 20 miles, would be an enormous one ?—Yes ; that was gone into by Captain Galton, Mr. Simpson, and Mr. Blackwell. I think they estimated the cost at something like 12,000,000*l.* as compared with 3,000,000*l.* or 4,000,000*l.*

1768. And in the result it was considered that, on the whole, this was the best place for the outfalls ?—It was.

1769. Do you see anything, as an engineer, to induce you to think that that is not as good a place as could have been selected for the outfall of the northern sewer, having regard to all the circumstances ?—No, I do not.

Cross-examined by Mr. LLOYD.

1770. Would you prefer to have the sewage diverted from the river altogether, or poured into it ?—If it were possible to divert it altogether, I would prefer that, certainly.

1771. That would be on several grounds, of course, sanitary and other grounds ?—That is *qua* the river ; it depends on where you divert it to and what you do with it.

1772. I mean *qua* the river. It is desirable to keep this sewage matter out of it if possible ?—No doubt.

1773. Therefore, the river is not the better for having the sewage poured into it at all ?—Certainly not.

1774. I suppose the idea originally was to keep out the sewage matter from the river. In all these new arrangements which are made for the health of towns, it is made a great point to prevent rivers being polluted by emptying sewage matter into them, is it not ?—I do not know that that was the prevailing idea at the time that this London scheme was formed ; at that time it was thought sufficient to divert sewage matter away from the population whence it emanated. It is subsequently that the opinion has grown that it is desirable to keep town sewage out of rivers if you can.

1775. Are you aware that the law courts have granted injunctions in many cases to prevent the pouring of town sewage into rivers ?—I believe they have.

1776. And that in the case of towns with a small number of inhabitants comparatively ?—Yes, I am quite aware that they have done that. I have thought about it a good deal, and I must confess that the more I think about it the more I see how difficult it is, in all cases, to carry out those views.

1777. Unless you propose to use the sewage matter for fertilizing land ?—No doubt ; that seems to be the only solution of the difficulty, as far as I can see.

1778. If it can be established that town sewage can be innocuously applied to the purposes of manure, that is to say, that the course of nature that we have talked of so much can be followed out, and that that which is the excrement and nuisance of a town may become, when applied to land, the means of producing aliment again, which is the natural process ; that would be a desirable course to adopt ?—No doubt, providing that it could be done so as to remunerate the parties who do it, because, of course, unless it is so it is impossible, however desirable it may be.

1779. (*The Commissioner.*) You do not think it is worth while to spend a guinea for the sake of getting 20*s.* ?—No.

1780. You have had a very large experience with tidal rivers ?—Yes.

1781. I suppose you know that it is very difficult to define where shore deposit comes from?—Yes.

1782. It would be difficult to prove that any special deposit comes from any specific place?—No doubt.

1783. The tidal waters in and out of river estuaries such as the Thames are constantly altering the surface of the banks and shores?—No doubt.

1784. The neap tides will make accumulations, and the spring tides will scour them down?—Yes.

1785. It depends upon the force of the tidal current and other contingencies; as, the shape of the banks, and a score of things which we cannot get at very easily?—No doubt you have to consider as to any reputed effect caused in the river in dealing with the question of outfall, that the Thames is about 100 miles long above this point, that its bottom is subject to abrasion, and that its banks are also subject to abrasion and therefore, even if you were to succeed with this irrigation scheme (which I hope you will) in removing the metropolitan sewage so as to use it for agricultural purposes, you will never get rid of all deposit from the Thames, or even to any considerable extent.

(*Mr. Lloyd.*) What we want is not so much to get rid of ordinary deposit in the Thames as to get rid of this nasty, filthy, obnoxious sewage matter.

(*The Witness.*) I hope you ultimately will.

Adjourned to Monday the 26th inst.

FOURTH DAY.

No. 6, Committee Room, House of Commons, Monday, 26th July 1869.

Mr. Horace Lloyd, Q.C., stated that in the unavoidable absence of Mr. J. H. Lloyd, he appeared to represent the memorialists.

Mr. George Parker Bidder called; examined by Sir John Karslake.

1786. You are a civil engineer as we know, and have had some little experience in your time?—Yes.

1787. Were you consulted by the Metropolitan Board of Works to design (with Mr. Bazalgette and Mr. Hawksley) the existing scheme of the metropolitan main drainage?—Yes.

1788. Amongst other things, did you devote a good deal of time and attention to the question of the relative position of the outfalls?—Certainly.

1789. Taking all things into consideration, did you come to the conclusion that the northern, or Barking, outfall in its present position was in the best place that could be selected?—Yes; and with regard to the southern outfall, had not it been that the general feeling was against it we should have recommended a higher point on the river.

1790. At the time you had to consider the subject were there plans by other engineers which had been suggested for the main drainage, and which plans you had the advantage of?—There were plans by several engineers for the main drainage, and very elaborate plans by Captain Galton, the late Mr. Simpson, and the late Mr. Blackwell, who were appointed I think by the Government of the day.

1791. We have had the exact position of the northern and southern main sewerage outfall works described already, in fact we have seen them; has your attention been drawn to the memorial of the Barking folk?—Yes.

1792. As to the allegation, "Your memorialists "beg respectfully to call your attention to the present "dangerous condition of the river Thames—dangerous alike to navigation and to the health of the "inhabitants of the parish of Barking, and of all the "populous and industrious towns below London, "consequent upon the concentrated discharge of "sewage through the main outfall sewers of the "Metropolitan Board of Works," is it the fact that there is any danger whatever to navigation from the sewage?—Certainly not. On the contrary, the mode in which it is delivered must tend to benefit the river Thames navigation.

1793. And in fact if the Metropolitan Board's soundings as put in be correct the navigation has been benefited?—So it appears.

1794. I do not say by the metropolitan sewage discharge, but by some cause or other?—Yes, it would appear so.

1795. The channel of the river Thames is deeper now than in 1864?—So it would appear. But what I state distinctly is this, the mode in which the London sewage is now delivered into the Thames has a tendency to improve the navigation.

1796. You mean as compared with the mode in which it was delivered under the old system?—Yes.

1797. Will you describe so as to get it on the notes what the mode of delivery under the old system was, and what the effect of it was upon the river?—Under the old system, as is very well known, the London sewers commenced delivering into the Thames as soon as the river water fell below the level at which the sewage had been penned back in the sewers; and they continued to deliver sewage into the Thames through the whole of the ebb and flood, and until the water rose again sufficiently high to block and retain the sewage in the old sewers; of course, so far as that part of the sewage which was delivered after the flood tide had made was concerned, it is perfectly obvious that whether it were more, or whether it were less, it came into the river in substitution of tidal water, that is to say, the upper reaches of the river would have to be filled; and whatever was the quantity derived from the sewage it would be in substitution of that which would naturally come up with the tide, therefore the upward scour would be so far diminished. I do not put great stress upon that, but I say that such is the tendency. Now the whole of this sewage water is penned up in the outfall reservoirs till an hour (40 minutes) after high water, and it is then delivered in the ebbing tide within the space of about two hours, that is to say, to about half tide. The result is that all the water that has been penned up is then delivered in addition to the outward scour, therefore you promote the upward scour by increasing the volume of tidal water, and you promote the downward scour in delivering all that is in substitution of tidal water at that period of the tide when the effect would be most beneficial. I therefore say that the tendency, in both respects, is to improve the navigation.

1798. The velocity with which the sewage is delivered from the sewers has also some effect?—The quantity now delivered at that period of the tide acts with the tide, and therefore it has a tendency to increase its velocity and consequently its scour.

1799. Have you watched the effect of delivering the sewage into the river?—Yes, I have been on the river the whole time of the sewage being delivered, from the time it commenced till it ceased.

1800. Did you notice whether it was speedily dispersed and mixed with the body of Thames water?

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—Much more speedily than I anticipated. I was prepared from our inquiries to find that the absorption of this sewage in such a large mass of river-water would dissipate it, but the rapidity with which it disappeared I must say was much more than I could have anticipated; within three quarters of a mile from the point of discharge the sewage was neither sensible to the eye, the nose, nor the taste.

1801. The volume of river-water, of course, as compared with the volume of sewage is enormous?—Yes.

1802. Did you make any experiments for the purpose of seeing how far the sewage, as sewage, went down before the flood tide carried it away?—No; but I assume that to be according to the mean velocity of the river, which is from two to three miles.

1803. How far did you follow the stream of sewage down yourself?—We lost all trace of it, as I have said, in three quarters of a mile below the outlet; we may have gone another quarter of a mile, and then we pulled inshore, and crept along inshore past Barking Creek, and there the river-water was not at all affected by the sewage. We had a very strong smell there, but we found it was from another source altogether.

1804. What was the chief source from which this smell arose?—I have no doubt this smell was from Mr. Lawes's manure factory.

1805. (*The Commissioner.*) The artificial manure factory?—Yes; and we were informed by the men that at times the stench was so strong when the wind was from the east, that they were obliged to leave off what work they happened to be about at the outfall reservoir.

1806. (*Sir J. Karslake.*) It has been said that a mud bank or shoal has been caused near the Barking outfall to the extent of 700,000 cubic yards?—That on the face of it is not tenable for a moment. In the first place, during these four years the whole quantity of solid matter delivered into the Thames is scarcely half that quantity. Therefore according to their theory by some miraculous means the whole of this is arrested on this particular shoal, when actually there could not have been above half that quantity delivered into the Thames.

1807. Will you just give us your estimate of the number of tons of silt per annum which are discharged?—In round numbers about 90,000 tons.

1808. Solid and otherwise?—Solid.

1809. When was the northern outfall opened?—Four years ago.

1810. If every atom of the quantity you have mentioned had been deposited it would not be 700,000 cubic yards?—No; if deposited in this particular spot, but where this shoal is alleged to be in the bend of the river, it would in fact be an advantage to the navigation if that nook were occupied by a solid embankment; and as you deepen the outward channel the probability is that a shoal will grow up in this recess of the river. In addition to that we know that a pier has been constructed there at which a number of vessels and barges lie, which have a tendency to aggravate the accretion of matter in that particular spot.

1811. Are there other causes besides in operation which affect the river Thames to your knowledge?—Yes, there are causes at this moment, as we know, the tendency of which is (I do not carry it beyond that) to affect the flow of the water of the river, and therefore to affect the scour. Blackfriars Bridge, or its site, has for many years been incumbered by a vast amount of scaffolding; anyone going under it in a steamboat must be aware of the rush of water. That means that so much water is retarded or penned back, which detracts both from the outward and the inward flow. We know that on removal of old London Bridge, which was a much greater dam than Blackfriars Bridge, the important effect it had on the bed of the river both above and below. In a much less degree the tendency of the removal of the scaffolding at Blackfriars Bridge will be to improve the condition of the river. Of course every obstruction you put into the river tends to prejudice the flow of water. Take for instance a thing that I observed the other day between Woolwich and Blackwall, a large floating pontoon intended originally I believe to lift wreck; there it is moored apparently permanently discharging screw colliers on both sides, a whole fleet of barges were there. I suppose in one shape or another that this pontoon and the barges occupied pretty nearly five per cent. of the sectional area of the river Thames at that place. That is placed there by permission of the Thames Conservancy for private advantage and profit only. I say the tendency of that is prejudicial, whereas the tendency of the mode in which the metropolitan sewage is discharged into the river is advantageous so far as it goes.

1812. Supposing any part or all the sewage silt came back to the spot where they say this shoal has been caused, is it in your judgment any appreciable quantity?—Certainly not.

1813. You doubt whether any part of it comes back?—I doubt if any of it comes back.

1814. Do you state that from your personal observation, having followed the sewage down the river and seen where it entirely disappears?—Yes.

1815. The day you selected for making your examination was the 10th of July last?—Yes.

1816. Did you go to Barking?—Yes.

1817. I will not go into the question of health so much as the question about the river. Did you make an examination of the quay and the barges that were there, and the nature of the business carried on at Barking?—Some part of the business.

1818. Had you the good fortune to find any manure barges there at the time you were there?—Yes, that nook, quay, or harbour, if you like to use the term, of Barking lies in a little bay. The channel of the creek is quite distinct from that. At the time we were there, just before high water, the water in the creek was flowing in a lively way past this basin and up through the bridge next the mill, and into the upper course of the creek; that water was comparatively clear, you could certainly see more than three feet through it.

1819. At what part was that?—In the channel.

1820. Did you go up in a boat?—I went down in a boat, and between the creek proper and the harbour there was a line perfectly distinct, as if drawn by chalk, only instead of being white it was black. The water in the inner harbour was absolutely opaque and perfectly distinct from the water in the creek; that was obviously the result of the refuse of some mill which was said to be a paper mill. If there is anything prejudicial from which the town suffers it must be from that polluted water and not from the tidal water in the creek, which was comparatively clear. This discoloured water had been penned back at an earlier period of the tide and forced into the inner harbour and kept there. The line was quite distinct.

1821. When you say the inner harbour, I do not exactly recollect what you mean?—I will make a sketch of it. Barking harbour is somewhat in that shape (*making a sketch*); all *this* water which was derived from the channel flowed direct across *here*, and *this* had been backed up the first part of the flood and so kept there. In this bay the water was perfectly opaque, while the tidal current *here* was comparatively clear.

1822. The polluted water was simply lifted up and down?—Yes, but when the ebb tide came a part of that would go away.

1823. (*The Commissioner.*) It would oscillate vertically?—Yes.

1824. (*Sir J. Karslake.*) If you had shut your eyes you could have distinguished that there were certain smells?—There were smells; when you were very near the dung barge you could smell that. My nose I admit is not a remarkably acute one, and we were mostly on the tidal water where there was no smell.

1825. (*Mr. Horace Lloyd.*) How far was that up?—A mile and a half.

1826. (*The Commissioner.*) Taking the line of the Thames, and taking the inequalities upon its shores, would the tidal current have a tendency to pass up and down and raise and lower any embayed water in a similar way to that which you have described?—If there are any nooks of that character, where the water does not flow out with the ebb entirely, it is just possible that you might have the water there raised up and down, which might take a tide or two before matters floating in it would disappear.

1827. (*Sir J. Karslake.*) Did you see those paper mills at Ilford?—No.

1828. They are some way up above Barking town?—I believe so.

1829. Do you know whether they manufacture paper from Esparto grass?—That is what I was told. You may remember as we went down by the railway the water in the creek that we crossed above Barking was quite black; quite a different colour to the river Thames water.

1830. Having made your examination of the water of the creek opposite the town of Barking itself, with the result that you have stated, did you go down the river Roding (or Barking Creek) in a boat to Barking town, and on by the creek, and so into the Thames?—Yes.

1831. Did you take particular notice of the state of the water in the river Thames and in Barking Creek as you went down?—Yes; Mr. Hawksley took samples, I only took a superficial view, testing it here and there, but I carefully examined the banks.

1832. Was that at the flood or the ebb?—That was on the flood.

1833. You went against tide?—Yes, I went down against tide.

1834. So that if there had been a stream of sewage filth coming up you would in all probability have discovered it?—Certainly.

1835. Was there anything of that sort at all?—Nothing. I did not see in the whole of the course other than what I should have expected to have come out of the town of Barking. I only noticed one small piece of fæcal matter, which was less than the size of an egg.

1836. That was in the whole course down to the end?—Yes. If anybody says that there is fæcal matter on the sluices of Barking Creek, I am not prepared to say it is impossible; I say, however, that it is in the highest degree improbable; but I say that it is mechanically impossible that it can have come from what flows out from the metropolitan northern outfall, and for this reason, as I said before, the metropolitan sewage is delivered upon the ebb, and it takes a course entirely divergent from the Essex shore; and at the time that it reaches a point opposite Barking Creek there is a strong current out of the creek which diverges it still more.

1837. That would have the immediate effect of deflecting it further into the river Thames?—Yes, away from Barking. Therefore on the ebb tide it is mechanically impossible that metropolitan sewage can find its way into Barking Creek. It goes down seven or eight miles before it commences to return, so that when it returns it is mixed with seven or eight miles of Thames water, and it has been churned up in every possible way; but supposing this matter to be retained in its original shape, the proportion due to what can go into Barking Creek cannot exceed a ton and a quarter per day. That is all the accretion that can take place supposing it is arrested there, which I do not mean to say is impossible, but which I say is in the last degree improbable.

1838. You were speaking about the banks of Barking Creek. As far as you could judge, is the mud on those banks ordinary river mud?—Yes.

1839. Was the vegetation healthy?—Yes.

1840. The mud seemed to be the same character of mud as you find elsewhere in the river Thames?—Yes, and generally in these creeks; of course these creeks' banks are not like the banks of the Thames, which in many places are to a great extent denuded from mud by waves created in the river by steamboats and wind; there is not space enough in Barking Creek to create such waves as those, therefore the banks are naturally more adhesive and muddy, but otherwise there is no feature in that creek other than I have observed in 50 other tidal creeks.

1841. There is an assertion here: "There are "banks within a few hundred yards of the houses of "some of your memorialists, composed of solid "sewage, 6, 8, and 10 feet deep; and the back-"water of nearly undiluted sewage sweeping up "Barking Creek is so great that it must infallibly, "beyond the possibility of doubt, breed a pestilence "sooner or later." Is there any truth in that statement?—Not an atom; it is perfectly imaginary.

1842. "It is only a question of time." Do you agree with that?—No.

1843. "Foreshores, which formerly were hard "shingle, are now pestilential mud; and what were "formerly valuable fishing grounds are now spawning "beds of fever and cholera?"—Whether they were valuable fishing grounds I do not know anything about.

1844. They are not now, you say, "spawning beds "of fever and cholera?"—Certainly not.

1845. They will not bathe there; perhaps they come to the Serpentine to bathe instead?—As far as the water is concerned, I should not hesitate to bathe in Barking Creek on the flood tide the least in the world, although I should on the ebb.

1846. In your judgment, so far as you saw, was there anything whatever attributable to the metropolitan outfall on the northern side that in any way was calculated to affect the comfort or health of the inhabitants of Barking?—Not in the least, and there cannot be.

1847. Something has been said about the navigation; did you see the Horse End shoal which has been spoken of?—Yes.

1848. Did you examine it?—Yes.

1849. What is the character of it?—There is a point of land which appears to be gradually wasting on the sewage reservoir side, and which as it wastes gives the appearance of the shoal being extended. I believe that is really a mistake. Beyond that there is a hard shingle bank, which has a tendency, and which no doubt has operated for many years, to arrest on the ebb tide some of the matters coming down from Barking, and to deposit them on it. To what extent that may have operated I cannot say. The tendency no doubt is (that shoal being there) to accrete matter at that place. Very little expense in dredging that shoal would relieve it to a very great extent. As far as I can judge from the evidence, when Barking was thriving and in a flourishing state I have no doubt many more craft used to go and lie there than do now. The tendency of craft moving over this mud was to scour it away. Therefore there are two causes in operation tending to create deposit: there is this shoal outside, and the absence of trade which formerly went to and up and down the creek.

1850. Vessels lying on a bank would have a tendency to loosen the mud?—Yes; they would not always lie in one place. They would lie first in one place and then in another.

1851. You did not see, when you were there, a coffer dam, which has now been removed, which was used for the purpose of putting the Essex Reclamation Company's sewage syphon pipe across?—I only heard it described.

1852. In your judgment would a coffer dam of that description half across the creek have a tendency to increase that shoal?—The tendency would be to increase the shoal just as I said before. The scaffolding of Blackfriars Bridge and the coal pontoon in the river Thames have a tendency to increase the mud shoals. Whether you can put a practical value on it I do not say, but the tendency, no doubt, of those things is to do that.

1853. I really think I need not ask you any question about the navigation, because you have told us what you have to say about the 700,000 cubic yards, and also as to the main channel of the Thames, which we

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know is deeper than it was formerly. Did you know Barking before this metropolitan sewage outfall was actually constructed?—I have known Barking itself for nearly 40 years, but I have not directed my special attention to it.

1854. As far as you can see, is there any injury done to Barking town which did not exist before the northern metropolitan main sewers outfall was placed where it is?—I have already said that there is none.

1855. Nor to the navigation?—I say that the outfall has not caused any injury to the navigation, and cannot.

1856. From anything you have seen in investigating this matter, with a view to your examination here, is the northern metropolitan sewers outfall, in your opinion, still in as good and convenient a position, taking all circumstances into consideration, as it can be?—Yes.

1857. You would not wish to make any alteration in it?—Certainly not; I think it only right that I should state that the recommendations of the report on which the present sewerage plan was based have been substantially and honestly carried out (as far as I can judge) by the Metropolitan Board of Works, and I have no hesitation in saying that the main sewerage works have fulfilled all the objects which we had in view in making those recommendations.

Cross-examined by Mr. Horace Lloyd.

1858. You mean by that that the metropolitan main sewerage works are executed in the manner which you intended them to be?—Yes.

1859. What was the year when you made this report recommending Barking Reach for the outfall?—1858, I think.

1860. You and Mr. Bazalgette and Mr. Hawksley made that report?—Yes.

1861. Was that after some months of consideration?—Yes, five or six months.

1862. Your investigation was simply, if I remember rightly, as to what was the proper place for the main sewers outfall?—Our investigation was upon the whole scheme of metropolitan main sewerage.

1863. Simply as a scheme for throwing the sewage ultimately into the Thames, the question being what, if it was thrown into the Thames, was to be the proper place of outfall?—And to throw it in in the manner which should be the least prejudicial to the river and the public health.

1864. However, your report assumed throughout that the whole sewage of London was at some points north and south to go into the Thames?—Yes.

1865. And Barking was the place you selected for the northern outfall?—Yes.

1866. Is it true that in the first instance a place nearer London had been suggested?—No, not that I recollect. There were various places suggested. There was that of the Government referees, which was a place below Gravesend; there was Captain Burstal's, Rainham Creek on one side, I forgot the point on the other. With regard to the south side, we became so possessed with the feeling that the sewage delivered in that way, namely, on the ebbing tide would certainly disappear rapidly (not so rapidly as it does), that we should have been inclined to have poured the sewage out above Woolwich, but we felt, as a matter of policy, it would be unwise to recommend it.

1867. As we all know. The Government referees, Messrs. Simpson, Galton, and Blackwell, suggested a point many miles further down the river Thames?—Yes.

1868. And nothing prevented that being adopted but the expense?—There were many objections to it besides that, but of course expense was the chief objection, the expense being something enormous. Even if by any possibility the sewage could have been delivered there at a less cost than where it is delivered now, the present is the better place. You will find that opinion set out at length in our report.

1869. You are very fond of your own child?—I have got reasons for it, it is not a prejudice, it is nothing to me which way it goes.

1870. What is your reason for saying that even if the London sewage could have been taken further down than Barking it would not have been better?—In the first place, the large sewers must have been tidal themselves, and to a great extent the water in those sewers, for the greater part of the tide, must have been dammed back and arrested, and wherever deposit took place, the stench from it would have been to a vast extent beyond that which is now experienced.

1871. Apart from the question of expense, might not all that have been obviated by pumping?—If you want more reasons I can give them. I am speaking from recollection, but if I had the report I could find out that passage for you.

1872. As to any proposal of sewage irrigation, there was none at that time?—No.

1873. Nor did you ever favour anything of the kind?—Yes, I have.

1874. For London?—All I say is this, whoever can profitably utilize the sewage of London will be a great national benefactor. If by spending 20*s.* he can get only 19*s.* back he would be a very great benefactor, but if he can get 21*s.* back he would be the greatest man of the present day.

1875. At the same time you think it impossible?—I do not say that. But I do not see how it can be done.

1876. You do not believe in any scheme which has yet been proposed for doing so?—I do not know of any scheme which professes to accomplish that object.

1877. You know I presume of several schemes, but you do not approve of them?—I have not said I disapprove of them other than because they are not effectual.

1878. Is not that the same thing?—No, because, as I said before, if they were only partially effectual it would be a very great advantage.

1879. Have you not said over and over again that as matters stand at present there is nothing for it but to throw the sewage of London into the Thames?—Yes, at present, as far as I know. But at the same time I further say that any scheme for the utilization of the sewage of London ought to have the most careful and the most candid attention.

1880. Have you given any careful consideration to any such scheme?—I cannot say I have given a great deal of attention to any such scheme, because it never came before me in a way to demand it. The only scheme I am aware of is the scheme of the Essex Reclamation Company. Part of that scheme I always viewed as chimerical. That is, as to the engineering part of it. I have had some experience in reclaiming land from the sea, and with regard to that part of it I am bound to say that this scheme is extremely chimerical.

1881. Have you ever had the curiosity, being so interested in this question, to go down to the farm at Barking and see the processes there carried on?—No; I saw something when I was there the other day, I think; adjoining the reservoir there is an acre or two of very good land covered with a sample of sand; from Maplin sands, and these are fertilized with sewage from the reservoir. The crops I saw were not of a very cheerful character.

1882. You know that that part is not now cultivated?—There is a crop at all events; but Mr. Hope will, I think, say that at present they are not of a very profitable character.

(*Mr. Hope.*) We are not cultivating it there with any care; it was only an experiment.

1883. (*Mr. Horace Lloyd.*) Have you been to the other farm?—No.

1884. In the first place, has your attention been directed at all to the matter of the main sewerage outfall between your report in 1858 and the time you were called upon to go down the other day?—No.

1885. You had, I suppose, in 1858, when considering the matter, the soundings in the neighbourhood of Barking ?—The published soundings ; we had the Admiralty chart.

1886. Have you taken any fresh soundings on this occasion, or do you rest on information you obtained from others ?—I have relied upon the old soundings.

1887. Have you any doubt at all that since the date of your former investigation this shoal has been formed, or do you believe that allegation to be chimerical ?—All I say is this, if there is a shoal there, and as a matter of fact I cannot dispute it, as I said before, it cannot be from the northern outfall sewage deposit nor the southern either.

1888. You do not doubt that there is a shoal, and that it has been deposited in that short space of time ?—There is a shoal there.

1889. And that it has been deposited there in that short space of time ?—That I cannot say. You must take the evidence of others about that. I am prepared to accept it as a fact.

1890. In the first place, you gave us the quantity of solid matter that goes in with the sewage at Barking Creek ; it does not go in as solid matter ?—It does not go into Barking Creek.

1891. The metropolitan sewage does not go into the Thames, you say, as solid matter, but as a stream ?—As a stream.

1892. Flowing at what rate ?—I did not take the time, but I should think we must have floated away down the Thames with it at that particular tide at the rate of two miles an hour ; I have no doubt it was very nearly that.

1893. I want you to draw a distinction between the rate at which the Thames is running down there, and the rate at which the stream of sewage from the sewage reservoir flows into the river ?—The velocity of the stream from the reservoir depends upon the height of the tide at the moment of discharge ; with what velocity the sewage issues from the culverts I cannot say ; I should say it would be rather more than the velocity of the Thames ; but immediately it is poured into the river it unites with and partakes of the velocity of the Thames, which would be, as I have said, about two miles an hour.

1894. Is it entirely in accordance with all your experience that two streams confluent in that way do immediately and completely mix ?—They did so here.

1895. It is not always so, is it ?—I do not know indeed ; we know that if coloured matter is poured into a river from a mine it does not disappear for miles. But we know that as a matter of chemistry sewage matter becomes oxidized within a very short time. I cannot refuse the evidence of my own senses, and I found that in three quarters of a mile below the outlet I could not detect sewage in the Thames in any shape or way.

1896. Is not it common knowledge that where two streams are confluent in that way, one being coloured and the other not, you may trace the demarcation between them to a very considerable distance ?—As a matter of fact you could not do so here.

1897. I am not speaking of this particular case, but are there not numbers of cases of that kind ?—There are numbers of cases where you cannot trace it. As I said before, if you take the colouring matter out of a tin mine or a copper mine and pour it into a clear stream like the Teign, it can be traced two or three miles. It has been very much to my disgust to find that a beautiful river like that should be allowed to be polluted for private advantage.

1898. (*Sir J. Karslake.*) You find that to be the case with every river in Cornwall ?—Yes.

1899. (*Mr. H. Lloyd.*) The quantity so poured in is very small indeed in comparison with the bulk of the water ?—I should think it was.

1900. There you had your eyes by which to trace the London sewage ?—Yes.

1901. Here you had, what ?—Eyes and nose and taste.

1902. How far did your eyes help you ?—Three quarters of mile, where the sewage totally disappeared.

1903. Could you by your eyes, apart from your nose and taste, at first trace separately the stream of sewage ?—We could ; it was quite marked, it came out black, it was discoloured in a very high degree ; but it gradually weakened, till in three quarters of a mile it partook of the ordinary colour of the river Thames water, and you could not further detect it.

1904. Then what security have you that a considerable deposit of silt was not taking place ?—It could not take place with that velocity of water.

1905. Why not ?—Because the specific gravity of the sewage matter is less than that of the Thames water. All the heavy drift matter is removed from the sewers before it could get to Barking. If the sewers had taken down the road drift your theory would be right ; it would be carried into the river, and if carried with a less velocity it would be deposited ; but here the matter which is delivered is of less specific gravity than the Thames water, and so cannot be deposited.

1906. What becomes of it, is it never deposited at all ?—No ; it is kept flowing backwards and forwards ; and in 30 or 40 days it is delivered into the sea.

1907. During which time it is floating backwards and forwards ?—Yes ; during which time you have not more than 10,000 tons of sewage matter floating in the river, but mixed up with about 20,000 times its volume of river water. Therefore I say that the sewage is totally inappreciable.

1908. Your theory of the impossibility of the return of the sewage depends upon the similarity between this matter held in suspension and a float ?—I say if the matter delivered from the sewers were of a very high specific gravity, and delivered into a slower current than that which delivered it, there would be a deposit. It depends upon the velocity with which it is delivered. If you throw into water which is only flowing at the rate of a mile and a half an hour an article which requires a velocity of two miles an hour to roll it along, it would be deposited.

1909. It depends upon the fineness of the division ?—Partly.

1910. The larger particles are deposited first, quite apart from the question of specific gravity ?—Yes.

1911. You do not believe that any of the London road grit is in this sewage at the time it is discharged ?—When you say any road grit, there may be an infinitesimal quantity, but nothing appreciable.

1912. Did you hear that the chemical analysis had traced the same materials as are in road grit in this shoal ?—Yes, it is quite possible, but I say that it is in an inappreciable degree.

1913. You yourself called attention to the fact that a stream coming to a wider part of the channel flows past that wider part without materially affecting a sort of bay which the wider part forms ?—Yes.

1914. And in the same way is there not at the mouth of a stream where it opens out a tendency for the current to flow straight out and to deposit at the sides ?—No, not necessarily so at all ; it depends entirely upon the outward velocity to that point. As I saw it at Barking Creek, the velocity with which the water was coming out of the creek was quite sufficient to prevent any deposit there ; it not only deflected it, but it rather increased the velocity with which the sewage was passing the mouth of the creek. What I say is, that at low water, when there is nothing flowing out of the creek but the land water, charged as it is with this stuff from the mill and all the drainage from the river Roding, the sewage of Barking and Ilford, and the population of the up-country, that that may be bringing down matter which is checked by the shoal at the mouth is possible. But that may very easily be remedied ; if the Barking people want to get rid of it, a few pounds in the way of dredging will remove that shoal.

1915. You have told us that if all the sewage of London were deposited here it would not give one half the shoal (700,000 cubic yards) that has been spoken of ?—That is not the shoal off Barking Creek, but the shoal of mud spoken to by Mr. Leach and Captain Burstal.

FOURTH DAY.

Mr. G. P. Bidder.

26 July 1869.

1916. You are now speaking of a different shoal from that at the mouth of Barking Creek itself?—No; what I said of Barking Creek was that the quantity of solid matter due to the area of that creek was a ton and a quarter per diem; if it had such an affection for the kindred fæcal matter of that creek that it was all arrested there, it would be at the rate of a ton and a quarter per diem over the whole creek, neither more nor less. But we know that as a matter of fact out of the ton and a quarter probably not five per cent. would be left. The accretion in the creek from the sewage of London is therefore a mere bagatelle.

1917. You spoke of the possibility of a deposit from the land water running down Barking Creek, where do you suppose that would be deposited?—At the shoal at the mouth of the creek.

1918. You spoke of the paper mill, is that at work now?—I should imagine so, but I cannot tell you; but whether there is a paper mill or not the character of the water in the creek opposite Barking town shows that it must be from some foul source.

1919. Are you not wrong in supposing that the refuse of paper mills is black?—I am told it is; at all events this was black, whatever it came from. Mr. Hawksley is much better acquainted with it than I am.

1920. (*The Commissioner.*) I may tell you briefly that Esparto grass loses about half its bulk in being turned into pulp, so that whatever number of tons of Esparto is dealt with one half goes away in waste; large quantities of chemicals are used in bleaching it, and if they are not utilized (which I do not think they are), they go with the waste of the Esparto, and the tendency of the waste is to cause fermentation in the stream, and unquestionably it is poisonous and deadly to fish; it also raises a scum which floats on the surface and causes stench.

(*Witness.*) There was a scum in the harbour of Barking on the day I was there.

(*The Commissioner.*) It is a very offensive scum giving off offensive gases, and according to the quantity of Esparto grass that is being dealt with you will have half of it coming down the stream.

1920*a*. (*Mr. H. Lloyd.*) If that meets fæcal matter it causes fermentation in that also?—That may be the chemical effect of the union of those two, but I cannot tell you, you had better ask those more familiar with the matter; but as a matter of fact there was no fæcal matter to meet it when I was there.

1921. What part of the river did you go down in the boat?—I went from Barking mill into the Thames.

1922. How did you begin your testing?—We began in the stream, but not in the black stuff.

1923. Where was it you could first perceive the metropolitan sewage?—Where they delivered the sewage. We put our boat over the outlet where they delivered it into the Thames.

1924. Was that at the hour of delivery?—The moment of delivery. We waited till they opened the sluices.

1925. How far off were you from the sluices at that time?—We were right over where the water was delivered.

1926. In your boat?—In our boat; the sewage and river water boiled up underneath us.

1927. And you saw it come into the Thames?—Yes.

1928. Did it run side by side with the water of the Thames?—No, it ran partly across the Thames; there is a barge moored below Barking Creek, and we went just below that barge, and just below that barge the whole of the sewage had entirely disappeared to sight, smell, and taste.

1929. You tested it by taking water from the surface?—Yes.

1930. Were any means adopted for taking water from deeper down in the river?—No.

1931. What was the depth of the water at that part?—The soundings will tell you; I cannot tell you off hand, probably from 5 to 6 feet.

1932. Was any of the mud from the bottom dredged up at that part?—Not that I know of.

1933. How far were you as to the channel of the river?—We were about a third I imagine across the channel.

1934. A third from the Essex side?—Yes, that is a guess, but somewhere thereabouts.

1935. The water there you say would have not only the sewage that had just been poured in, but so much as remained of the sewage of many days past?—Yes, you have 10,000 tons of sewage in 200,000,000 tons of river water; that is to say, taking the whole time between the particular day that the sewage is delivered at Barking and the day at which it finds its way into the sea, it is mixed in somewhere about that proportion, 10,000 to 200,000,000, or 1 of sewage to 20,000 of Thames water.

1936. There is no doubt, I suppose, that if the sewage remains mixed up with the water and is not deposited, the quantity is sufficient to render it comparatively innocuous?—There is no doubt about that. I say it cannot be deposited from the current of the river; it is impossible that it can be deposited in any way that you can detect.

1937. What becomes of it?—It is oxidized, it becomes entirely changed in its nature.

1938. It undergoes a chemical change, being kept in suspension till that happens?—I will read you if you like from our report Dr. Taylor's remarks:—Dr. Taylor, the eminent analytical chemist, in his examination before a committee of the House of Commons on "the Metropolis Water Supply Bill," speaking of the effect of water on sewage matter states: "All such substances are very rapidly decom-" posed and destroyed; the nitrogen is converted into " nitric acid; the sulphur is converted into sulphuric " acid; so that those fœtid and putrid substances " which go into the Thames from London, when " rolled about by the action of the water, containing " an enormous amount of air, are all oxydized and " destroyed; within a certain limit they may be " found; but still after a very short passage they are " very soon indeed destroyed."

1939. If the matter is kept in the water and the water is continually flowing, that action is accelerated by the air and vegetation, the movement of weirs, and so on?—If you ask me whether by any possibility an atom which comes out of the sewers is not deposited on the banks of the river, I cannot say that that is not so, because any other atom of matter in the river may be deposited, but I say you cannot distinguish it from ordinary matter in suspension in the river, it is impossible to do so.

1940. Do you think nothing comes out in the way of fæces large enough to be deposited?—Certainly, some of that is large and visible, but it will not deposit. There is fæcal matter coming out, to my surprise, from the mouth of the sewers, but that floats; if it had deposited we should not have seen it.

1941. Your theory is, that it is the specific gravity that saves it from being deposited?—Yes.

1942. There is then an abundance of fæcal matter, if deposited, to poison Barking and 50 other places?—It cannot go to Barking. If you can imagine it taken down *en masse* to Erith, and deposited there in the same condition it is in as it comes out of the mouth of the outfall, without being mixed and diluted, it would be a horrible nuisance to Erith; but as far as the town of Barking is concerned it cannot get there at all, that is a mechanical impossibility.

1943. Your theory is that it floats about until what?—Until it goes to sea; every atom of matter that passes here in a certain number of days finds its way to the sea.

1944. And every particle of fæcal matter that is insoluble?—It is not insoluble, fæcal matter is decomposed directly. It is the very first thing that is decomposed.

1945. Surely it is insoluble?—It is not insoluble, and it is rapidly converted into a substance which is perfectly innocuous. There is no fæcal matter that

can be distinguishable at all in the river Thames within three quarters of a mile below the main sewers outfall.

1946. We are speaking entirely of different things, of course I am not speaking of chemical changes. I say as long as it remains fæcal matter it is insoluble, it may be in finer particles or larger pieces, but still it is insoluble?—It is not insoluble.

(*The Commissioner.*) I think you are really misapplying terms. A thing that will dissolve is not insoluble, and a thing in the course of dissolution cannot be called insoluble. Mr. Bidder means to say it is in the course of dissipation or passing away.

1947. (*To the witness.*) That is what you mean, is it not?—That is what I mean; if I were to throw into the river a piece of flint I should say that that was insoluble.

1948. That is to say insoluble in that water?—Yes.

1949. We can hardly say correctly that anything is insoluble?—No.

1950. You mean relatively?—Yes.

1951. You mean that any fæcal matter is there in the course of dissolution?—Yes, and rapid dissolution.

1952. (*Mr. Horace Lloyd.*) The sole question is whether it is deposited before it becomes dissipated?—There can be no question about that, as it cannot be deposited.

1953. Supposing it were deposited, then the process of its becoming innocuous would be stopped?—You are putting the case against what is possible; you might just as well ask me if two and two make five; it is a proposition that I cannot accept in any sense.

1954. Why not? The whole of the banks of the Thames between the bridges for many years were covered with a slime which was deposited, and which did contain an immense amount of putrescent matter?—I admit it as you put the case now, but that is not the case you put before. One of the objects of the Thames embankment, and one object of these sewers, is to relieve the banks of the Thames in the immediate neighbourhood of the outfall sewers from the nuisance that formerly took place there, which nuisance arose because there had not been time to admit of a sufficient volume of water to mix with the sewage and to decompose it.

1955. There are circumstances under which fæcal matter will deposit on the banks and remain there?—If those sewers issued into the bight which has been described to the Commissioner as a bight of deep water, past the mouth of which the tidal water scours without mixing with it, banks of it would be formed of a very unpleasant character.

1956. But in that case then the fæcal matters would not float, they would be deposited?—If there were no current they would be deposited.

1957. They would be deposited at last?—But not in the shape of fæcal matter.

1958. But in the shape of putrescent matter?—Yes.

1959. (*The Commissioner.*) That which floats, or is capable of floating, in the bay or eddy would rise and fall like the scales of a weigh-beam as the tide went in and out?—Just so; as you loaded one scale the other would go up.

1960. (*Mr. Horace Lloyd.*) That which floats at the top rises and falls?—Yes.

1961. (*The Commissioner.*) That is illustrated by the corks we heard of?—They were, so to speak, an army of corks that came out of the sewer. It appeared to me that they had been immediately arrested on arriving at the pier, and had drifted in there, and there remained jammed up till the ebb tide, and then away they came in a body.

1962. (*Mr. Horace Lloyd.*) Then the causes which you have suggested are the only ones you can point out that would alter the current of the river Thames and give rise to mud shoals at the present time. Blackfriars Bridge and the floating pontoon?—I do not say that they are the only ones, but they are obvious ones, and on a large scale.

1963. Can you point out any others?—No, but the creation of mud shoals in a particular place like where this may be is quite consistent with the channel of the river being in a state of great improvement. I believe there is in existence a map prepared by the late Mr. Walker for the Admiralty when the river was surveyed, upon which map I daresay you will find that this particular shoal was proposed to be enclosed. I have no doubt that it would be a very good thing for the river if that were done. If it were not, the Thames Conservators ought not to have allowed that jetty to have been placed there.

1964. Have you taken any pains to ascertain whether the part of the river which is complained of as having the mud stinking and putrescent really had the mud in that state, or did you rest your opinions on your surface experiments?—That is a matter of fancy entirely.

1965. Then Captain Burstal and Mr. Leach are both mistaken in their statement upon that point?—No. I am speaking of the Barking memorial. I understand the memorialists to allude to banks of mud in the creek itself. If they allude to the bank of mud about which Captain Burstal and Mr. Leach have spoken, and if they say that is putrescent matter, I do not deny it, but I say that their inference that it came from the northern outfall sewer is totally erroneous, and that there is not the slightest ground for saying so. I do not pretend to say from what other source it comes, it is for them to find that out, but it could not come from the northern outfall sewer.

1966. If you do not deny that there may be the abundance of fæcal matter that they speak of in that shoal, can you suggest anything that can have brought fæcal matter there?—No, because I do not believe it has any foundation in fact, to begin with. If they say it is offensive matter, as a matter of fact I cannot deny that, but I say to assume that it is fæcal matter, and that it all came from the metropolitan outfall sewer, is not correct.

1967. Can you suggest anything that can have brought this fæcal matter there?—No, I cannot suggest anything. It is not for me to suggest. I did not come here to treat of the river Thames generally.

1968. We have stopped the pouring of fæcal matter into the river Thames over a very large number of miles within and above London, and the banks of mud and so on have disappeared. For several miles no fæcal matter goes into the river at all?—Yes, and we know as a matter of fact that at Kew the river is now purer than it is through the whole of its extent up to its source.

1969. So much the better for my theory. I want to know, supposing that fæcal matter is deposited in abundance at this point, where it could have got into the Thames?—I do not know.

1970. You say the river Thames is purer at Kew. From that point down they are forbidden to pour sewage in until they get to Barking Creek?—Yes.

1971. Can you, then, suggest where the sewage mud found deposited on this bank is to come in, because the Thames does not go through the process of generating fæcal matter?

(*The Commissioner.*) The low level sewer is not completed. Mr. Bazalgette will tell you, and Mr. Bidder knows, that there is a vast quantity of fæcal matter passing into the Thames now within the metropolitan area, and will do so until the low level intercepting sewer has been completed; and that is contingent on the Thames embankment being finished.

(*The witness.*) Yes, that is so; but I am sure the Commissioner knows perfectly well that whatever that quantity is it has nothing to do with this mud shoal.

(*The Commissioner.*) No, I do not say that it has.

1972. (*Mr. Horace Lloyd.*) And moreover, the volume of sewage entering the Thames at London is very much smaller, whatever it is, than the quantity that was poured in years ago, before these intercepting sewerage works were executed at all?—Yes.

FOURTH DAY.

Mr. G. P. Bidder.

26 July 1869.

Re-examined by Sir J. KARSLAKE.

1973. I suppose that sewage which was poured in years ago is still floating up and down the river, and depositing itself in different places, is it not?—That has gone.

1974. Entirely?—Yes.

1975. That has all gone to seaward?—Yes.

1976. As I understand you, you know nothing at all about the formation of this mud bank, or whether it contains fæcal matter or not?—No.

1977. Assuming that fæcal matter is to be found there, you say it does not come from the metropolitan sewers because the quantity discharged from the sewers during the last four years will not account for anything like it?—It will not account for anything like it, and from the nature of things the sewage that comes out of the metropolitan sewers must go eight miles down the river, and eight miles back, before it gets to that mud shoal; and therefore I say before it arrives there all vestiges of putrescence are taken out of the sewage water.

1978. As to the discharge from the sewers of the fæcal matter, as distinguished from road grit, we know that the road grit, so far as possible, is arrested, before it comes down into the sewers?—Yes.

1979. And I suppose road grit, or something like it, comes from other sources into the Thames?—No doubt it does.

(*Mr. Horace Lloyd.*) What sources?

(*Sir J. Karslake.*) The washing of the roads.

1980. (*Mr. Horace Lloyd.*) That goes into the sewer?—Not where the low level sewer is.

1981. (*Sir J. Karslake.*) As regards this fæcal matter, is it exceedingly flocculent?—Yes.

1982. Quickly broken up?—Yes.

1983. And being broken up, is it more likely to become oxidized and to disappear?—Yes.

1984. In your judgment is it possible that this matter which comes out floating, by some process or other ceases to float and goes to the bottom and there remains?—No.

1985. It gets lighter and lighter instead of getting heavier and heavier?—Yes, that must occur; if it were otherwise it would be against all chemical laws.

1986. Are you aware that the velocity of the liquid in the sewer is less than that of the Thames which it meets?—Yes.

1987. Does that cause the discharge to be made in the most favourable manner for the purpose of getting rid of the sewage?—Yes, because whatever the sewer can bring at a lower velocity the river must remove, as it is flowing at a higher velocity.

1988. You have been asked about two streams when they are confluent, and you stated that you can discover a difference in the two streams; is that generally to be accounted for from the nature of the water or the nature of the substance in one of the streams?—Yes.

1989. (*Mr. Horace Lloyd.*) The Rhine and the Moselle for instance?—Yes.

1990. (*Sir J. Karslake.*) Where you find two pure streams coming into the same estuary, or becoming confluent, you can account scientifically for the water of those streams keeping separate for a considerable distance?—If they are by any chance of a different specific gravity it would account for it fully, but if they are moving at a very high velocity they are sure to get intermixed.

1991. (*The Commissioner.*) Did you ever see the Rhone below the Lake of Geneva, where it meets with the Arve which comes from Chamouni?—No.

1992. There you have two waters, one white coloured and the other deep blue, and they run parallel for many miles; but you easily see how it is accounted for, because the water of the lake has cut itself a deeper channel, has a much larger volume, has a quicker velocity, and it is all its way down as it were turning the white water back upon itself. That can easily be accounted for; but with regard to the London sewage it finds its way into the midst of the tidal current, where you say generally the tidal current has a velocity something plus that of the delivering sewer, and the tendency is to mix the sewage with the river water on both sides, and below?—Yes.

1993. And to dissipate it?—Yes.

1994. And you say not only its tendency is that, but that is the effect?—Yes, that is so, so far as we can judge. There is no doubt about it.

1995. But the fact that you lose its appearance of course simply means that the appearance is lost; the fluid whatever it may be is necessarily there, and whatever that fluid contains?—No doubt.

1996. In some form or other?—Yes.

1997. Except the fæculent matter which you have spoken about, which if it rises to the surface and is constantly oxidising, dissipating partially into the atmosphere and combining with the water, losing its character and so going away; is that your view?—Yes.

1998. (*Sir J. Karslake.*) I suppose that which is so oxidising and passing away into the air is the most offensive part of the discharge from the sewer?—No doubt the most obviously offensive.

1999. You have no hatred to sewage farms, as I understand?—No; on the contrary, I say they would be of very great advantage.

2000. You would vote a statue to anybody who could utilize sewage?—I should be very glad to have one put up. I would cheerfully subscribe to such a statue; as whoever can do it effectually ought, in my opinion, to have a statue.

2001. You have always entertained the opinion, notwithstanding everything that has been said in the House of Commons and elsewhere, that the Maplin sands scheme will not answer?—Commercially.

2002. Were roots actually growing on those Maplin sands?—There were crops of some sort.

2003. Mangold wurzel?—No, what I saw principally was potatoes.

2004. They did not show very well?—Mr. Hope says they are not cultivating with any care.

2005. You stated to my learned friend that the metropolitan main sewerage works are executed in the manner you intended them to be?—Yes.

2006. Looking back to what you advised years and years ago, and what has been done, does it occur to you that, having regard to all the circumstances, any better scheme could have been adopted for discharging the sewage of London away from the population than the works which are now in operation?—No, I think not.

2007. My friend has asked you about the main sewers being carried down very much lower. In the first place, would not the expense have been enormous?—Yes.

2008. In the next place, you say they must have been tidal?—Yes.

2009. Following the level of the land?—Not the level of the land.

2010. (*The Commissioner.*) Not necessarily tidal, if they had chosen to incur the expense of pumping?—Just so. If they took them down three or four miles further, and had another (Abbey Mills) pumping station, they might deliver the sewage in the same state as now.

2011. (*Mr. Horace Lloyd.*) It comes back to cost?—It comes back to cost without any advantage.

2012. That you say?—That I say, and that I maintain.

2013. (*Sir J. Karslake.*) You say that carrying the sewage away three or four miles further would be no advantage?—If you went to Rainham Creek, which is Captain Burstal's point, you must lift the sewage some 10 or 12 feet. You must incur all the cost of erecting a second Abbey Mills at that point, and after doing so you would be no better off than you are now, so far as the health of the public and the convenience of the navigation are concerned. My opinion is that it would be incurring a vast outlay without an atom of advantage.

2014. The expense would have been 8,000,000*l.* or 10,000,000*l.*?—No, not to carry it down to Rainham.

2015. (*The Commissioner.*) In the event of this sewage being utilized, the more distant outlets proposed would have carried the sewage past a great portion of land that might be made productive, if all we hear of it is true, and you would then have had to bring the sewage back again?—Yes, if the sewage is ever to be utilized the sooner you take it up the better.

2016. I did not quite catch what you said was the relative volume of the sewage as compared with the tidal water at that cross section?—No, not the cross section; what I said was this, that there would be 10,000 tons of sewage held in suspension before it was delivered out of the Thames, and that it would be mixed with 20,000 times its volume in that process.

2017. That would be what was due to the 24 hours?—No, 40 days; the sewage would be 40 days flowing before it got ultimately into the sea; I take the sewage at 250 tons a day; 40 times 250 are 10,000 tons, and in that time it would be mixed with 200,000,000 tons of river Thames water.

2018. (*Mr. Horace Lloyd.*) That is solid?—What you may call solid.

2019. (*The Commissioner.*) Upon what basis did you form the estimate of 90,000 tons, which you state is the total amount of the sediment passing from the sewers?—250 tons per day is 90,000 tons per annum, in round numbers.

2020. Was that taken from a calculation as to so many grains in a gallon?—That was taken very carefully by ourselves when we made the report; you will find the details in the report at page 71. I cannot tell you from recollection the data, but we took it very carefully.

2021. Then, with regard to the velocity, you have estimated the velocity with which the sewage is discharged from the outfall sewer at about 1½ miles per hour, but the velocity of the river Thames I assume would differ with spring and neap tides?—Yes.

2022. Do you know the maximum velocity of the tide in the mid channel at half tide?—At spring tide I should think it is from 3 to 3½ knots.

2023. Not more?—I think not.

2024. In the Mersey it is about 7 knots?—It may be, but it is nothing like that here in the Thames.

2025. In the Mersey there is a much higher rise of tide than in the Thames?—Yes.

Mr. JOHN POLLARD called; examined by Mr. PHILBRICK.

Mr. J. Pollard.

2026. You are clerk to the Metropolitan Board of Works?—Yes.

2027. I believe you have been so since its formation?—Since December 1859.

(*Sir J. Karslake.*) I may state that I think this evidence is only somewhat collateral to the issue; but as evidence has been admitted on behalf of the memorialists with reference to the conduct of the metropolitan board injuring the Essex Reclamation Company, and so on, we think it is right to answer it, to show that nothing was said at the board for the purpose of throwing any discouragement at all on the irrigation scheme, or anything of the sort.

(*The Commissioner.*) It is not necessary for my information, but as this evidence is to be published and laid before Parliament, you may desire to put it upon the notes.

(*Sir J. Karslake.*) It is solely upon that ground that I tender it. If I had been present when the evidence was offered in the first instance I should have objected to it; but as the evidence has now been given, we are anxious to show that the Metropolitan Board of Works, so far from having done or said anything against the irrigation scheme, have fostered it in every way that they could.

2027*a*. (*Mr. Philbrick.*) Mr. Hope said this: "When "I have been on the point of success, I have always "been thwarted by the Metropolitan Board of Works. "The Metropolitan Board of Works have stated on "several occasions—some of its leading members have "stated it verbally, and the board has stated it in "writing in official reports to the ratepayers of "London—that the utilization of sewage was not a "commercial success, and I have been met by that "statement, and what was difficult before became "almost impossible." Is there a word of truth in that statement of Mr. Hope's? Is it erroneous or not that the board have made any report to the ratepayers of London, that the utilization of sewage was not a success?—No; on the contrary, they have assisted the irrigation company in carrying out the scheme in every possible way.

2028. Have you been through the whole of the minutes of the board, having regard to that statement of Mr. Hope?

(*Mr. H. Lloyd.*) You may consider that there is no reference to that statement. It is not worth calling a witness upon the question.

(*Sir J. Karslake.*) But as Mr. Hope has made that statement, we desire to contradict it through this gentleman, who, as clerk to the board, has the best means of knowledge on the subject.

2029. (*Mr. Philbrick.*) Have you looked through the records and minutes of the board, to see whether there has been any report which is at all prejudicial to this sewage utilization scheme?—I have searched the minutes very carefully, both the board minutes and the committee minutes, and I can find no resolution that would bear that interpretation. The annual reports are here, and probably if I put them in that would be the best way of answering the question.

(*The Commissioner.*) It would give me the best and fullest information upon that point.

(*Sir J. Karslake.*) I think a convenient plan would be to say there are the reports, and then my learned friend can refer to any report that he thinks proper.

(*Mr. Philbrick.*) It is a misconception on Mr. Hope's part to say that the board has in any degree acted contrary or in opposition to that irrigation scheme.

(*Mr. H. Lloyd.*) He said they discouraged the scheme. I will read some (as I consider) damaging words from the report; perhaps it will be convenient if I do so at once.

(*The Commissioner.*) What paper is that you are going to read from?

(*Mr. Horace Lloyd.*) The report of the Metropolitan Board of Works, 1867-68, presented pursuant to the Metropolitan Board of Works Act, ordered by the House of Commons to be printed 19th February, 1869, page 12:—"Utilization of the Sewage" North side of the Thames. "In the year 1865 the board "granted to the Metropolis Sewage and Essex "Reclamation Company a concession of the sewage of "the northern part of the metropolis for a period of "50 years, subject to certain terms and conditions "which, in the interests of the ratepayers, they con-"sidered it desirable to impose. The sewage irri-"gating operations at Barking, which the board "described somewhat fully in their last report, have "been continued by the company as experiments "during the past year, and they have recently sent "for the board's inspection duplicate samples of some "of their crops which they have exhibited at various "agricultural shows, and which it is stated are quite "unprecedented. The sample of wheat sent to the "board was grown on land which bore a wheat crop "last season, and the oats were produced by means of "the unexhausted manure remaining in the land after "4,000 tons of sewage per acre had been applied to "it last year, the same land having produced 71 tons "of (*Italian rye*) grass per acre last season." This, which follows, is what I want to call your attention to:

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26 July 1869.

"The results obtained by these operations have so far "tended to confirm the previously expressed opinion "of the board with regard to the value of sewage as "a fertilizer of the soil; the question as to its value "in a commercial point of view, however, is one "which still remains to be solved."

(*Sir J. Karslake.*) There is nothing in the print that would induce you to believe that the board dropped their voice at the words "these operations "have so far tended to confirm the previously ex- "pressed opinion of the board." My friend read it extremely well, no doubt.

Cross-examined by Mr. Horace Lloyd.

2030. You declined to give Mr. Hope a certificate of having solved the question of sewage utilization in a commercial point of view, treating it as a question which was in no way solved?—Yes.

2031. Commercial success, I suppose, is the essential thing, the other is very little without the commercial success. You do not suppose that the Essex Reclamation Company will do any good with the public unless they can make their project a commercial success?—No; I should think not.

2032. In the first instance, before the Act was got, your board were satisfied that it was a commercial success, were they not?—Are you alluding to any document?

2033. I am referring rather to Sir John Thwaite's evidence, and the concession of the board. Let me remind you what the reported opinion of the select committee was on the evidence, including that of Sir John Thwaites:—"Your committee are of opinion "that the scheme which has been submitted to them "is a useful and profitable mode of applying the "sewage of the northern portion of the metropolis, "and they have no reason to suppose that any more "useful or profitable scheme could be devised." That is the report of the select committee of the House of Commons on that bill, which was treated as a "hybrid bill," the committee consisting of ten members?—I do not remember to have seen that bill.

2034. You (the Metropolitan Board) were represented throughout the proceedings of the committee and were watching the bill, were you not?—Very likely. Those reports speak precisely in the same terms as to the experiments which have been made by the Utilization Company. Every effort was made in those reports I believe to do fair justice to that company. With regard to the commercial value, that I apprehend still remains to be proved.

2035. You have so stated to the public and the House of Commons I believe?—It is stated in that report. I believe those are the only words that refer to the company as a commercial speculation in any of the reports, or any of the proceedings of the board. At that time I believe, if my memory serves me rightly, the company had given up the intention of carrying out the principal portion of their works.

2036. Mr. Hope is not responsible for that; it is not his wish that the works should not be proceeded with. You mean by a commercial success, that however perfect the agricultural value of sewage may be, you are not satisfied that it would pay?—Perhaps I should read the following paragraph, which immediately follows that which you have read, "One of the stipulations "of the concession above referred to is that the "company shall within four years construct and com- "plete certain brick culverts and works for conveying "the sewage out of the main drainage outfalls to the "Maplin sands on the Essex coast for the purposes "of irrigation, and they have deposited with the "board, in pursuance of the agreement, a sum of "25,000*l.* as a guarantee for the due execution of "such works. Recently the board's attention has "been directed to the circumstance that the construc- "tion of these works has been in abeyance for some "time, and they have referred it to one of their com- "mittees to inquire and report as to the position "of the company and the present condition of their "works. The board have also, under the power "given by their agreement, instructed, their account- "tant who is one of the auditors of the company, to "investigate the company's accounts, and to report "generally as to their financial proceedings." There was some doubt at that time as to whether the company was really a commercial success.

2037. That is to say, whether the company had got its capital; but it is not a question of the company, it is a question as to the value of sewage in a commercial point of view. Do you consider that that is not proved, notwithstanding that the agricultural results are so satisfactory?—I have seen nothing yet which induces me to believe that the Essex Reclamation Company is a commercial success. I believe that sewage has been applied, in some places, profitably, not only as a regenerator of the soil, but also in a pecuniary point of view.

2038. You are confusing two things; one is the commercial success of a company, the other is the value of sewage as a fertilizer in a commercial point of view, that is to say, whether it is worth while so to apply it in order to return a profit?—An article may be of extreme value, but a company in using it may exercise some very expensive means of utilizing it, so as to prevent its being commercially profitable.

(*The Commissioner.*) Might I suggest this—I am afraid, looking at the memorial, and also considering the instructions I am acting under, that I may be liable to be called to account for allowing this inquiry to drift into the question whether sewage irrigation is or is not under all conditions to be successful.

(*Mr. H. Lloyd.*) It certainly seems to me that we have drifted away from the subject of your inquiry, but Mr. Pollard has been put forward to meet this matter. I have called his attention to what the board have in fact stated, and then I ask whether they are justified, after admitting that it is an agricultural success, in saying that the Essex Reclamation Company is not a commercial success.

(*The Commissioner.*) I individually know so much of this sewage utilization question, and have seen so many various places in which it may ultimately be necessary for the experiment to be compulsorily carried out, whether it pays or not, for other sanitary purposes, that I have long since ceased to look upon it as a necessary fact that sewage irrigation under all conditions shall pay, or that it is to pay extravagant sums in the shape of dividends under any conditions. The ulilization of town sewage on land for purposes of agriculture will be less costly to a town than any form of sewage clarification known. Filtration over and through large areas of land alone chemically purifies town sewage with any chance of paying.

2039. (*Mr. H. Lloyd to the witness.*) There is one other matter which has nothing to do with this point; I thought this had been put in, but I am told it has not. That is a copy printed by order of the House of Commons of your correspondence with the conservators, is it not (*handing a paper to the witness*)?—Yes.

(*The correspondence was put in.*)

(*Mr. H. Lloyd.*) This has been referred to before by the conservators themselves. It begins with a letter from Captain Burstal to Mr. Pollard on the subject of the reports with respect to the formation of shoals in the Thames, and they sent afterwards a further report from their engineer.

Re-examined by Sir J. Karslake.

2040. I will not inquire into your views as to the commercial success or not of this company. That is the worst report my friend can find against Mr. Hope and the other gentlemen who are concerned in the Maplin sands scheme?—If that is thought to be damaging that is the worst.

2041. (*Mr. H. Lloyd.*) That is the last?—That is the last Report.

2042. (*Sir J. Karslake.*) That is the only report that deals with this matter?—All the others speak of it as a success, so far as the application of sewage is concerned.

2043. (*The Commissioner.*) Do you think that the Metropolitan Board of Works, or the persons who framed this report, had it in their view that the sums of money reported to be about to be expended upon the proposed sewage irrigation works might be of so extensive a character as to interfere with the payment of dividends on so large a capital?—The impression upon my mind is that at that time some doubts were expressed as to whether the company would not be compelled to give up.

2044. On account of the large expenditure?—On account of the enormous expenditure upon works that they were being put to, and those words were put in, I believe, rather to qualify the previous expressions in the report, so as not to mislead the public with regard to shares.

2045. You considered, I assume, that, as a board, you had no right, in the first place, to depreciate a commercial concern, and you had no right, in the second place, prominently to state anything that might mislead the outside public?—That was precisely the view of the board.

2046. You have very probably heard many discussions on this question; do you believe that the Metropolitan Board of Works, as a board, would be extremely gratified to find that this Reclamation Company was commercially floated and likely to end as a great success?—Yes; I believe that there is not a member of the Metropolitan Board who does not feel and wish that.

2047. It would relieve the board of a certain amount of responsibility, and it would put to a proper purpose that sewage which they have to dispose of, and which now is going into the Thames?—Yes.

Mr. Charles Hutton Gregory called; examined by Mr. Philbrick.

Mr. C. H. Gregory.

2048. You are a civil engineer?—Yes.

2049. You are the president of the Institute of Civil Engineers?—I am a member of the Institute of Civil Engineers.

2050. Have you examined the main sewers outfall on the northern side of the Thames, and the river itself, at Barking Creek and the neighbourhood of the outfall?—Yes.

2051. For the purpose of considering how far the allegations of this Barking memorial are well founded or otherwise?—Yes; I made such an examination about three weeks ago.

2052. As to the shoal in the Thames which is said to exist outside the mouth of the creek, is that in any sense a shoal of mud, or an accumulation that can be traced to the discharge of metropolitan sewage into the river?—The shoals so far as I have had an opportunity of examining them seem to be of the same sort of material which is to be found to a large extent on the banks of the Thames, differing very little in apparent quality to ordinary mud deposits in different parts of the Thames, whether above London or below.

2053. Giving no special trace then of the proximity of the outfall of the metropolitan main sewer?—Immediately in front of the outfall there was mud of a different character, very black, and rather strong smelling, but to a very small extent.

2054. Did that extend up to Barking Creek in any way?—No, not in any way at all; it was immediately in front of the outfall of the main drainage works.

2055. At the point of discharge into the Thames?—At the point of discharge.

2056. The banks of mud within the creek, as I understand you, or at the mouth of the creek, are banks of ordinary river mud?—So they appeared to me.

2057. Of course without analysing?—Yes.

2058. As you proceeded up Barking Creek was there anything at all in the banks or the vegetation which led you to suppose that the metropolitan outfall had affected the creek?—Not at all. Just at the mouth of the creek I sounded in a boat and found the bottom to be gravel, at a point which I presume to have been the end of the Horse End shoal; I found the bottom there to be gravel, river ballast. On proceeding a little further into the actual mouth of the creek, I found mud, and continually sounding I found that that mud extended to a distance of, I should think, about a quarter of a mile up the creek. From that point the soundings showed mostly gravel, and occasionally a little bit of chalk, which appeared to have come there casually, but gravel was the characteristic bottom. I followed that gravel up to near Barking. I understand evidence has been given that persons had walked down the creek on the hard bottom, and that that bottom was described as being gravel. That added to my own observation would show that with the exception of a distance of about a quarter of a mile up the creek to Barking, or immediately in the neighbourhood of Barking, the bottom was gravel.

2059. At Barking itself and just by the town quay were there traces of mud?—At Barking itself close to the town there was a good deal of mud of a disagreeable character; it was a very strongly smelling mud when I was there.

2060. Could that in any degree in your judgment be traceable to the outfall of the metropolitan sewer?—It would be perfectly impossible, I think.

2061. The fact of the interval from near the creek's mouth up to Barking itself being a gravelly bottom, and the water being comparatively pure, would tend to show that, would not it?—A gravelly bottom principally shows that there has been no diminution of depth in the creek by reason of the deposit of any sewage matter, because sewage matter could not possibly have brought down gravel; and that *pro tanto* would seem to show that the bottom of the creek has not deteriorated, as has been alleged in this Barking memorial.

2062. Have you also seen the two cross sections of the creek which Mr. McDougall produced to us at the last meeting?—Yes, I heard Mr. McDougall's evidence, and that evidence seems to confirm that view, in fact to prove it.

2063. So far as your observation extends, does it accord with the evidence which those cross sections would present?—Yes; therefore any complaint with regard to injury to the navigation of the creek is not confirmed by my own observation, coupled with the evidence of the instrumental observations taken by Mr. McDougall.

2064. Do you believe that there has been any effect on the navigation of Barking Creek in a prejudicial degree?—I believe not. My observation to that extent does not go to denying the possibility of an increase of the Horse End shoal, although finding that just at the point of it it was gravel would seem rather to show that if any increase has taken place there, the metropolitan sewage could have had nothing to do with it.

2065. It would rather point to the natural causes at work in the river, and to show there was no accumulation of sewage?—That the accumulation was not that of sewage, but that it arose from those changes that always will take place in such a river as the Thames.

2066. Subject to the action of wind and tide?—Yes, of wind, tide, and flood.

2067. Having regard to the facts which now are admitted, that the discharge of sewage from the northern outfall takes place an hour after high water, and knowing, as we do, that the velocity of the current in the Thames is greater than that with which the sewage comes down the main sewer, do you think, speaking in a scientific point of view, that the discharge of the metropolitan sewage is effected under favourable circumstances?—Yes, I think so. I think that any matter

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brought down by the sewer must necessarily be carried out and mixed with the enormously greater volume of the Thames water, and I should naturally have expected such a result as that which has been described by Mr. Bidder in his evidence, namely, that after a very short passage down the river this sewage matter would become mixed with and diluted by the river Thames water in such a manner as to be untraceable in the river.

2068. So far as your knowledge and observations have extended do they confirm the opinion which you would otherwise form?—Certainly.

2069. Do you see any evidence of any material change or impediment to the navigation of the river Thames owing to the discharge of the metropolitan sewage at the outfall?—The evidence that I have heard proves that if there has been a temporary diminution in the Thames waterway, that has been more than compensated for by the proved subsequent increase in the waterway.

2070. But at present there would be no impediment to the navigation?—Not that I can understand at all.

2071. Owing to the quantity of shoal being less now in the river than it was when the soundings were taken in 1867, the condition of the river Thames to that extent would be improved?—I understand the condition of the river has been improved within the last year, as is shown on the sections which were exhibited at the last sitting at Barking.

2072. (*The Commissioner.*) You say that it has been improved?—I did not mean an artificial improvement. I meant an improvement by the operation of natural causes, such as the ordinary flow of the river.

2073. (*Mr. Philbrick.*) Is there anything in the mode of the metropolitan sewage discharge or the fact of the discharge which has, in your judgment, a tendency to impair the usefulness or the condition of the river Thames?—In my belief, nothing.

Cross-examined by Mr. Horace Lloyd.

2074. When was it you went to examine this outfall?—Three weeks ago.

2075. Is that the first time that you have had occasion to consider this subject of the metropolitan sewage outfall?—It was the first time that I visited either the outfall or Barking for the purpose of considering this question.

2076. At what time of the tide was it that you went up Barking Creek?—When the tide was slightly on the rise, just a little after low water.

2077. You then took soundings and brought up gravel from the bottom?—The soundings were taken with a boat-hook; they were not actual soundings, but trials made with the boat-hook or blade of an oar.

2078. What were the banks like?—The banks were mud, just like the river mud for miles above and below.

2079. What thickness of mud was there over the gravel, because I suppose there was gravel under there?—I did not sound the depth of the mud on the banks.

2080. The mud being such as to prevent your landing and walking across it?—I did not try it, but I should certainly prefer not attempting to land; there are causeways here and there at which I could have landed, they are chalk causeways.

2081. (*Mr. Philbrick.*) Artificially formed?—Yes.

2082. (*Mr. Horace Lloyd.*) Do you say that you began your inspection at the end of the Horse End shoal and got gravel from there?—It is my belief it was just at the end of the Horse End shoal.

2083. Are there not several feet of mud at the end of that?—As far as my observation went, if I am right at the point at which I took the soundings, it was just at the end of the Horse End shoal.

2084. Did not Mr. McDougall state that there was mud at the end of it?—I did not hear whether Mr. McDougall said so or not; if he did say so he is more likely to be correct than I am.

2085. You say that the navigation of the creek cannot have been interfered with seriously because you found this gravel at the bottom?—I say that that showed that the bottom could not have been raised by reason of the operations of the northern outfall sewer, because, if it had been, the deposit from it would not be gravel, but something slippery.

2086. How broad is that part where the gravel lies before you come to the muddy banks?—I did not measure it.

2087. Is it narrow?—It is narrow; the slope begins very shortly indeed. The moment the slope begins I should fancy there is mud.

2088. Are you aware of the fact that insurance companies have refused to allow colliers to come up Barking Creek?—No.

2089. If that is so, can you account for that? What do you suppose would be the reason?—I do not know the reason; if it has been so, I was not made aware of the fact.

2090. Would a deposit to a considerable thickness of mud over the original banks have anything to do with that?

2091. (*Sir J. Karslake.*) Are you an underwriter?—No.

(*Mr. Horace Lloyd.*) He has given an opinion on the navigation.

(*Witness.*) If the channel were made worse, either in depth or in width, if it were practically worse, it is a possible thing and a natural thing that it would increase the difficulties in the use of that channel, and possibly it might affect the insurances.

2092. The thick deposits of mud on the banks would do that, even although the centre part of the channel might remain of the same depth?—The deposits of mud on the banks might make the channel bad although the depth in the centre remained the same as before; but the sections to which I alluded just now show that the channel is as good as before, not only in the depth but in the width. There is a slight alteration in form, but the available area is equally good.

2093. By reason of the deposit of mud on the banks?—No; the soundings show that the change in the section of that bank has been very small. In one part you might find it a little improved, in another part not quite so good; but the total result of those soundings shows that the section of the river is as good as it was before the working of the northern metropolitan outfall sewer commenced.

2094. That is to say, you are taking it from your reading of the sections themselves?—From anybody's reading of Mr. McDougall's section.

2095. For a quarter of a mile you say you found mud in the creek?—Yes.

2096. Did you examine the character of that mud?—Yes.

2097. What was it?—It seemed to me similar to the mud on the banks.

2098. Was it perfectly unobjectionable to the smell?—I did not find it at all disagreeable. I carefully smelt every piece that came up.

2099. Nor on the banks?—Nor on the banks. The only mud I found that smelt at all was that taken out from immediately in front of the northern outfall, and that smelt, but it was very little.

2100. Were you at Barking when we put some mud before the Commissioner?—No, I was only at Barking the last day.

2101. However the mud you saw was black?—No.

2102. Do you mean that the mud on the banks is not black mud?—What I saw was not black.

2103. What colour was it?—Very dark brown; it is very difficult to describe the exact colour.

2104. Without any offensive odour?—It was without any offensive smell that I could perceive, at all events I did not smell anything offensive, and I smelt every piece that came up.

Re-examined by Sir JOHN KARSLAKE.

2105. You say there is some mud at that Horse End, that was the mud bank which my learned friend was referring to, that is the bank on the right-hand side going down the river?—Yes.

2106. Just where the creek meets the Thames?—On the right-hand side going down the creek.

2107. That is now so formed that there is a sort of point comes out, narrowing the channel to some extent?—Yes.

2108. In your judgment would the accumulation of mud at that spot be likely to occur from a coffer-dam a little way up the river or creek, as you call it?—That might have had a possible tendency to cause it.

2109. Now as to this mud; you saw the thing yourself at low water, did you not?—Yes.

2110. What would it cost to dredge off that point?—I did not measure the quantities. I do not know the actual depth of the mud, but I should think something very small. But the exact sum I do not know.

2111. Is it the fact that the underwriters do increase their premiums on vessels wishing to go up the creek?

(*Mr. Horace Lloyd.*) That was not it, but that they forbad ships to go there at all.

2112. (*Sir J. Karslake.*) Very well; let it be so. You say that you yourself smelt some mud which was taken up from the banks of the creek?—Yes.

2113. About how far up the creek?—I smelt every portion or specimen of mud that was brought up from the time we struck that mud, that is, just inside the creek, up to the time when the mud ceased.

2114. Several different samples you smelt?—Several different samples I smelt.

2115. You also smelt a sample of mud taken up from the northern outfall?—Close under the northern outfall.

2116. Was there a marked distinction between the two?—There was a decided distinction, but what I saw at the outfall was very small in quantity.

(*The Commissioner.*) I would suggest to those instructing you, Sir John Karslake, that we perhaps might avoid some of this vague evidence as to the character of the mud, if we rely more on the evidence of the two eminent chemists I see here, if they are going to give evidence as to the chemical character of the mud. Evidence from these gentlemen will be much more reliable than the opinions of engineers.

(*Sir J. Karslake.*) I am much obliged, we will follow your suggestion.

Mr. T. Hawksley.

Mr. THOMAS HAWKSLEY called; examined by Mr. PHILBRICK.

2117. You are a civil engineer, and one of the three gentlemen who devoted their attention to devising and maturing the plans of metropolitan main sewerage which were afterwards carried out by the Metropolitan Board of Works?—Yes.

2118. At the time when the present plan was brought before your attention and that of your colleagues other plans were also submitted to you, I think?—Yes.

2119. Was the matter one of very great consideration and deliberation amongst you before you reported in favour of the plan which you adopted?—Yes; great consideration, and a very prolonged research.

2120. I daresay you also watched the construction of the works?—Yes.

2121. Has your attention since been called to the allegations in the Barking memorial?—Yes.

2122. And you have been over the *locus in quo*, with a view to see how far the allegations in this memorial are supported by the facts?—Yes.

2123. Having regard to the opinion at which you and your colleagues arrived when you framed your report, and bearing in mind what has been stated in this memorial, are you still of opinion that the river Thames has not been injured by the metropolitan main sewerage outfall works?—In my opinion the river Thames has not been injured. There is a small deposit of mud at the mouth of Barking Creek, but that is explainable on other and sufficiently natural grounds. The facts with regard to the Thames are very manifest. All the metropolitan sewage went into the river Thames before these outfall works were made, and all the road drift and other detritus also went into the river, as scarcely any of it was caught and taken out of the sewers before it reached the river. Now, a very large proportion (if not quite the whole of the road drift and detritus) is removed before the sewage matter proper goes into the river, and consequently, at the present time, there is less heavy solid matter going into the river than formerly. Heretofore the whole of the solid matter of which I am speaking (metropolitan road and street detritus) found its way down to Barking Creek, and thence to the sea, as it would do now if it were let into the river; therefore no new injury is done to the river Thames by reason of any road drift going into it with the sewage matter. On the contrary, there is a benefit conferred upon the Thames by more of the road drift being kept out of the river; consequently, the river instead of being injured by the addition of heavy solid matter is now necessarily in a much better condition than it was before.

2124. (*The Commissioner.*) You mean, I suppose, that the new point of discharge gives it, if we could compare the thing to a race, so much start to its ultimate resting place, wherever that may be?—Yes, and besides that, there is now a very much larger quantity of road drift kept out of the river than there was before these works were made, for in the olden days no care was taken to keep the road drift out of the sewers. If it clogged the sewers it was then removed, but it was only removed because it did clog the sewers; whereas now, considerable attention is paid to intercept the road drift, so as to prevent its going into the Thames at all, and consequently the river is so far in a better state, and I may state this remarkable proof (because it is remarkable in its way) of the accuracy of this part of my statement. On my last visit to the outfall works, I had occasion to go into the reservoir, and the reservoir bottom was so slippery, so entirely free from road grit, that I was obliged to be assisted to stand; it was slippery with that gluey sort of matter which always collects at the bottom of sewage reservoirs, but so free was it from road drift, that I could not walk about without the assistance of a person with nailed shoes on, to keep me upright, for otherwise I should have been down in the slush repeatedly.

2124*a*. (*Mr. Horace Lloyd.*) You have never been in the Fleet sewer, I suppose?—I have been in the Fleet sewer, head foremost almost.

2125. (*Mr. Philbrick.*) That is with regard to the exclusion of solid matter which would have a tendency, or might have a tendency, to have silted up the Thames, and which must have been put into the Thames under unfavourable conditions before the outfall was opened?—Yes; not only is it the fact that what does go in now, if any goes in at that point, is much nearer to the sea. But so much less goes in.

2126. And the conditions under which it goes in are more favourable, are they not?—Decidedly.

2127. There is the dilution?—It goes into a body of water so large that it becomes quite insignificant.

2128. Twenty thousand times its volume we hear?—As to any solid matter, it is a very much less proportion than that even.

2129. The quantity we have been given is the total volume of sewage?—Yes; but as regards solid matter it is very different from that.

2130. (*The Commissioner.*) Do you mean, or did Mr. Bidder mean, 20,000 gallons of river water to one gallon of sewage?—I was not present to know what Mr. Bidder said. Of course I do not know what he meant.

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(*Mr. Philbrick.*) We can give you the precise figures presently as far as that point is concerned.

(*Witness.*) The ordinary sewage matter of London contains only about 35 grains in a gallon, that is $\frac{1}{2000}$ part of solid matter; and then when you come to take that again into the vastly larger proportion of water which is flowing down the Thames, in comparison to the quantity of water which is let out from the sewers, of course it may be estimated by the millionth part if it is reckoned in that way, when you come to take the solids in the sewage, as they may be taken at $\frac{1}{2000}$ part.

2131. (*The Commissioner.*) Did you mean 35 grains of free matter, or 35 grains partly chemically combined and partly suspended?—No; 35 grains of matter which is undissolved. That which is dissolved of course is not in question.

2132. It does not include the 16 grains of bicarbonate of chalk which hard water contains?—No, because that remains in solution; what I mean is the actual fact as obtained by examination and analysis, and the actual fact is that about $\frac{1}{2000}$ part of the sewage consists of solid matter.

2133. Is that what would be filtered away by a blot sheet filter?—Yes, and a large proportion, or nearly the whole in fact, of this other matter I am speaking of, namely solid matter, is organic matter, and that organic matter decomposes with extraordinary rapidity, when it is mixed with a competent quantity of water holding oxygen in solution; it then ceases to be solid matter to a great extent.

2134. (*Mr. Philbrick.*) Mr. Bidder told us that taking from the point of discharge, and going three quarters of a mile down the course of the stream all apparent trace of the sewage matter was lost in the volume of water. Is that so?—Yes.

2135. I do not know whether you went down?—I did.

2136. Do you confirm that statement?—Yes. There was a little cloudiness in the water, but it was exactly the same kind of cloudiness that you see in other parts of the Thames.

2137. Nothing which either to the eye or to the nose could be attributable to the outfall?—No.

2138. So far as regards Barking Creek itself, except the little accumulation of mud at the mouth, is there anything in the creek itself which is due in your judgment to the sewage of the outfall works?—No, but I must make this qualification, there may be a little at the mouth of the creek.

2139. At the Horse End?—At the Horse End; but then it must be borne in mind that it is admitted and stated on the other side in this inquiry, that the mouth of the creek has been for a considerable time past enlarging and widening. As a matter of course the velocity of the outflowing water is diminished just in the inverse ratio of enlargement. Then as we know in all such cases, deposits of matter, which would not have been deposited if the velocity had been maintained, will take place; and there is at the mouth of the Barking Creek a deposit of black mud of a very light description, which would be very easily moved away if the mouth were again contracted by artificial means, which would be the right and proper course to pursue, and then the outflowing water from the creek, especially when assisted by the upland floods, would scour it all away, and being of that light character very much resembling what you see at the bottom of an inkstand, it would be very easily moved away. And there is another shoal, a distinct shoal, a little below that down the river, nearly in front of Mr. Laws's works, which has nothing to do with the Creek at all or with the sewage works; it is a shingle shoal which has been there, I suppose, from time out of mind, and upon trying that I found no mud on it at all, it is quite clean.

2140. I think they call that the Shelf?—Yes; that is not exactly at the mouth of the creek, it is slightly seaward. Then there is another reason, if you will allow me to mention it while I am upon this (and I wish very much to mention it), why it cannot be sewage mud in the creek, and that is because the water is let out of the reservoir on the receding tide, and at the time of the receding tide (here I am speaking not merely from theoretical knowledge but from actual observation) the water is also coming out of the creek. The consequence is that the two streams meet, and the stream of the creek combining with the stream of the Thames, causes a deflection of the sewage which is then issuing from the reservoir, and it goes in a diagonal line about south-south-east across the river, and can be distinctly traced; probably at this very hour it may be seen if anyone has the curiosity to go and look. So that the metropolitan sewage matter cannot enter the creek, and does not.

2141. Is there anything at all from the main sewer outlet which could enter the creek naturally?—No; I am perfectly certain there is nothing at the time of the sewage being admitted into the Thames from the reservoir that can by any possibility enter the creek; if you followed a cork you would find that it would not go up the creek; on the contrary, the cork would be deflected slightly diagonally, but perfectly perceptibly, because you can see the two streams clearly, and trace them for about three quarters of a mile. It would be deflected across the river instead of entering the creek, and I paid particular attention to that. I wish to state it not as a matter of theory but as a matter of fact, and as a matter of fact it was so.

2142. Of course a cork which presented any free-board to the wind might be affected?—Yes; but take a gooseberry or an apple, or something which is of nearly the specific gravity of the water, which would not be likely to be affected, and it would go as I state. But the most obvious thing, and in that sense it is remarkable because it is so obvious, is the line which bounds the blackish colour of the sewage and the whitish colour of the water of the creek, and you find that instead of the blackish fluid going up the creek the blackish fluid goes distinctly across the Thames, partially across towards Crossness.

2143. The tendency of the stream from the creek coming down the river Roding would be to aid in further deflecting the sewage across the river?—Yes, the two come in in this way (*illustrating it*), nearly at right angles; the third, which is the stream of the Thames, is the more powerful, and when they meet together they go diagonally (as is natural according to the resolution of forces) in that way. This pencil which represents the creek water remains white, while this which represents the sewage water is distinctly black; and in three quarters of a mile the two become so intermixed as to become undistinguishable.

2144. With regard to the allegations of the memorial (I do not know whether I need take you specifically through them), having considered them, and seen how far the facts support them, if they can be said to support them at all, and having viewed the operations of the metropolitan main sewerage outfall, are you still of opinion that the operations of the outfall in no degree prejudicially affect either the navigation of the Thames or Barking itself?—Certainly; and I should like to state a thing which I believe has not been up to the present moment stated, and which is a very important fact to be borne in mind. I am well acquainted with the river Roding; a large population has grown up on the course of the river Roding, above the town of Barking, and a very large quantity of sewage is sent into the river Roding by that population, which sewage comes down from above to Barking. And there of course it meets a certain portion of the sewage of Barking, and the two proceed together, with all the vegetable matter which is washed off the country above, down the creek, and (as in all such creeks, and I could give a hundred instances) you find deposits of mud upon the banks. You find on the surface a reddish clayey kind of mud, and underneath that you find a black mud. You will find it almost in every pond. The reddish colour is given to it by the oxidization of the iron which is

contained in the mud. The mud changes from the black dye colour by which it is tinted in the first instance (whether vegetable or animal is quite immaterial), and then the surface becomes red, and that you find all the way down the creek, exactly as things ought to be.

2145. There is nothing abnormal in the condition of Barking Creek?—Nothing at all; you find creeks everywhere exactly the same, where there is that kind of matter, and where there is vegetable matter and a little iron in the soil it is the same.

2146. Having regard to the opinion expressed in your joint metropolitan main sewerage report, and having seen the existing condition of matters, is there anything which has occurred which has induced you to believe that the conclusion you then came to that the proper point for the discharge of the metropolitan sewage on the northern side of the Thames is wrong?—I know of none so good.

2147. Can you suggest any improvement in the mode of discharge?—I think not; the sewage is discharged now upon the receding tide and practically before half ebb. I do not know anything that could be done better than that.

Cross-examined by Mr. Horace Lloyd.

2148. As to these people on the river Roding, are you not aware that they do not drain into the river?—I am perfectly aware that they do, because I made some of the sewerage works myself.

2149. Where?—At Wanstead.

2150. This large population on the river Roding, which you have referred to, I may take to be that of Wanstead?—Wanstead is a place which is becoming very populous. A very large quantity of building has been done there within the last three or four years.

2151. What is the distance from there to Barking?—Not more I should think than three miles by the course of the river. It may be four perhaps.

2152. Not more than that?—No, three or four miles.

2153. You say that the London road drift is taken out of the sewage now. Do you mean at Barking?—No.

Sir J. Karslake explained that evidence had been given that catch-pits were formed which intercepted the road drift from going into the metropolitan sewers, that plan having been adopted in consequence of the very great expense involved in removing the road detritus from the old sewers.

2154. (*Mr. Horace Lloyd.*) The catch-pits only do what the sewer itself did in the olden time?—No; the sewers in the olden time had a very much larger fall. They proceeded directly from the north side of London into the Thames by the shortest possible course. Now, the first thing that has to be done is to take them into these very long main drainage sewers, and then the water has to be pumped when it gets down to Abbey Mills, and then it has to proceed several miles again before it gets to the outfall. Of course, in consequence of the small fall, any heavy matters (I am speaking now of the more heavy matters) that escape the gullies have to be got out of these sewers, where if they were not got out they would concrete and form a bed.

2155. Have you any idea how often those catch-pits are emptied, and how much is taken out of them?—No, I do not know; it has been mentioned I think in evidence; I did not hear it distinctly. I think Mr. Bazalgette gave some evidence about it.

(*The Commissioner.*) I think, Mr. Lloyd, we shall save time if I tell you that all that can be said about catch-pits was said by Mr. Bazalgette, and is on the notes.

(*Sir J. Karslake.*) It amounts to this, that they cannot catch all the grit and do not catch it all, but they catch all they can. The scavengers are never allowed, under a penalty, to sweep road grit into the sewers, and every precaution is taken as far as possible to prevent it getting into the sewers. Their own interest makes them take it out of those gullies as far as possible.

(*The Commissioner.*) According to Mr. Bazalgette it costs to get road grit out of the catch-pits 2*s.* 6*d.* per cubic yard, but it costs to raise it from the sewers at the rate of 1*l.* per cubic yard.

2156. (*Mr. H. Lloyd.*) Do you know whether any analysis has been made of the sewage as it is in the reservoirs, which would show how far it is free from road drift?—I am not certain, but I think there has been, I have given the practical analysis. If there had been any considerable quantity of road drift in the reservoir I could have walked about in it with perfect ease, because road drift is a very gritty material, and there is no difficulty in standing upon it, even when a considerable quantity of sewage matter is mixed with it, but here the sewage reservoir invert was as slippery as ice.

2157. I thought you were speaking of the sewer at that time, but you were speaking of the reservoir?—Yes, the outfall sewage reservoir.

2158. Do not you know that the reservoir is scoured out and kept clean?—It had not been scoured out that day, because we were there present when the sewage water was run out, and as soon as the sewage was run out I went in.

2159. Still the reservoir is scoured out between the times of use, is it not?—Not to my knowledge. It may have been, but it was not on that occasion. I should think it was not.

2160. Does not the mere process of emptying tend to carry off a great deal of detritus and scour it out itself?—No doubt, if there is any considerable stream just about the outlet; but they have a great many outlets, and for a few yards round each outlet there must be a considerable commotion in the water of the reservoir when sewage is being let out, and to the extent to which that commotion reaches of course road-drift would be washed out, but then it would remain in the upper part, and grit was not there.

2161. The quantity of road-drift would vary very much as the weather is dry or wet?—Yes. In certain states of wet weather, a thunder storm for instance, the quantity of road-drift which is washed away from the streets would be very considerable. What becomes of it afterwards I really cannot tell you.

2162. What was the date you went down and into the reservoir?—I was there on two recent occasions, besides many previous ones.

2163. Were those recent occasions in dry weather?—Both of them, they were within the last fortnight or so.

2164. What do you say is the proportion of solid matter held in suspense in ordinary sewage water?—Are you speaking of the sewage of London?

2165. Yes.—About 35 grains in a gallon.

2166. Is that one two-thousandth part?—That is one two-thousandth part of the sewage; but then, when that is admitted into the river, that one two-thousandth part has to mix with another very large proportion of river water. It would not then be more than one part of a million.

2167. One two-thousandth does not sound very much, but it is sufficient to produce all the unpleasant effects we know of?—It is sufficient to make the water what you ordinarily see it, to give it a brownish colour, and thicken it to a certain extent, very slightly.

2168. You gave us an illustration by means of two pencils; that, as I understood it, had reference not to the metropolitan sewage coming into the Thames, but to the water down the creek coming into the Thames?—It had reference to both.

2169. Would it do equally for either?—No. It will not do for either. It will do for both only. The illustration was as to the effect of the two motions combining to form one.

2170. You do not mean to say if the depth and the volume of the two are different you can resolve them by the composition of forces, as if they were forces acting upon a rigid body?—Yes; and that is the action, and you see it, and there is nothing can

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possibly be more distinct. You may satisfy yourself at any moment that nature performs that very operation.

2171. Combines the two forces into one?—Yes.

2172. How do you explain the cases where the two are separate and act separately, as if the two streams were running in different beds, parallel to each other?—In the way I have mentioned. Suppose the thickness of this quill represented the breadth of the river Thames, and the thickness of this quill represented the breadth of the creek; when the two meet together they combine to institute a third motion; and for a considerable distance the two fluids do not mix. They act on each other forcibly, but without mixing, and the consequence is that the river Thames coming down straight, and the water of the creek entering the river very nearly but not quite at right angles, the two streams together combine to form a third stream, but the two still for some distance remain unmixed, though they gradually do mix and then flow on together. Here is the Thames going down this side, blackened by the metropolitan sewage, and here is the water of Barking Creek remaining uncoloured; there is a distinct line of demarcation between the two.

2173. Where your hand was just now what is there there?—This is the shore of the river Thames.

2174. I will draw a plan. Here is the bed of the Thames, with the current running down it so (*illustrating it*), and here is the smaller stream running in at right angles.

2174*a*. So you say the effect of the streams is that there is a compound stream which tends over to the other shore?—Yes. Allow me to amend your sketch according to the facts. Here is the outfall; the two waters meet here. To make it more simple I suppose this water to hug the shore. Then the two streams meet at the Horse End. Then this becomes deflected so, going gradually across in that way; but here you find a distinct line of demarcation. This is blackened, not black, and *this* is white, and by-and-by they become mixed together.

2175. Do you say that from your line of demarcation here up to the bank is wholly occupied with water that came down the creek?—It is wholly occupied with the white water, and apparently with water from the creek.

2176. Is not the volume of water lying between that line of demarcation and the bank greater than the volume of water that has come down the creek?—No; velocity is the important point to be considered rather than the volume, because if the water coming down *here* with a considerable velocity loses its velocity *here*, there would be a very large volume *there* moving very slowly, while *here* there would be a very small volume moving very rapidly.

2177. Is not there more water here than is due to the creek?—I think not, noticeably. I paid particular attention to the circumstance, and certainly I did not form that opinion, and one reason why it would not be so is because this is a very shelving shore, and of course the water would spread a considerable distance here without being of much depth.

2178. You have no certainty that there is not a compensating current below which replaces the water so carried over to this side?—I am quite sure there is not.

2179. Why is there not, there is no impossibility, is there?—It does not exist; it is not there; you may look for yourself, you will not find it.

2180. You could not see it if it existed?—Yes, I could, certainly, because I should see the blackened water there.

2181. Whether there is blackened water or not, may not there be water coming in below to supply the water which by the composition of forces is carried over to that side?—No, because the tendency of that would simply be (and it is the fact that it does so) to make this stream gradually get straighter, and bye and by, in perhaps a mile or so, it will turn round into the shore, and there become mixed together.

2182. In the first place the Thames is much deeper than this I presume?—Not deeper than here.

2183. Deeper than at the point where the stream from the creek strikes it?—No; each of the two are of the same depth down here, this is partly shallower and partly deeper.

2184. I am speaking of the bed of the stream, and the depth to which the current extends. Does not the stream from Barking Creek impinge on a deeper stream in the Thames so as only to affect the top of that stream?—Now I understand; certainly not in that sense. The depth of the river Thames in the centre at high water I suppose is something like 40 feet, and the depth of Barking Creek may not be very much more than half that, therefore in the sense in which you use the word deeper (but I cannot accept that) no doubt there is a shallower stream entering into a deeper stream.

2185. The effect is expended upon the top of the deeper stream only?—No.

2186. For any purposes of deflection?—No; whatever may be assumed as the theory, we see the facts. I am only describing the facts and expressing how closely they coincide with what might have been the theoretical view of the subject, but we see the facts. Now along here (*referring to the plan*), the very place I am speaking of the water in the Thames is no deeper than it is in the creek. This sketch plan is exaggerated. The Thames is very wide *here*, the river should be *here* (*pointing to the diagram which had been sketched by Mr. H. Lloyd*).

2187. Surely the main body of the Thames flows on unaffected by any such small stream as this?—Certainly not.

2188. Surely any effect of that is superficial?—No.

2189. Do you mean that it affects to the bottom the whole current of the river Thames?—Yes, down to that bottom; the bottom I am speaking of and the bottom which there exists. This part of the Thames down here is not the deep part of the Thames, the deep part of the Thames is here (*further out*). You have not drawn this sketch plan accurately. If I were to put the papers together the other side of the Thames would be about here. This is a shelving bank, and then you come down here and you get to a wider part, and you come here again to a shelving bank. All we are speaking of is just this bit of shelving bank here, the creek is no deeper than that and no shallower.

2190. Surely if that is deflected to the side it must interfere with the rest of the current; where does that go to when it is pushed?—It accelerates just like two billiard balls; if two billiard balls are struck in that particular way there is an acceleration.

2191. Besides the acceleration, according to you, there is a lateral effect upon it?—No; I have not said anything of the kind.

2192. That would be so if it is a composition of forces?—Wherever there is acceleration there is no doubt somewhere or other a heaping, but that is so infinitesimally small here that even if you were to apply a level it would not be discovered.

2193. Do you mean to say that?—Yes, it is so very small.

2194. However, there must be such a heaping according to your theory?—It is only theoretical, it is not a practical heaping.

2195. You said that the corks showed you that the current did run in a certain direction?—No; what I stated was that if you were to put a cork in, there being no wind, you would find that it would follow that black line.

2196. That is the same point over again?—Yes.

2197. That you offered to put to the test of experiment?—Yes; not that you want such an experiment, because the sewage itself represents, if you like, a million corks, and you see the sewage going down in a perfectly distinct line.

2198. Now about this extension of the Horse End shoal, what do you attribute that to, to the matter in the Roding itself?—No; I do not say altogether to matter in the Roding itself; it would be attributable

to any matter that was suspended in the water in the widened portion, whether from the Roding or otherwise. It is only what takes place in the mouth of other rivers. Every river almost has a bar; if by accidental or by artificial means we expand the mouth of the river the bar becomes enlarged, and if we want to get rid of the bar we contract the mouth and then the bar goes away.

2199. You agree then with this, that the deposit is not at all necessarily due to the river Roding?—I should think it is more due to the Roding than to anything else, but it is not necessarily due to the Roding. I could not pronounce any opinion as to where this little deposit comes from. This very small bank of thin light mud may be there from a variety of causes.

2200. If there is a deposit there, is not it probably because there is a tendency in the water to come to rest there and to deposit?—Or to diminish its velocity.

2201. A backwater or something of that description, or a place of rest?—There at a certain period of the tide the water is perfectly stagnant.

2202. More than at other places near it?—No.

2203. Is not that a sign that at that part there is either, by backwater or something of that kind, a point where the water has a tendency to come to rest even when the water about it is moving?—Not at all; all that it shows is that that is a part of the river in which the velocity, owing probably to the expanded mouth, is less than in other parts of the river, and therefore silt can be deposited there which cannot be deposited elsewhere.

2204. Still if there is a deposit of silt at that point there must be some condition favourable to such deposit, that is to say there must be more stillness?—There must be a diminished velocity.

2205. But not merely a diminished velocity as compared with the water above, but as compared with neighbouring parts on the same section?—Undoubtedly so, and it is so in fact.

Re-examined by Mr. PHILBRICK.

2206. Does that plan which is before you show by the bluer tinted portion the line of sewage discharge?—It shows very well indeed what I saw myself in the ordinary course of the working of the outfall; we had a steamer, and I was upon the river with other gentlemen going about in this steamer to observe all the effects. I did not make that plan, but I recognize it at once as a correct plan; that shows the discharge from the outlet (*handing in the plan to the Commissioner*).

(*The Commissioner.*) Who was this plan made by?

(*Mr. Philbrick.*) It was made by our surveyor.

(*The Commissioner.*) Do you put this in?

2207. (*Mr. Philbrick.*) Yes. (*To the witness.*) As I understand you, from what you saw that plan accurately corresponds with and represents the facts?—It does.

Dr. WILLIAM ALLAN MILLER called; examined by Mr. PHILBRICK.

Dr. W. A. Miller.

2208. Are you a fellow of the Royal Society?—Yes.

2209. Professor of chemistry at King's College?—Yes.

2210. And a doctor of medicine?—Yes.

2211. Conjointly with Dr. Odling have you examined various samples of deposit from the sewage reservoir?—Yes.

2212. Some from the Thames at different parts of its course between Teddington and above to below Crossness?—Yes.

2213. Some from the London docks?—Yes.

2214. Some from Barking Creek?—Yes.

2215. Both above and below Barking town?—Yes, that is to say, from the river Roding.

2216. First of all, take the mud from Barking Creek, what is the average amount of organic matter in that mud?—The mud in Barking Creek itself?

2217. What is the average amount of organic matter in the mud of Barking Creek itself?—16·2.

2218. That contains, I think, 3·1 of nitrogen?—Yes; that is, in 100 parts of that organic matter, 3·1 consists of nitrogen.

2219. Is that greater than either the organic matter or the nitrogen contained in the sample of mud taken from the river Roding above Barking town above the mill?—No; the mud of the Roding above Barking contained in 100 parts in the top sample, 17·3 parts of organic matter; that contained rather more nitrogen, 3·17 parts of nitrogen in 100 parts of organic matter.

2220. So that as regards impurities of the mud, they are worse above the mill in the Roding than they are below, and between Barking town and the outfall of Barking Creek?—Yes; there are only two samples from the Roding above the town; I have six from the creek below.

2221. As to the mud in Barking Creek itself, is there a large proportion of mineral matter containing clay and aluminium, or whatever it is?—Yes.

2222. I think to the extent of very nearly 84 per cent., 83·8?—Yes.

2223. Take the mud of the Thames itself from Chiswick to Westminster, and compare that chemically with the results of your analysis of the mud in Barking Creek?—It may be said to be practically the same as far as the proportion of organic matter is concerned; there is 15·8 per cent. of organic matter in that mud, and of that organic matter 3·05 consists of nitrogen.

2224. The 15·8 you compare against 16·2, and the 3·05 would compare against the 3·1?—Yes.

2225. Practically the same?—Practically the same. The proportion of mineral matter is very nearly the same, 83·8 in Barking Creek, 84·2 in the mud of the Thames between Chiswick and Westminster.

2226. Take the mud from the London docks, are there similar characteristics in that?—From all the docks in succession there were six samples taken, from the London Docks, St. Katharine's Docks, the East and West India Docks, the Commercial, which is on the Surrey side, and the Victoria Docks, so that five of the docks are on the north side.

2227. Will you give us the average results from those six samples?—The average of those six samples contained 15·8 per cent. of organic matter, and of that organic matter 3·07 consists of nitrogen. Of organic mineral matter there was 84·2 per cent.

2228. Again corresponding very closely with the mud in Barking Creek?—Yes, absolutely identical with the mud in the Thames, with the exception of one figure in the decimal.

2229. There is one-fiftieth part of nitrogen in excess in the sample from the docks over that taken from the Thames?—Yes.

2230. (*The Commissioner.*) Do any metropolitan sewers, or the adjoining street sewers, empty into the London docks?—I believe not; but I believe all the filth from the shipping goes into the docks. I should not like to say positively, but that is a question upon which information may be had.

2231. (*Mr. Philbrick.*) As a fact, none of them do so. You have told me that you analysed the deposit from the main sewer reservoirs; what do you find as to the organic matter in them as compared with the mud of Barking Creek?—There is a difference in the composition of the mud from the two sides of the river. We have examined samples both from Barking and from Crossness. In the Barking reservoir the organic matter amounts to as much as 58 per cent. of the whole, and of that the proportion of nitrogen is 4·27 in 100 parts; while at Crossness the organic matter amounts to 37·1 per cent., and of that the proportion of nitrogen is 4·51 in 100 parts.

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2232. That is the sewage deposit proper?—Yes.

2233. Take the mud from Horse End Point?—The mud from Horse End Point contains less organic matter than any samples I have had occasion to mention, only 7·2 of organic matter, and 100 parts of that organic matter contains only 2·51 of nitrogen.

2234. Take the mud of the bank in the Thames which has been formed, and which Mr. Leach spoke of, the bank near the pier of the Chartered Gasworks?—That is also very like river mud. It contains of organic matter (it is just above the outfall) 14·4 per cent., and of 100 parts of that organic matter 2·84 consists of nitrogen.

2235. In point of fact I am not very wrong in calling that ordinary river mud?—Yes; but that it contains rather less organic matter than some of the other samples I have spoken of.

2236. At Barking Creek itself; suppose we take the town quay. Did you see there considerable local nuisance?—At the time I was there there were barges unloading dung, which made it very offensive in the neighbourhood. There was a good deal of smell from the quay.

2237. Is the deposit of mud there, speaking generally, better or worse than the deposit of mud at the end of the creek nearest the outfall?—It is worse. This mud happens to contain as much as 25·4 per cent. of organic matter.

2238. And a large proportion of that is nitrogen?—A large proportion of that, I cannot say the exact figure, is nitrogen.

2239. You know enough to know that it would be a large proportion of nitrogen?—Yes.

2240. Would you say as the result of your analyses of these different samples that in Barking Creek there is any deposit of sewage from the outfall works?—The material (mud) is of the same character as that which is deposited on the banks of the Thames all the way down.

2241. There is nothing traceable in the analysis to the discharge of metropolitan sewage?—There is nothing peculiar in that mud, certainly.

2242. No elements which you could as a chemist say would be due exclusively to metropolitan sewage deposit?—I believe all the mud on the Thames is contaminated more or less with sewage.

2243. But there is nothing special and differing in the mud at Barking from the ordinary mud of the river Thames?—No, the composition is the same as nearly as may be.

2244. When you get up the river Roding above Barking town the result is that it is worse considerably?—I should not say considerably, I should say practically it is the same; it is nearly the same; a little worse, may be, certainly not better.

2245. At Barking quay how is it?—At Barking quay it is worse.

2246. In these investigations had you the benefit of the assistance of Dr. Odling?—Dr. Odling has been associated with me from the commencement.

2247. You have arrived at the results, after checking each other by your joint process?—Yes.

2248. I believe you have seen the parts of the river and the creek which are said to be affected by metropolitan sewage?—Yes.

2249. Do you believe any proportion of the organic matter contained in the mud of Barking Creek has been increased by the discharge of the metropolitan main sewerage outfall?—Judging from the analyses I should say it has not, because the composition of the mud in the creek is the same as that in the river Thames immediately above the metropolitan outfall.

2250. Speaking as to the chemical composition of the organic matter in the sewage, do you believe as a chemist that it would be dissolved in the river water or suspended in the river water and finally carried away, rather than deposited?—Some proportion would be carried away and some would be deposited.

2251. Would that proportion which is deposited be a large proportion?—It would vary from time to time.

2252. According to the amount of rainfall and various other matters?—Yes. I should not like to commit myself to any positive opinion upon that point.

Cross-examined by Mr. Horace Lloyd.

2253. More or less no doubt sewage mud does deposit, because you found traces all the way down?—Yes.

2254. And to some extent to this day all through London and downwards?—On the banks and foreshores of the Thames there is no doubt a quantity of organic matter in all the mud.

2255. And that, I suppose, as in most other cases, is one of those instances where analysis gives you very little idea of the actual state of the thing, so much depends upon its condition?—There is a general similarity in the appearance and properties of the river Thames mud; you can tell its character by physical appearances, by the smell, and by the composition.

2256. The condition of any particular mud is easily determined?—You may find some more putrescent than others, no doubt, yet having apparently the same composition.

2257. What mud have you examined in the immediate neighbourhood of the main sewers outfall?—I have examined some from the metropolitan main sewers outfall. I have taken some from the Horse End Point, and some from the bank opposite the Chartered Gas Company's works.

2258. That which I put down as being in the reservoir itself was taken from outside the reservoir?—No; but I can give you a statement of the composition of the mud that was taken outside. That which I gave was from the reservoir itself. In Barking Creek, close to the sluice, the proportion of organic matter was 14·84, and of that in 100 parts 2·43 consisted of nitrogen. Then there was a sample taken at Barking, 50 feet below the apron of the sewage, or outlet.

2259. (*The Commissioner.*) In the Thames?—This I did not myself take, therefore I cannot say exactly the spot, but the plan which is in the room will give that. It is No. 60; that is just at the outlet of the metropolitan main sewer. That contained 59·61 per cent. of organic matter, and of 100 parts of that organic matter 3·19 consisted of nitrogen.

2260. (*Mr. H. Lloyd.*) Therefore a considerable deposit takes place immediately outside the point of discharge?—The walls are covered with a portion of the discharge from the outfall.

2261. Whatever we may be told about specific gravity, or matter being held in solution, some is immediately deposited before it has travelled more than a few feet?—Some hangs on the sides of the outfall.

2262. Besides taking that which hung on the sides of the outfall, you also took a sample some distance off?—This is the opening as it widens. It is a brickwork wall, and this appears to have been taken from the bricks themselves, so that there is a portion of mud hanging to the wall.

2263. Apart from the mere clinging to the wall, does the mud below show the same character?—The mud below, that is to say, from the Horse End Point, it so happens contains less, I do not know why, than any other sample that I examined.

2264. You cannot say how far any such deposit from the reservoir extends?—The banks of the river are coated with mud for a very considerable depth down.

2265. How far that is of the condition of ordinary river mud, or strongly impregnated with sewage, you cannot tell?—I have not found any samples of mud, except such as were specially taken in the reservoir or from the exact outfall, which showed any serious difference.

2266. How near to the reservoir have you taken any other?—The nearest sample was that mentioned just now as clinging to the walls of the outfall.

2267. Apart from that which you say clung to the walls, which is the other sample nearest to the reservoir?—On the other side I have taken samples at various times.

2268. Take the Horse End?—The Horse End shoal, that is the nearest, and then immediately opposite, that is to say, just opposite the mouth of the Roding, another sample was taken, which I have not mentioned, but which I can give the particulars of. That is on the other side of the river Thames, across the river.

2269. I will not trouble you about that. Did you take those samples yourself?—A great number of them were taken in my presence.

2270. And you selected the place where they should be taken?—Yes. I desired them to be taken for the purpose of ascertaining what the composition of the mud was.

2271. What weather was it, wet or dry?—It was dry.

Re-examined by Mr. PHILBRICK.

2272. You were aware of the inquiry, and the points to which the Commissioner's attention had been directed, and you required those samples to be taken from those particular spots, in order, as far as you could, to test the matter?—I have been examining this question for the last twelve months on behalf of the Metropolitan Board, so that I have made a great number of examinations, not only from the neighbourhood of Barking but also across at Crossness, and at various points where deposits of mud have occurred.

2273. Your evidence has been given not only as to the specific samples; but also as to the general conclusions as to which I have asked you, and I assume nothing has occurred in your experience with regard to any one of those samples which leads you to alter the opinion you have expressed?—No; they were taken with great care, with the view of ascertaining accurately the composition of the river Thames mud, for the purpose of an inquiry of this nature.

Dr. WILLIAM ODLING called; examined by Mr. PHILBRICK.

Dr. W. Odling.

2274. You are a fellow of the Royal College of Physicians?—I am.

2275. And professor of chemistry at the Royal Institution?—Yes.

2276. Have you yourself, in connexion with Dr. Miller, analysed the various samples of river Thames mud and other specimens of mud taken as he has described?—Yes.

2277. Both of sewage deposit and river mud taken from the Thames, from Barking Creek, and from the river Roding?—Yes.

2278. You have inspected personally most of those localities?—Yes.

2279. I will just ask you a general question or two. In the first place, does the mud which is in Barking Creek, and that accumulated at Horse End, come from the Thames, or does any of it come from the Roding above? Are you able to tell the Commissioner whether or not that mud contains sewage deposit?—No, it does not.

2280. Is it ordinary river mud?—It is ordinary river mud.

2281. Does the analysis, as well as the personal observation that you have made of the substance before chemically analysing it, confirm your view?—It does.

2282. Does the mud of Barking Creek separate from the water in a distinct stratum?—Yes; and the surface of the mud is of a light colour, showing that the surface at any rate is fully oxidised.

2283. Mud due to sewage deposit I think would have a flocculent character on the top?—*That* is a specimen of sewage mud from the reservoir; and *that* is a specimen of mud from the Chartered Gas Company's bank (*producing two samples*). The first has a flocculent character and has very little tendency to subside.

2284. When oxidised or exposed to the action of atmospheric air I think it does not turn to the brown colour which the mud in Barking Creek does turn to?—It requires very long exposure indeed; I may say it is almost impracticable for sewage mud to become oxidised while in a state of mud; but when suspended in a large quantity of water it is different.

2285. So far as organic matter contained in the mud of Barking Creek itself is concerned, do you see any indication of its having been increased, or that its presence is due to the discharge of sewage from the metropolitan outfall?—No; the amount of organic matter contained in the mud of Barking Creek, from one end to the other, is very much the same. It is the same practically as that of the same river Roding above, and the same practically as that of the bed of the Thames.*

2286. The variations which have been found in the different samples analysed I suppose are not more than what you would naturally expect to find?—They are extremely minute.

2287. They are not more than one would expect to find from analysing samples taken from so many different places, unless there were some disturbing cause?—Quite so; that is to say, in some parts of the Thames you will find gravel; in some parts you will find sand; in some parts you will find mud. Where you find mud it is substantially of the same character everywhere.

2288. All the samples which you have taken, except those which are pure sewage from the mouth of the sewage reservoir of the main sewerage outfall, bear distinctive elements of Thames mud, and do not indicate the presence of sewage matter?—Except in the sense that organic matter found in the mud of the river Thames from one end to the other is derived not entirely, but in a great measure, from sewage, or something in the nature of sewage.

2289. They do not indicate any special result as being due to the proximity of the metropolitan main sewerage outfall works?—No, certainly not.

2290. With regard generally to organic matter which may be contained in sewage, so far as your experience and knowledge of its chemical constituents goes, would it be likely to subside and precipitate itself directly?—No, the organic matter of sewage has a specific gravity which is very slightly above that of water; consequently it only subsides very slowly from still water when it is not putrefying; when it is putrefying the putrefaction lifts it up, and if in a running stream it does not subside at all.

2291. The difference between the specific gravity of organic matter in sewage and that of water is small, and the force of any motion or current in the water would have a tendency to keep it in suspension?—Quite so, and it would keep much heavier matter than organic sewage in suspension too.

2292. Having seen the metropolitan sewers outfall, and the works in connexion with it, what is your opinion as to the organic matter that is held in suspension in the metropolitan sewage; do you believe that it accumulates in the river Thames, or is disposed of otherwise?—When the sewage is discharged from the outfalls it is becoming putrescent; it has a strong smell, but you would hardly call it putrid as compared with what absolutely putrid sewage really is; it is not strictly putrid, because it abounds in animal life, but it is black. You can trace this black stream down for a considerable distance, and then it gets brown. I have no doubt this stream of sewage can be traced for a limited extent, say three quarters of a mile, when it alters its colour; it is beginning then to get oxidised; the organic matter does not, however, wholly disappear.

* Barking Creek and the river Roding are one stream. The tidal creek extends from the Thames to Barking town, the river Roding above Barking town.

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Organic matter is not necessarily unwholesome. A fresh beefsteak is organic matter. But it is organic matter in a putrid state that is unwholesome.

2293. Speaking generally, is there anything like an accumulation of sewage filth or refuse concentrated near the dwellings of some of the Barking memorialists?—Certainly not.

2294. Or anything which would at all justify the words "spawning beds of fever and cholera"?—From an inspection of the locality, and a good deal of observation connected with it, I do not think that the discharge of the metropolitan outfall sewage has the slightest effect upon the health of the people living in the town of Barking.

2295. With regard to the analysis, I do not know that I need trouble you as to the exact figures, because you heard those given by Dr. Miller?—Yes, and I checked them.

2296. You checked them as he gave them?—Yes.

2297. And your result and his substantially coincide?—Yes.

2298. The results of your analyses were arrived at by a joint process?—Yes.

2299. You have brought here to show the Commissioner these two samples?—This (*pointing to a sample all black*) is a sample of the sewage as deposited within the sewage reservoir, the other is a sample of the deposit of mud taken from the mud bank in the river Thames opposite the Chartered Gas Company's new works.

2300. No. 1 is sewage proper?—Yes; the other is mud from the Chartered Gas Company's bank. It has got a little shaken up in coming here; the surface gets rapidly oxidised; the bottom forms a distinct stratum; it has the character of clayey mud.

2301. (*Mr. Horace Lloyd.*) The other does not oxidise?—That from the sewage reservoir does not oxidise with anything like the rapidity; in fact mud in this state will hardly oxidise at all; but when it is mixed with a very large volume of water, under those circumstances it loses its colour as this has done, and is no longer in a putrid state. I may say, with reference to this sample (*pointing to the sample from the sewage reservoir*) that I was obliged to put it in another bottle this morning, because it burst the bottle in which it originally was. That (*pointing to the sample taken from the Chartered Gas Company's bank*) has been in the bottle for more than a week, and but for the bursting of the other bottle that sewage reservoir sample would have been in its bottle for more than a week also.

2302. (*Mr. Horace Lloyd.*) It (the mud) is not in these conditions in the Thames (*pointing to the Chartered Gas sample*)?—No; in the Thames, instead of having standing water like that it has the flowing water of the river over it.

2303. (*Mr. Philbrick.*) That is a sample of mud from the bank?—Yes, from the Chartered Gas Company's bank. You see the top portion is quite oxidised, it does not smell.

Cross-examined by Mr. Horace Lloyd.

2304. Would it smell if you shook it up?—It would then smell very badly, no doubt. I will try if you like. (*The witness took out the stopper.*) It does not smell. I thought that very likely it would. It would smell if you shook it up.

2305. You have performed the operation of watching the black sewage coming out of the sewage reservoir and finding its way into the Thames and along the Thames?—Yes.

2306. And you have traced the stream of sewage in a boat?—Yes.

2307. And seen it distinctly as a separate body?—Yes, for a considerable distance.

2308. Then you say, losing its colour, it becomes browner and fainter?—Yes.

2309. And then imperceptible?—Yes.

2310. Do I understand that, according to your view, a complete mixture with the river water has not taken place by that time, but that the colour of the separate stream has so altered that you are unaware that there are two streams in the Thames?—Yes. I should say my individual opinion is that you would be able to trace the sewage a good way longer down the river if this stuff continued black instead of becoming brown.

2311. That is to say, if you could see the chemical compounds, instead of the sewage water becoming transparent?—I do not quite understand you.

2312. I mean if the sewage waters which have a different character retained a different colour?—Quite so. (*The Commissioner.*) If you were to take mud from the bottom of the Thames opposite to this building (Westminster New Palace) you would see that it was not very far from the colour of that mud.

2313. (*Mr. Horace Lloyd.*) However, do you consider that by the time that sewage mud has lost that colour it is innocuous?—It is innocuous for the time.

2314. Under what circumstances, or for what length of time?—By the time that this mud has acquired a brown colour it is no longer putrid, but there is still some organic matter in it. If that were put in a condition in which it could absorb no more oxygen it would then further putrefy.

2315. I want to know how it is that the Thames mud on the banks of the river all along has that unpleasant putrescent odour?—At the present time, as a rule, the mud banks which are below the surface of the water, and are covered, do not smell, but a mud bank near where a sewer is discharged the material undergoes putrefaction and does smell. The mud banks of the Thames, as a rule, are covered with a brown surface and do not smell.

2316. Between the bridges?—Yes.

2317. What is it I can smell as I go down the river?—Where the mud smells it is no doubt putrid.

2318. Am I to understand that your belief is that a stream of sewage travelling on in that way is first black, that it then becomes brown, and that it then loses any colour that you can perceive from a boat on the surface, nothing having been deposited and the whole being there?—There is a certain amount, not a large proportion, of insoluble gritty matter brought down, no doubt, and some of that certainly subsides. The whole bed of the Thames contains 16 per cent. of organic matter on the average, and a certain proportion of that has been derived somehow or other from sewage.

2319. The mud containing organic matter which has become partially oxidized you say may again be placed in a condition in which it may become just as unpleasant as it was originally?—Yes, we saw it in the Thames eight or nine years ago, during the great heat of summer, but in the winter one was unconscious of it, the river was perfectly brown. Then in the heat and drought of summer, when the flow of water in the river became extremely small, the whole of the river between the bridges was black, or approaching to black.

2320. And, moreover, when the sewage mud was deposited on the banks it smelt worse than the water in the river itself?—It was very bad indeed, exceedingly bad.

2321. Can you undertake to say, looking at the currents and cross currents in the river Thames, that none of that metropolitan sewage matter would be deposited, say on the Horse End shoal?—As a matter of fact, the bed of the Horse End shoal is composed in a very large measure of sand, combined with a very small proportion of organic matter. I suppose there is some current there which washes away the lighter portion and leaves the heavier.

2322. Are not the last additions exclusively mud, and not sand or gravel?—I did not take that particular sample myself, but as a matter of fact it was as I have stated. The sample contained 93 per cent. of mineral matter, and only 7 per cent. of organic matter.

2323. The organic matter was not sand or gravel?—No; but it contained a considerably less proportion

than the average. It contained a proportion approximating to that which we find in other parts of the river where there are strong eddies.

2324. Did you take any pains to ascertain how far the mud so deposited is homogeneous, or how far it will vary in its character within a few feet or yards?—We have made a very great number of examinations at different depths, and I do not find that they differ very much from one another. One taken from the surface would contain more organic matter than one a little deeper, but as far as alterations within a few hundred yards are concerned, there is not any appreciable difference.

2325. Unless there are special local circumstances to account for it?—Unless there are special local circumstances to account for it.

2326. If there are local circumstances, a distance of a very few yards may make a very great difference?—Of course it is possible that it should. We find that the mud from the Barking quay is very different from the other mud of Barking Creek.

2327. You would not say that the mud at the Horse End shoal, a few yards from where you took it, may not be different?—I have not tried it, but judging from the sandy character of the sample there is a current there which is very strong, and which allows nothing more substantial than sand to subside, and which is opposed to the deposition of clayey matter, or organic matter.

2328. Do you call this sand (*pointing to the Chartered Gas sample*)?—It is a mixture of sand and clay.

2329. Is there much sand?—There is a good deal of sand in that, but not so much as at the Horse End Point, and there is also a good deal of clay in it.

2330. You were yourself there and took the samples?—No, I did not take that sample.

2331. This sample you took?—No, it was sent to me.

2332. Where was that taken from?—Out of the sewage reservoir itself, inside not outside the reservoir.

2333. Did you see how far there was any special deposit from the reservoir just outside?—Where the reservoir discharges into the Thames on that bank there is a considerable amount of deposit.

2334. What is the character of the mud taken from the inside?—Not so very much unlike that; Dr. Miller gave the analysis of one such sample.

2335. You said that in your judgment the mud of the Roding was ordinary river mud?—Yes.

2336. Did you trace any sewage from above Barking town in it?—Yes, and it contains about 17 per cent. of organic matter. I should think that the mud of rivers which receive no drainage would not contain so large a proportion as that.

2337. You do not think that any part of that organic matter could have come from the other direction upwards?—No. The sample was taken above the mill at Barking, and three quarters of a mile above the site of the town of Barking.

Re-examined by Mr. PHILBRICK.

2338. What is the analysis of mud taken from the river Mole, which contains no sewerage?—There is no mud in the Mole, it is all sand and gravel.

2339. Then, of course, the organic matter would be reduced to a minimum?—Two or three per cent. It is, in fact, almost nil.

2340. Is it consistent with your experience, that even in rivers which receive no sewage at all the mud presents traces of organic matter to some considerable extent?—I have had occasion to analyse the mud of the river Medway. That receives some sewage; but it is a small proportion as compared to the large volume of water in the Medway, and that mud has much the same composition. Wherever you have mud and organic matter the mud carries down the organic matter with it.

2341. My learned friend asked you about the confluence of the stream of sewage discharged from the metropolitan main sewers outfall with the volume of water in the river Thames. As I understand you, you can trace it by the colour a certain distance. Then, after it has flowed down the river to a certain point, and has had an opportunity of mixing with the water for a certain period, it becomes oxidized?—Yes. It loses its colour, and therefore I infer oxidization has taken place.

2342. That of course would be due to the action of the external air and the river water?—Chiefly, and to the air dissolved in the river water.

2343. The eye loses all trace of it at that point?—Yes.

2344. I understand that the opinion which you have expressed about Barking town not being affected by the discharge of sewage from this metropolitan outfall is not only formed upon your observation externally, but is confirmed by the result of your analyses?—Quite so.

2345. With regard to the water of the river itself as distinct from the mud, have you analysed that at all?—I have not analysed any samples of Thames water in that neighbourhood.

2346. Suppose there were more solid matter found in the water of the river Thames now than heretofore, would that in any degree necessarily indicate that it proceeded from metropolitan sewage?—My lowest experiments on Thames water have been made at Greenwich. The variation in the volume there is so great from season to season, that I should say, applying that to the samples of water at Barking, no reliable opinion could be formed. The variation is so great that you can form no useful contrast.

2347. Nothing upon which a judgment might safely be formed?—No.

2348. Would your analysis of the river Thames water itself be likely to lead to any results on which you could form a judgment?—The conclusion I came to was, that while there is very little inland water running down the Thames tidal or sea water comes up very much higher, and you then necessarily get a very much larger amount of sea water at high water at Greenwich and upwards than you do at other times.

2349. (*The Commissioner.*) That is simply where you have brackish water to deal with and not fresh water?—Yes. The amount of organic matter in salt sea water is greater than it is in fresh river water.

2350. Would the material in these bottles—sewage—mud and fluid—be useful as manure if applied to land?—Undoubtedly.

2351. Both samples?—I have not any actual knowledge of that fluid (*pointing to the sample from the Chartered Gas Company's bank*).

2352. But the other sample, sewage from the reservoir, would be a good material to irrigate with?—Most excellent.

2353. Do you know what per-centage of manurial value that has in it?—The metropolitan sewage from the metropolitan Barking main sewers outfall is very rich sewage no doubt. I cannot give the worth to you in money value, but it is above the average of town sewage.

2354. And it would, if applied to land, be a rich manuring material upon the land?—Certainly. I should say a far richer manuring material than any I have chanced to meet with at places where sewage irrigation is practised.

2355. If it is feasible to put that sewage material upon the land with any chance of getting a profit, that is how it ought to be applied?—Yes; I know of no other way of dealing with it, either that, or throwing it away, as at present.

2356. When sewage mud becomes black like that in that bottle is it any indication as to its age, or as to whether it is passing into a putrid state or not. Is fresh sewage of that colour?—No; fresh sewage is not unpleasant looking stuff. It looks very different from that. That sample is quite putrid; but when it runs out from the sewage reservoir, though it is as black as that sample, it is not so putrid as that. It does not smell so strong, but it abounds in worms and other things which are alive.

FOURTH DAY.

Dr. W. Odling.

26 July 1862.

2357. If the metropolitan sewage were put upon land hour by hour and day by day as generated, would it become of that black colour?—I do not know how long the London sewage takes getting from remote places into the sewage reservoir. So far as I have seen, the sewage which is sent into the reservoir is always black.

2358. The minor sewers in the metropolis are in length largely in excess, of course, of the intercepting sewer?—Yes.

2359. And the character of their sewage would be stamped upon the whole volume of sewage by what they as tributaries brought in?—Yes; because when once fermentation has set in it goes on through the whole volume of sewage very quickly.

2360. As we know, there are many miles of old sewers in London which retain sewage deposit; these old sewers give a character to the metropolitan sewage generally?—Yes.

2361. But nevertheless, taken as it is with its blackness, if put on land it would make a rich manure?—Undoubtedly.

2362. (*Mr. Philbrick.*) Is it possible to apply that sewage to land without causing a nuisance to the neighbourhood?—I do not know whether it would be practicable or not to do so.

Mr. G. W. Hemans.

Mr. George Willoughby Hemans called; examined by Mr. Philbrick.

2363. You are a civil engineer, and have been in practice for many years?—Yes.

2364. You have at present large works under your control?—Yes.

2365. Are you acquainted with Barking town and the neighbourhood of Barking Creek?—Yes, I am pretty well acquainted with them.

2366. Have you made it your business to go through the allegations contained in this Barking memorial, so far as they involve statements of facts in an engineering point of view which you can speak upon?—Yes, I have.

2367. Have you examined the cross sections which have been taken in the creek, which Mr. McDougall furnished to us during this inquiry?—Yes; I have examined the sections both of the creek and of the river Thames.

2368. What is your judgment upon the allegations in the memorial, so far as the navigation of the river Thames and the navigation of the creek are concerned?—They (the allegations) appear to me to be not founded upon fact.

2369. So far as the waterway of the river Thames and the creek are concerned, do they appear to you to have been prejudiced in any way by the opening of the main sewerage outfall works?—It appears to me impossible that the amount of solid material delivered from the London outfall works into the river can get up into Barking Creek at all; the amount of sediment is so small in comparison with the body of water with which it is mixed in the Thames, that it cannot obstruct that river, or cause any of those mischiefs which are complained of.

2370. At one point near the metropolitan main sewer outfall there is a piece of foreshore which to some extent is silted up I believe?—There is a portion above the outfall where there is an evident mud shoal.

2371. Can you trace that in your judgment to any deposit from the discharge from the main sewers outfall?—It does not appear to me possible that that mud shoal can be derived from anything coming out of the outfall. The whole river Thames is full of abrasions. There is a certain amount of mud and grit and sand which is washed from the banks in all directions, and of course there will be deposit in places similar to that where that shoal occurs.

2372. Supposing you take it as we now understand is the fact, that the chemical constituents of that shoal present no appreciable difference from those of mud taken from the Thames at Westminster or at Teddington, would that tend to confirm your judgment that natural causes in the river, other than the metropolitan main sewers outfall, have produced that shoal?—I think it is quite evident that the mud of the Thames, at all events at present, must to a certain extent have sewage in it. It is very well known that the upper part of the metropolitan northern system of sewerage is not yet completed, and consequently the London sewage comes down the Thames, and therefore both that and the sewage of Barking must leave some trace in the river as they come down; and if there is sewage found in that shoal I should attribute it to that, and not to the Barking and Crossness sewers outfalls.

2373. Have you calculated what the cross sectional area of the Thames water is at the time of the discharge as compared with the area of the sewage discharged from the sluices?—The area of the Thames is between 300 and 400 times the area of the outlets for the discharge of the main sewer, and therefore the dilution must be very great indeed, and as you are upon that point, I may as well mention that in Mr. Bidder's evidence, when he gave the quantity 250 tons a day of solid matter delivered by the metropolitan sewers, he did not mean that that came from the northern outfall. He told me just now (and it is evident from the report that that is what he meant) that that was the total quantity collected or delivered from all the London sewers, both north and south, in their original condition, before their improved condition and before the improved gullies. The quantity from the northern outfall is only 71 tons a day, therefore the dilution is very much greater.

2374. The larger quantity was that which was present to the gentlemen who were consulted about the scheme, as that which they ought to provide for in any scheme for the drainage of the metropolis?—Yes, that included all the sewers north and south in the metropolitan area, but no such quantity comes from the northern outfall at present. According to the carefully calculated return which Mr. Hawksley gave in his evidence it is $\frac{1}{2000}$th, and that $\frac{1}{2000}$ is about 71 tons of solid per day, but instead of being mixed in the proportion of one ton to 20,000 (as Mr. Bidder gave it), it would be one ton of solid to about 60,000 tons of water; so that it is three times more diluted. I know I am right, because I have just mentioned it to Mr. Bidder, and he agrees with me that he had taken the whole of the original calculation of the deposit that might arise.

2375. No doubt what was present to his mind was what he had before him in making his original report?—Yes.

2376. But so far as relates to the volume of sewage matter which is discharged, and which may be in a state of mechanical suspension in the water, do you believe when it is discharged into the tide, ebbing as the tide does an hour after high water at Barking, that any of that returns?—It is contrary to all mechanical laws and all laws of hydraulics; unless it can be proved that there is some very extraordinary back eddy caused by some unknown circumstances, it is impossible to understand how any of it can return. It has been long ago proved that anything thrown into the Thames with the specific gravity of water will fall a mile seaward with every tide, and therefore sewage discharged to-day will be a mile lower down to-morrow, and how it is to get back against the strength of the current is not comprehensible to me.

2377. I believe you have had occasion to watch and make yourself acquainted with float experiments?—I have had a good deal to do with that matter. I was engineer to the Sewage Utilization Company, who executed a portion of their works at Barking, and in connexion with that I had occasion not only to see the creek a great deal, but also to consider the whole subject. With regard to that, I think I may take the opportunity of mentioning that some of the evidence given by Mr. Hope I cannot at all either concur in or pass unnoticed, and that is that part of his evidence which was intended to lead to the assumption that the failure of the sewage company was owing to some want of correctness of principle in the design and conduct of the works. He gave evidence to the effect that the engineers, who were Mr. Bateman and myself, and we were both perfectly agreed upon the subject, had conducted the works on a wrong principle, and made

them a great deal too expensive. The facts really are, that in passing the Act of Parliament, Mr. Hope and his friends felt that it was absolutely indispensable for the sake of popularity, and in order to get the bill passed, that they should agree to have a covered brick conduit the whole length of the utilization scheme, in order to protect the public from the stench of an open conduit. I had always, in concurrence with both Mr. Bazalgette and Mr. Bateman, contemplated that the sewage might be carried for a considerable distance in open channels, which of course would have been a great deal cheaper; but in passing the bill through Parliament the promoters, Messrs. Napier and Hope, considered it was necessary that the sewage conduit should be covered in, and that necessitated a brick culvert from one end to the other of ten feet in diameter, the construction of which is an extremely costly affair. There is only one way of doing it, and that is in the way in which it has been begun. Therefore I think the statement that there has been any failure on account of the design of the works is exceedingly unjust, and ought not to have been made. There is no doubt that at the beginning of the work this heavy brick culvert had to be laid on a very bad foundation, in 20 or 30 feet of mud. An aqueduct had to be constructed, which enhanced the expense of the works. That however had nothing whatever to do with the failure of the company as a speculation. I also think it right to say that in my opinion the company received every possible assistance from the Metropolitan Board of Works in every stage of their proceedings. The company fought a very troublesome bill through Parliament, with the encouragement, assistance, advice, and attention of the Board of Works, which otherwise they (the company) would not have succeeded in passing.

(*Mr. H. Lloyd.*) That is a strong thing to say.

(*Witness.*) Sir John Thwaites, the chairman, gave evidence in their favour.

2378. (*Mr. Philbrick.*) During the time when your attention was called to the matter, and when you were examining the neighbourhood for the construction of the sewage irrigation works, previously to giving your evidence before the select committee, did you notice the appearance at the mouth of the creek?—I noticed the creek frequently from one end to the other. I had frequently walked in the course of inspecting the irrigation works, which I had charge of, from Barking to the end of it, so that I know the creek tolerably well.

2379. Is there any justifiable cause of complaint as to the navigation of the creek being impeded?—I frequently had occasion to attempt to get into the creek in a steamer at low water, and very often by a boat at low water, and occasionally I must admit that the steamer could not get in; and sometimes the boat did not get in on account of its being so shoal. But that there has been any accumulation through the metropolitan main sewers outfall has never been proved, nor does it appear to be proved now. It appears to me that the Thames tidal water comes up with a great quantity of mud, which slips off the banks of the river at Sheppey, and all along the coast, and when the tidal water reaches Barking Creek of course it spreads out, and the moment it spreads out there will be a partial deposit. In my opinion that is more likely to be the cause of the mud shoal than anything else.

2380. As to the mud on the banks of the creek, is there anything in that, so far as your observation extends, different to what you find in the ordinary mud banks of other rivers?—The creek appears to me (except that it is very dirty near the town of Barking) to be exactly like all tidal creeks; that is to say, there is a great accumulation of alluvial mud, and reed beds grow exactly as in the case of all tidal creeks, but I think the town of Barking itself is very dirty. There is a great deal of manure brought there.

2381. You have stated that you were engineer to the Essex Reclamation Company. During the time of the construction of the works were you necessarily much at the point where the sewage syphon is carried across the creek?—Yes, I was there frequently.

2382. Of course that was the most difficult engineering operation connected with the works?—It was.

2383. Did you or not experience any annoyance from the manure and chemical works at the mouth of the creek?—Those chemical works are extremely offensive. There is no doubt that the London sewage gets the credit in the public mind of causing nuisance which is really due to those works, they are most offensive things to pass at any moderate distance; as you are passing along the river you smell those works, and they are extremely disagreeable.

2384. (*The Commissioner.*) What works are those?—The bone manure works and others; which are immediately opposite the mouth of the creek.

2385. Are those the works known as Lawes's artificial manure works?—Yes.

2386. Does he use bones?—Bones, skins, and all kinds of things you see on the banks. It is artificial manure. I once went through the works, and they are very offensive.

Cross-examined by Mr. Horace Lloyd.

2387. How long have Lawes's works been there?—I cannot tell you; I do not know the exact date of their establishment.

2388. Have they been there a long time?—Yes; as long as I have been going there I have seen them; and I think they have recently been enlarged, but there were works of that sort ever since I remember.

2389. I understand you to say that you think any shoal at the mouth of Barking Creek is due to the deposit from the water that flows up the Thames with the tide?—It is impossible for anybody to say exactly what the cause is, because the behaviour of the river is so uncertain; but that occurs to me as the most probable cause of the shoal.

2390. Do you consider that water to have no sewage contamination in it as it so flows up and deposits?—Tidal water coming up ought to have no sewage contamination, and I believe it would have no sewage contamination in it.

2391. None at all?—None at all.

2392. What becomes, then, of the sewage contamination; do you mean it never gets as far as Barking?—It has been proved by experiments which are well known, that sewage discharged to-day will not return by the tide to within a mile of the point at which it was discharged.

2393. I thought all that theory founded upon the float experiments had been exploded, and that it had been found that it did come up above the mill?—I have never known that the theory had been exploded. On the contrary, I have always believed in it.

2394. If mud comes up from Sheppey, and is deposited opposite Barking, why will not that which is far short of Sheppey be also carried up and deposited?—I do not mean to say that the mud deposited is solely the mud from Sheppey, but the whole of the river Thames is in a state of abrasion, more or less, except where it is protected by pavement or pitching. The water of the river being full of this mud, or having a large proportion of this mud coming up in the manner in which it does, the moment there is a lateral opening or bay into which it can flow it naturally spreads, and will have a tendency to drop a portion of what it carries.

2395. I do not understand why, if mud can be brought up from Sheppey, and be deposited opposite Barking, London sewage, which has not got a third of the way to flow, cannot also be brought back and be deposited there?—I do not mean to say it is exactly from Sheppey. I say it is a soft muddy shore there, and along with all the rest of the shore of the Thames it combines to cause a great deal of stuff to be kept

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in suspension. I am not prepared to say that Sheppey mud does come to that point. It is only some of the mud contained in the Thames tidal water.

2396. Do you consider it impossible that in any shape, noxious or innocuous, any of the sewage discharged at the Barking outfall should ever get above that outfall again?—Unless there is some extraordinary eddy, which has not been proved or seen by anyone, I do consider it impossible. I do not see how it is to get up at all.

2397. You believe that that is travelling seaward, as if it were a solid float, at an average rate of a mile a day?—Considering that it is driven into the river with a certain power and velocity, and that it finds the river in a state of motion of two or three miles an hour, I cannot see how it is to return upon itself. If the experiments with the floats are to be trusted, I believe it is impossible that London sewage can return to Barking or above Barking. Of course the theory may be wrong, but I rely upon that theory. It was a very careful experiment, conducted for most important objects, and we have every reason to believe in the result derived from it.

2398. What you depend upon is, that theory of the float which treats the sewage as if it were a solid?—If that theory is wrong, and if the float can be proved to return above the point of discharge.

2399. I do not put that to you. If there is no analogy between the sewage and the float, that equally disposes of it, does not it, though it might be true of the float?—I do not see how you make a difference between the two. If you put the float in the sewage, and if you see, as everybody can see, that the sewage takes that course, I think you may consider it as a matter of course that it will act as the float does.

2400. When you are pressed for a reason for the sewage products appearing just above the outfall, you say that may be ascribed perhaps to the sewage which still finds its way in not having been intercepted by the low-level sewer?—I do, undoubtedly. There is also an enormous amount of shipping in the Thames, besides the London sewers, which still discharge into the Thames. That alone is sufficient to cause a trace, and independently of that, it is only recently that the London sewage has been turned in at the Barking outfall, and there may be ancient traces of sewage in the shoals.

2401. You would rather account for it in that way than by supposing that it could get from the main sewers outfall and so upwards under any circumstances?—I do not know that I can account for it by any other theory. That seems to me the most natural way of accounting for it.

2402. Now let me take you back to the year 1865. At that time you were the engineer engaged in promoting the bill of the Essex Reclamation Company?—Yes.

2403. At that time you were an ardent supporter of sewage utilization?—Yes; and I am still an ardent supporter of sewage utilization.

2404. And you desired to intercept the metropolitan sewage and keep it out of the Thames?—It was the desire of everybody connected with the business, the promoters and also the Board of Works, and is still, I am sure, if any means can be shown of doing it successfully.

2405. Let me relieve your mind on one point. Do you know that the accusation, as you please to call it (I do not know that it came to that), was merely that the covered sewage conduit, as designed, was of too expensive a character, not that it ought to have been an open one?—Are you referring to Mr. Hope's evidence?—Yes.—Mr. Hope says distinctly that the failure of the works was owing to the obstinacy of the engineers, who would not adopt suggestions of his by which means the whole expense could have been immensely reduced. Now I entirely deny the truth of that statement. Mr. Hope may fancy he has got fair grounds for making such a statement, but it is absolutely incorrect. Mr. Hope never produced any practical plan at all that would have complied with the Act of Parliament that either I or Mr. Bateman obstinately refused to follow. No such thing ever occurred. We had to make a brick culvert of 10 feet in diameter, and that we commenced and nothing else. There were no unnecessary or improper works about it.

2407. Surely you have got wrong in some way, because your original estimate for this brick culvert must have been made before there was any Act of Parliament, therefore it must have been in an earlier stage than that at which the brick culvert was resolved upon?—After great consideration it was decided to present the bill before parliament with a covered brick sewage conduit, under the despair of being able to persuade any committee to pass a bill authorizing an open conduit to carry the London sewage.

2408. But not in the course of the bill?—It was more in the course of the preparation of the bill I should say.

2409. Before the bill was deposited, surely I am right in that statement?—I think you are. It was in the preparation of the bill, in discussing the matter with the engineer of the Board of Works, and with everybody interested in it; we had a very hot opposition from people who wanted to make out that they could secure more benefit to the company by their plans.

2410. I do not want to lose time over a matter which is beside the main question. Was not the discussion, I do not call it a dispute, whether you could not have managed a light iron tube conduit with a less expensive support in the way of concrete and foundations, when you got down into the marsh country, whether you could not have laid a light iron tube above the ground with comparatively slight supports, so as to have made your works less expensive at that part, but still having by means of the iron tube a covered culvert?—At the time the Act had passed, and it was therefore entirely out of the question to do anything else than that which we did. Before the Act passed there were several considerations with regard to iron. It was discussed whether it would be better to have an undulated pipe working under pressure, or whether it would be better to have it of cast iron or of wrought iron; but after weighing all these things, nothing like a definite plan could be arrived at at all cheaper than what was proposed. I say distinctly no such plan was ever suggested by Mr. Hope, or by anybody else, which could be shown to be cheaper and more effective. No arrangement of iron could be devised so good as a solid brick culvert.

2411. That was the military engineer against the civil?—Mr. Hope is not a military engineer; Mr. Hope has simply been an officer in the army, with no engineering skill except what he has picked up. He is a man of great ability no doubt.

2412. He has made it a study, has he not?—As to his being an engineer, he knows well that he is nothing of the kind. He is merely an amateur.

2413. (*The Commissioner.*) What would be the proportion of weight between the fluid to be conveyed and the tube to convey it. If you were making any special tube for the sake of lightness, would not the great weight to contend with be in the fluid you were going to move?—Undoubtedly the weight is in the fluid, but the misfortune we had to contend with in the commencement of those works was that for the first mile the conduit was on a treacherous foundation of deep mud, and the weight of the fluid as well as the weight of the tube had to be supported upon a viaduct in some manner or other. That was the cause of the very great expense.

2414. Take it hypothetically; if the tube, supposing it to be of wrought or cast iron, weighed one pound per lineal yard, the probability is that the fluid would weigh fifty pounds?—Undoubtedly; it would be very much in excess of the weight of the tube.

2415. In constructing the tube you always calculate the weight of the material to be carried?—We always calculate the tube to be chockfull. The weight of the fluid would have been very great in proportion to the structure.

2416. Therefore the difficulty of getting over any treacherous foundation would not have been met very materially by a light conduit?—Scarcely at all. It would only be the difference between the wrought or cast iron and the weight of the bricks.

2417. (*Mr. H. Lloyd.*) That is something beside the present question. No doubt the question of the excessive cost of the sewage conduit works was that which prevented the success of the sewage litigation company?—What prevented the success of the company in my opinion was the total failure of inducing the public to subscribe to the project.

2418. Whether the public subscribed or not the capital was subscribed. A portion of it, at any rate, was advanced by the International Loan Company?—Somebody I suppose also put their names down, but they never paid any money.

2419. The International advanced half the capital, did they not?

(*The Commissioner.*) I do not think we ought to have gone into this money question.

(*The witness.*) I should never have alluded to it but for Mr. Hope's evidence.

(*The Commissioner.*) I may find it necessary to put my pen through this part of the notes, because I do not at present see what bearing it has upon this inquiry.

Re-examined by Mr. PHILBRICK.

2420. As to these float experiments which my learned friend has put to you, he says, Supposing the sewage dispersion theory is applicable, your conclusion would be right, but that if there is no analogy between the sewage on the one hand, and your float on the other, it might qualify your views. Of course the float is a thing that comes backwards and forwards?—It is supposed to be an article which balances exactly with the water. A float does as the water does, and would do as the sewage would also do.

2421. The sewage itself is subject to disintegration?—No doubt.

2422. And that disintegration of course would prevent particles being brought back again as they naturally would be if they were kept *in statu quo* as discharged, and then by the action of the tide be brought back to within a mile lower down?—If they (the sewage particles) were capable of being brought back in the condition they were in when they started, they would be more likely to return than if so agglomerated as just to float and no more.

2423. The action of the river water upon the float would be greater than it would be upon the particles of sewage which would be liable to be disintegrated in their course down the river?—Yes, the particles of sewage would follow the current more readily.

2424. The discharge of the sewage into the Thames is allowed, we hear, to take place about an hour after high water?—Yes.

2425. Then the sluice gates are then shut?—Yes.

2426. During the whole of the ebb tide has that sewage an opportunity of flowing down the river?—The sewage is going down, and it goes down seven or eight miles before the tide commences to return.

2427. During all that time the sewage is subject to the disintegrating action of the much larger volume of river water?—During the whole of that time it is mixing with the volume of Thames water, and during the time it returns it is still in contact and mixing with the river water.

2428. That process of disintegration is always going on, whether the sewage is flowing up or down the river?—Yes.

Mr. WILLIAM HAYWOOD called; examined by Mr. PHILBRICK.

Mr. W. Haywood.

2429. You are a civil engineer?—Yes.

2430. And I believe surveyor to the Commissioners of Sewers of the city of London?—Yes.

2431. You have charge of the city sewers and roads?—Yes, and have had for the last 23 years.

2432. In your official position you have had to advise upon sewerage matters, and to consider the whole of this subject repeatedly?—Yes; there are very few matters connected with sewerage that I have not had something to do with.

2433. Prior to the works of the Metropolitan Board of Works being determined on, or in fact prior to the incorporation of the board, do you remember a plan being proposed for the interception of the northern portion of the sewage of the metropolis?—Yes, perfectly, in the year 1851.

2434. Was Mr. Frank Forster associated with you in that?—He was then engineer to the Metropolitan Commissioners of Sewers. I was associated with him in the preparation of a scheme for the interception of sewage on the northern parts of the metropolis; that was the first time any scheme of interception assumed a definite form.

2435. It assumed a definite form at the time the Main Drainage Act was passed. At that time did you consider what would be the proper point of discharge for the northern outfall?—Yes. There was a large amount of investigation took place, and it resulted in the outfall for the northern side London sewage being brought to Barking, at the very spot at which it now discharges.

2436. That was decided by you and Mr. Forster in 1851?—Yes, it was.

2437. You, I think, were subsequently associated with Mr. Bazalgette in 1854, when this main sewerage scheme began to assume more definite proportions for the metropolis?—I was.

2438. And again the same spot for the outfall was selected?—It was. In the scheme of 1854 a much larger area of the metropolis was included, and the scheme was altogether amplified, as to meet not only the exigencies of the time but also the exigencies of a great number of years to come. Further investigations were made as to the best point of outfall, and the present outfall at Barking was again selected.

2439. I believe at that time there was consultation with Sir William Cubitt, the late Mr. Robert Stephenson, and others of great eminence?—Yes; and also afterwards I may mention the London Drainage Company's consulting engineer, Mr. Wickstead, also selected the site at Barking as the most eligible place for the outfall.

2440. Therefore you are pretty well acquainted with the system which has since been carried out?—I am.

2441. Our metropolitan main drainage tax is what? Is it not 6*d.* in the pound?—I do not know; but it is rather heavy.

2442. We have spent not quite 4,000,000*l.* I believe on the main sewerage works?—About 4,000,000*l.*

2443. Keeping within reasonable pecuniary limits, and not running to the expense of 12,000,000*l.*, or anything of that kind, do you think any better outfall could have been selected for the north of the Thames than Barking Creek?—I do not, and I think it fulfils well the requirements of the metropolitan population, as well as of those persons who live below the point of the main sewer outfall.

2444. Has your attention been called to the several allegations of this Barking memorial?—I have read that memorial.

2445. Have you examined into the truth of the allegation as to the navigation of the river being impeded either in the Thames or in Barking creek?—With regard to the Thames, I must take the statements as placed before me by Mr. McDougall, and the statements which have been made by Captain Burstal and Mr. Leach, and upon them I come to the conclusion that though undoubtedly a considerable accumulation of mud had taken place in the river Thames at one time, yet that it seems to have arrived

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at its maximum and is indeed falling off, and that the navigation has really never been impeded, for the accumulations have taken place at points out of the line of navigation, and have therefore not been injurious to it. That is my opinion with regard to the Thames. Then, with regard to the river Roding (Barking Creek), I have simply heard the evidence which has been given. I have been up it and seen it, and I have come to the conclusion that there is some deposit of some sort at the mouth of the Roding, but as to the extent to which it affects the navigation of Barking Creek I am unable to give an opinion, except an opinion based on the statement of others. I have calculated that a very small affair, 250*l*., would remove the mud bar if it is as explained to me, probably less than that. I went up the river Roding.

2446. That is from whatever cause any bar might arise?—Whatever cause it might arise from.

2447. Having regard to the metropolitan sewerage works at the point of discharge can you form any judgment as to whether the sewage discharge is properly to be credited with that?—I have no belief whatever that the accumulation at the mouth of Barking Creek can be attributable to the metropolitan outfall sewer. The conditions under which the sewage is discharged are such as must quite prevent its accumulating upon the mud banks, or forming those shoals, at least forming that mud bank which has been alluded to, and which I believe to be the principal one, and which is to the west of the metropolitan outfall sewer.

2448. The Thames Conservancy have authorized a pier at the new gasworks site; of course they would not have authorized that if they supposed that the navigation of the Thames there was of any importance?—The pier of the Chartered Gasworks projects 200 or 300 feet into the river Thames, and I apprehend they would not have allowed that pier to be constructed there if they had deemed that the navigation at that spot on that shore was at all important. If you look at the river it is evident that it is out of the line of the main channel, and is therefore not a matter of importance.

2449. Probably a better thing for the river in an engineering point of view, if the Thames Conservancy had the funds to do it, would be to embank that portion of the foreshore?—In the course of years, and as the population spreads eastwards, which it is doing rapidly, and as manufactories grow up on the banks of the river Thames, I have very little doubt that a very large portion of that bay, if I may so call it, will be reclaimed from the river.

2450. Does the mud in Barking Creek present to you any traces of sewage mud, or is it ordinary river mud?—I went up the creek, and it appeared to me to have the ordinary aspect of mud in the river Thames. It was examined; a pole was pushed into it at various places, and in some places the matter beneath was of exactly the same character as on the surface. In one place it came up a little black.

2451. It was tried with a pole?—Yes. I smelt the mud. It had not a pleasant smell; in fact, no mud in the river Thames has; in a great many other rivers the mud is of a similar character. When a pole is put down and mud is brought up from the bottom it has a somewhat unpleasant smell, but it certainly had not the distinct smell of sewage, with which I am reasonably well acquainted, having been through a great many hundred miles of the London sewers in my time.

2452. When you got up to Barking town did you find the mud was better or worse?—I have not been up so high as Barking town for some years. I went what I should guess a quarter of a mile up from the embouchure or mouth of the creek till I got to a hard bottom. I saw the mud on each side, which had the usual characteristics of Thames mud.

2453. Having reviewed the facts as far as you can inform yourself of them, and having considered the allegations of the Barking memorial, is there any better point of discharge within a reasonable compass than that at which the northern metropolitan main sewer outfall discharges?—I do not think there is, and as I said before I think it fulfils all the requirements of the Act of Parliament.

2454. Both in the construction and in the mode of operation?—I have no hesitation in saying that it is a simple impossibility that the quantity of deposit, which I think is set down as 700,000 cubic yards, could have come from the London sewers, and for this reason, that I do not think the sewers have discharged in the four years which are referred to altogether anything like so large a quantity of solid matter. I agree with Mr. Bidder, though I have had no communication with him upon the matter, and I do not know by what process he arrives at his opinion, but by my own process I arrive at the conclusion that the quantity of solid matter which is due to simple sewage from 3,500,000 inhabitants (taking the population of the metropolis at 3,500,000) is about 92,000 tons annually. I am now dismissing the question of the detritus from the roads, or any alien substances, and as the quantity said to be deposited is 700,000 cubic yards, if I am right as to the 92,000 tons annually, it is clear that seven or eight years must elapse before that quantity could be deposited from the metropolitan sewers. That is, assuming that all that ever did come out of the London sewers was deposited in the Thames at the spot named. It is a simple impossibility.

Cross-examined by Mr. Horace Lloyd.

2455. There is, however, this mud bar?—There is. I went up at nearly low water. There is a small bar lying across the mouth of the creek. I do not attempt to deny that.

2456. Do you attempt to deny that it has made its appearance within the last four years?—I cannot say that. I am not able to tell you.

2457. Or what the character of the mud is as it is brought up by the chains of the anchors of vessels that anchor there?—No. I saw the mud which they brought up at the end of the pole that was pushed down till they felt the hard bottom, or what appeared to be the hard bottom, and it was, upon the whole, of the character of the usual Thames mud.

2458. You perceived no sewage character about it?—I saw at the end of the pole when it was brought up some blackness, but whether it was sewage or not I cannot tell you. That would have to be determined by chemical analysis. It might be mere vegetable matter brought down from the river Roding.

2459. Would not the nose tell you whether it was sewage matter?—The nose did not, because I smelt it and it had not the smell of sewage. It had a close unpleasant smell. But I say far above the locks, when I have been fishing. I have seen black mud brought up from the bottom of the river looking very much like it, and smelling very much like it.

2460. (*Sir J. Karslake.*) Have you ever driven along the Serpentine when boys have been bathing in the evening?—No.

(*Mr. H. Lloyd.*) That is from sewage matter which was deposited for a number of years in the Serpentine.

(*Witness.*) I do not deny that it was sewage, but what I state distinctly is that it had not the smell of sewage, and it looked to me not unlike vegetable deposit which had been brought down by the river Roding.

2461. With respect to the choice of Barking for the main sewers outfall, it was selected as being the best place at which the metropolitan sewage was to go into the river?—It was selected with the belief, firstly, that the sewage would all go away into the sea, and, secondly, that it would do so without creating any annoyance to the inhabitants on its journey to the sea.

2462. The inhabitants of London?—No, not only the inhabitants of London, but when the plan was determined on it was our belief that it would create no nuisance to persons far below London.

2463. It was never considered that Barking town

could by any possibility be affected?—It was believed that no towns or villages would be affected injuriously by the London sewage, nor do I believe they are in the result.

2464. It was never intended that they should be?—Certainly not.

2465. It was intended that it should be no nuisance to any part of the adjoining population?—Certainly, nor is there any nuisance in my opinion.

2466. If there is any nuisance it is quite contrary to the original idea when the outfall at Barking was authorized?—I apprehend that the Metropolitan Board of Works had no intention to set up a nuisance, and indeed they would not be permitted, to create a nuisance anywhere, nor do I believe that any nuisance is created. I have seen this London sewage discharged at all times of the tide. Circumstances have brought me repeatedly to this outfall, and therefore I have seen the stream of sewage flowing, and I have smelt it. I do not wish you to understand that when the sewage is discharged there is no smell. There is a smell, but looking at the condition of the neighbourhood, and looking at the point at which it is so merged with the general body of the Thames water as to be invisible, I consider that no harm whatever is done to the neighbourhood by the discharge of the sewage at that point.

2467. You do not believe in the possibility of any eddy or current that would bring back the sewage charged water, and cause the sediment to be deposited at any such point as that which we speak of?—Not in the quantity spoken of, nor as a rule. I think it is just possible that under certain conditions, say once a year, or once in two years, and for the period of a day, sewage may come up the river. It has been given in evidence that salt water has been clearly detected as high as Westminster Bridge. If therefore salt water comes up to Westminster Bridge, then certainly with it may come what is in the salt water; but those cases have occurred at intervals of five, six, seven, eight or nine years apart, and for periods of one, two, or three days at the utmost at a time. With those exceptions, there is no probability of the return of sewage above the outfall so as to form deposits upon the banks of the Thames and create a nuisance to the neighbourhood of Barking.

2468. What is the distance from Westminster Bridge to Barking by the river?—I do not know, but it is a good many miles.

2469. Six or seven miles?—Quite that.

2470. Then if the salt water may find its way up to Westminster Bridge, much more may the sewage find its way half a mile above Barking?—The same conditions which bring the one up would bring the other up, and it would not be more frequently brought up than the salt water.

2471. That is what I cannot understand. If the salt water will come seven or eight miles above Barking for three days, why may not the sewage, which does not start from so low a point, come half a mile above Barking for 30, 40, or 50 days?—Because the occurrence is very rare, and it is only a conjunction of circumstances which could bring salt water up to so high a point in any degree. It is then only traceable by analysis. I have merely the authority of chemists for it; and it can only occur in the event of there being a long drought, and consequently a very small quantity of fresh water coming down the river, very high tides, and winds favourable to its passage up the river, conditions which an only occur conjunctively at very remote periods.

2472. Having got up to Westminster it goes gradually down at the rate of a mile a day?—The probability is that directly after the conjunction of such circumstances storms would arise, and great quantities of rain water would come from the uplands, which would cause salt water and sewage to disappear very rapidly, as it did a few years ago.

Re-examined by Sir JOHN KARSLAKE.

2473. Those things happen under very exceptional circumstances?—Yes, at intervals of years.

2474. You say it was not intended that there should be any nuisance, but it was intended that the primary destination of the sewage should be the river Thames?—Yes.

2475. That it should be carried away into the river?—And so ultimately find its way to the sea.

2476. Whether it should be utilized upon farms, or used for any other purpose, was a matter for further consideration?—Yes. But I wish I could see it on farms.

2477. (*Mr. Philbrick.*) There is the question as to the deposit of road grit, which I did not ask you about, have you considered that question?—I have.

2478. You have to deal with that in the city of London?—The detritus from the roads which comes down is diminishing, and in all probability will diminish year by year. The whole tendency of the construction of the gullies in the metropolis is to make them intercepting gullies, which of course keeps the road material from getting into the sewers. It is found economical to make sewers with intercepting gullies in that way, for the reason that if the road grit is scooped out of the gullies it costs comparatively little, whereas if it once gets into the sewers it costs a very great deal of money per cubic yard to get out. But then, assuming that the road drift does get into the sewers, the inclination of the large mass of the sewers in the metropolis is so slight, and the current in them so small, that there is no probability of its finding its way into those main sewers that ultimately connect with the intercepting sewers, so that we may take for granted that the largest portion of the road drift is kept out of the main outlet sewers, as it does not and cannot find its way into the intercepting sewers. But there is something more than that; supposing it was in the intercepting sewers in any large quantities I believe it would lie there, for I think the average current in the outfall line of main sewer is not sufficient to carry heavy road drift into the sewage reservoirs.

2479. Birmingham has been mentioned, and the weight of road and street detritus annually brought down by the sewers set forth. I believe you had your attention directed to Birmingham; that town is, however, entirely macadamised?—It is entirely macadamised, but with a stone having neither the specific gravity nor the hardness of granite; it is macadamised for the most part with stone called "Rowley rag," and another stone called "Kirkstall rag," both being stone which is more friable and more easily crushed, and I think could be more easily washed away than the detritus of granite. But there is another reason why more road drift may get into the sewers of Birmingham than does in London; Birmingham for the most part is a town with steepish gradients, and moreover nearly the whole of it is macadamised, and without speaking disrespectfully of the town in any way, I think there is not so much care bestowed on the cleansing of the roads as there is in the metropolis. Year by year the tendency in the metropolis is to keep the roads and streets cleaner and cleaner, and to keep out from the sewers the detritus, and therefore though the quantity of sewage will augment in the ratio of the population, yet I believe the quantity of road and street detritus will diminish. I am quite convinced of this, that at the time when the whole of the main sewer outlets discharged into the river Thames, and when scarcely any of the gullies, except those to the pipe sewers, were made intercepting, far larger quantities of sand and grit went into the river opposite London than now. I do not mean to say some road drift does not go into the river through the new intercepting sewers, in fact I believe to some extent it must, but still it is a very small amount. I do not know how their pump valves are made at the sewage outlet works, but if there were a great quantity

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Mr. W. Haywood.
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of road drift in the London sewage at the sewage pumping works, the pump valves would very soon find it out.

2480. (*The Commissioner.*) Have you any large and open side entrances on your London sewers that have no intervening gulley pit, but simply form what you may term a weir under the side pavement, which will pass the whole surface channel water, whatever it may be, direct into the sewer?—There are a large number of those still, left not only in the city but throughout the metropolis, through which everything falls right into the sewers.

2481. So that they would pass the material from the surface into the sewers in whatever state it may happen to be?—Yes, but in the majority of the sewers in the metropolis the gritty material would lie in the sewers till it was removed by hand labour.

2482. Do you know whether or not in the sewers in Birmingham washings of the street surface are admitted in that way by large side slits, I cannot call them gullies, slit-over-falls under the edge of the curbstone, similar to those they have in Paris?—Unless the system in Birmingham has been changed within the last four or five years that is the mode of construction adopted there in place of gullies. I know some few years ago the surveyor told me he shot into the sewers all his street sweeping material and then flushed it away. The street and sewer gradients are steeper at Birmingham than in London.

2483. The surface gradients are very much steeper taking the whole town than London, and therefore the fall of the sewers is greater?—Yes.

2484. And that method of passing in the street grit is, you say, practised in the lower parts of Birmingham?—Yes. It is practised at Paris, as you know, but there the macadam is formed with a limestone, which is easily converted into impalpable powder.

2485. I may put this to you, as the statement with regard to the Birmingham sewers is upon my authority, that if you make a rule of three sum apply to the case of London, and take the 350,000 of Birmingham population and the 42,000 tons of Birmingham sediment per annum, and work out the calculation to see what 3,500,000 of population would give in sewer sediment, we should not come to correct conclusions?—We should not; the conditions of the road surfaces, the inclinations of the sewers, the mode of construction of the gullies, and the system pursued, which in London is one of trying to keep out as much as possible the detritus of the streets, and in Birmingham of making the sewers scavengers, are so different that the same rule undoubtedly could not apply. There are very fair gradients to the sewers in the city of London, taking the average of the city, they are as good as in any part of the metropolis, and better than most of the sewers in the metropolis; yet when the material, which is not of a heavy nature, which falls into the sewers from the macadamized roads gets into the sewers of the city through the gullies, which are not intercepting gullies, there for the most part it lies. The sewer has to be raked down to enable it to be removed; and it is removed by us systematically, because we make a systematic examination of the city sewers.

2486. During all this lengthened dry weather, and also during last summer, you would have nothing comparatively speaking in your drains and sewers other than the waste water supply as pumped in?—That would be so.

2487. You would have the minimum sewage flow?—Yes.

2488. And consequently you would have the minimum scour?—Yes; and throughout the metropolis, or nearly the whole of the metropolis, any material that got down from the roads into the sewers during those periods would, I believe, lie in the sewers, with the exception of such sewers as the Fleet, the London Bridge, and some of the arterial lines. But if you take 92,000 tons per annum of solubate matter, and you imagine for a moment that as much as 100,000 tons of road drift got into the outfall sewer, making together 192,000 tons, or say 200,000 tons, that in three years would not make the 700,000 tons which are assumed to have been deposited from the metropolitan main outlet sewers. That would assume that not an atom of the solubate matter had been decomposed, and as we all know, what are called the soluble matters of sewage would, by constant change and exposure to the atmosphere, be decomposed, and it would also assume that not an atom of road drift or hard material washed out of the sewers had gone below Barking Reach to the sea.

2489. (*Sir J. Karslake.*) That 700,000 tons as attributable to London is entirely supposition?—Entirely. I take those figures as a mere assumption.

2490. Ninety-two thousand tons per annum is taken by you as the amount of the sewage sediment of the metropolis?—Yes, and 92,000 tons per day is allowing three ounces of solid per day for every one of the three millions of the population. That assumes that the whole of the fæces of the population goes into the sewers. That is the average figure arrived at on medical testimony.

2491. (*The Commissioner.*) With regard to what you term "solid," you know, I suppose, that the solids of the human body in the larger proportion go away in the urine in chemical combination?—As I understand, the total voidance is about 1½ lbs. for every individual on the average, solid and liquid, of which a quarter of a pound or thereabouts is solid, the other being liquid.

2492. If that were desiccated it would be nothing like that weight?—If it were freed from all its water it would weigh nothing like that. I understand that a rumpsteak has 85 per cent. of water in it. If you desiccated these 92,000 tons I cannot say how much would be solid and how much would be liquid.

2493. That, however, would be the true test of the solid?—Yes; of course as directly that solid gets knocked about by currents moving in all directions in the river Thames, produced first by the natural flow of the water, and then generated by steam boats and other causes, it is subject to infinitesimal subdivision. There is the town of Ilford above Barking, which discharges a good deal of excreta into the river, but that is three miles above Barking, and the run of three miles destroys (disintegrates) a great deal of the excretal matter in the stream.

2494. (*Sir John Karslake.*) What according to your calculation is the quantity of solid that would remain after desication out of the 92,000 tons?—I have no idea.

2495. The 92,000 tons are solid and liquid, as I understand; am I right in that?—No; the 92,000 tons are the fæces of 3,500,000 of people per annum.

2496. (*The Commissioner.*) What is termed solid?—Yes.

(*Mr. Philbrick.*) It never is desiccated.

2497. (*Sir John Karslake.*) It does not include the urine?—No.

2498. That is, not according to your calculation?—No, urine is water; the quantity of three ounces is not upon my authority, but it is the average taken upon medical testimony. It varies; in winter it is more than in summer.

2499. There is one question which I forgot to ask you. In addition to any detritus, sand, or gravel in these outlet sewers, is there a very large area of agricultural land draining into the Thames?—The total drainage area of the Thames is 6,000 or 6,500 square miles; a very large proportion of that is agricultural land, all of which is highly manured, and after heavy rains I should imagine that from that would be brought down a considerable quantity of organic matter.

2500. (*The Commissioner.*) What is the area of the Fleet sewer?—The Fleet sewer drains about seven square miles.

2501. About 4,400 acres?—Yes; and nearly the whole of it is densely inhabited. I should consider that the Fleet sewer, for the area it drains, brings down more foul matter than any sewer in the metropolis.

2502. Do you remember what is the difference between its dry weather flow and its wet weather flow in volume?—I cannot say, though I believe I was the first person who ever made extensive experi-

ments on the flow of sewage. It is quite immeasurable, because the dry weather flow was taken over weirs; but a very slight rain brings down such a great volume of sewage water that you can only estimate the quantity by knowing the depth that it is running and taking the usual means to calculate it. I should think the flood volume was 100 or 200 times the dry weather volume.

2503. Would you say 500 times?—Scarcely that; as floods come down very suddenly.

2504. From my experience, I should say that the flood flow from the Fleet area is from 500 to 1,000 times the dry weather flow, abstracting the water supply?—Very likely.

Mr. Horace Lloyd here intimated that he was obliged to leave.

Sir John Karslake stated that if the Commissioner had no objection he would examine a few witnesses, whose evidence would be very short.

The Commissioner acquiesced.

Mr. JOHN GRANT called; examined by Mr. PHILBRICK. *Mr. J. Grant.*

2505. You are one of the assistant engineers to the Metropolitan Board of Works?—I am.

2506. And you have the superintendence of those portions of the main sewers which lie on the southern side of the Thames, including the outfall at Crossness?—Yes, I have.

2507. Under Mr. Bazalgette, the superintending engineer of the board?—Yes.

2508. Of course your duties take you frequently down to the point of outfall at Crossness?—Yes.

2509. There, as we hear, the discharge of sewage is somewhat larger than it is on the northern side?—It is at present.

2510. The outlet sewers on the northern side are not quite completed?—Just so.

2511. Is there any nuisance occasioned by the discharge of the sewage on your side of the river, either to the inhabitants or to the navigation of the river Thames?—No.

2512. Have you had any complaint of any kind from the inhabitants?—No.

(*The Commissioner.*) Are you going to ask the witness whether he has read the allegations in this Barking memorial?

2513. (*Mr. Philbrick.*) Yes. (*To the witness.*) Is there any unhealthiness caused by the discharge of the sewage at the Crossness outfall?—There is apparently not the slightest unhealthiness as far as our workmen and their families are concerned.

2514. Have you some 160 people, men, women, and children?—We have 161 men, women, and children.

2515. Living on the works?—Yes; 84 adults, and the rest are children.

2516. Have you had any epidemic?—We have not had any epidemic since the Crossness sewage pumping works were commenced.

2517. Or any unusual state of health at all?—No, we have not. We have had eight deaths in five years, two of which were from accidents.

2518. None of them traceable to the sewage?—None.

2519. Has there been any special illness or complaint of being unwell from sewage, or from any local cause of that nature?—No. I can give you the details of such sickness as there was in 1867.

2520. No, we will not trouble you with that. Has there been any obstruction to the navigation of the river Thames through anything discharged by the Board of Works at the Crossness outfall sewer?—I have not heard of any.

2521. None has been brought to your knowledge at all events?—No.

2522. Are you able to tell how this allegation got into the Barking memorial about a vessel being stranded on a bank formed in the channel of the river Thames?—I know nothing about it except from seeing that statement in the memorial.

2523. That is the only thing you know of it?—Yes.

2524. Has it any existence or foundation in fact as far as you know?—It has none, as far as I know.

Mr. EDMUND COOPER called; examined by Sir J. KARSLAKE. *Mr. E. Cooper.*

2525. You are one of the district engineers to the Metropolitan Board?—I am.

2526. On the north side of the Thames?—Yes.

2527. I believe you have been connected with the board and their predecessors for 17 years?—I have.

2528. You know the outfall works well at Barking Creek?—I do.

2529. Did you yourself superintend the construction of them?—I did.

2530. There are ventilators, are there not, over the sewage reservoirs and over the works there?—Yes.

2531. If you stand over those ventilators when the reservoir is full, when there is a considerable quantity of sewage in it, is there any smell?—Yes.

2532. How far off can you distinguish any smell?—It depends on the wind a good deal. I should think at 100 yards distance you could not perceive it.

2533. Under the worst circumstances?—Under the worst circumstances.

2534. Except for about four hours in the 24, I believe the main sewer outlet is entirely covered with water, is it not?—It is.

2535. And there is no discharge at all after the tide has left the soffit of the arch?—No.

2536. Do you go almost daily from East Ham to these works?—Not daily; perhaps once or twice a week.

2537. Then of course you have often witnessed the discharge of sewage from the sewer?—I have.

2538. At a short distance from the discharging place is there any disagreeable smell at all?—I should say not, or not extending to above 100 or 150 yards from it.

2539. The system of discharge has been the same, has it not, since these works were constructed, namely, discharging sewage within an hour after high water on the ebb tide?—It depends on the tide in the river and the height of the water in the river. If it will allow of an earlier discharge the sewage discharge commences earlier.

2540. Have you ascertained what is the ordinary daily flow in 24 hours of sewage into the Thames from the Barking outfall?—In 24 hours about 32,500,000 gallons.

2541. No; 4,500,000, is not it?—That is cubic feet.

2542. I believe the sewage reservoir is emptied in about 3½ hours after high water?—Three hours sometimes.

2543. You yourself live at East Ham?—I do.

2544. Are there 30 or 40 persons, including men, women, and children, living close to the Barking outfall sewer and the sewage reservoir?—Within 100 yards of the reservoir.

2545. Amongst that population are there 22 children?—Yes, there are.

2546. Is it within your knowledge that since those works have been constructed the children and all the population have been healthy?—Very healthy, especially the children. There has never, so far as I know, been a doctor called to attend any of the children.

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Mr. E. Cooper.

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2547. Are they living close to the sewage reservoir?—Within 100 yards.

2548. In your judgment is there any foundation for the statement in the Barking memorial as to there being any fear of disease or danger to health of the inhabitants of Barking?—Not the slightest.

2549. I believe you have read through the Barking memorial carefully?—I have heard it read several times.

2550. We know that some part of it has been proved to be incorrect. I will just ask you this question—is there any part which is even substantially correct, according to your view of the subject?—No, I do not think there is any part correct.

W. Barnes.

WILLIAM BARNES called; examined by Sir J. KARSLAKE.

2551. Do you live at the Barking outfall and attend to it?—Yes.

2552. You do not look ill?—I am not very often ill.

2553. As to the rest of the inhabitants how do they get on?—Very well indeed.

2554. Have you ever found among any of the people living there that there has been any detriment to their health in consequence of their living near the London sewage discharge works?—Not the slightest.

2555. You are not only close to the main sewer outfall yourself and sewage reservoir, but close to the Thames?—Yes.

2556. Do you ever find anything disagreeable from that, so as to annoy you?—No, and I am generally on the Thames and amongst the sewage daily.

2557. Do you hear any complaints from others living in the neighbourhood?—I have never received any complaint.

2558. It blows over your heads then and goes into Barking?—Apparently so.

2559. You yourself attend to the discharge of the sewage?—Yes.

2560. You draw the sluices, or see that they are properly drawn?—Yes.

2561. That is regularly done under your superintendence?—Yes.

2562. (*The Commissioner.*) Do you ever go into the sewage reservoir?—I should think four or five times a week for some purpose or another.

2563. Do you take any special precautions to ventilate the reservoir previous to going down into it?—None whatever.

2564. Have you any rats down there?—No.

Adjourned to Saturday the 31st inst. at 11 o'clock.

FIFTH DAY.

FIFTH DAY.

Mr. C. A. Tobey.

31 July 1869.

No. 6, Committee Room, House of Commons, Saturday, 31st July 1869.

Mr. CHARLES AYLWARD TOBEY called; examined by Sir J. KARSLAKE.

2566. Do you live at Plumstead?—Yes.

2567. Were you at one time the chief boatman in charge of the coastguard station at Barking Creek?—Yes.

2568. Did you join that station on the 8th of September 1848?—Yes.

2569. And left it on the 13th of November 1866?—Yes.

2570. Between those dates where you there constantly?—Constantly.

2571. Now I think you are employed at Woolwich Arsenal?—Now I am employed at Woolwich Arsenal.

2572. You have a pension from the Government?—Yes.

2573. Where was your vessel moored at the time you were coastguard boatman?—At the time I was at that station she was moored in on the bank at the entrance of the creek's mouth at Barking.

2574. What was the vessel called?—She was called the "Royal George."

2575. You went there you say in 1848?—I went there in 1848.

2576. First of all, where did you get your supply of water from when first you went on that station?—Our supply of water we got from Flint's brewhouse at Barking town. We took our small water casks in the boat and proceeded up to the town, and filled them from the brewhouse water.

2577. Did you ever take your supply of water for your coastguard ship from the creek at any time, from 1848 till you left?—Never.

2578. Do you remember the fishing smacks that used to ply to Barking, when first you went?—Yes.

2579. Where used they to lie generally?—Outside the creek in the river Thames.

2580. Was that near you?—Yes; somewhere about a quarter of a mile distant from where we lay.

2581. Do you know as a fact that for some time they got their casks filled from the water of the creek?—They had their water casks filled with water from the Thames.

2582. Outside the creek?—Outside the creek.

2583. Was that when first you went there?—That was when first I went there.

2584. Did they give up that practice at any time, and if so, when?—They gave up that practice in 1851 to the best of my recollection.

2585. Do you know why the practice was given up at that time?—The water in the Thames was so bad then that it was not fit for the men to drink.

2586. Where did the smacks get their water from after that time?—They received it from a water tank that came out from the town of Barking, and they used to fill their water-casks.

2587. As far as you know, did they ever receive their supply of water from the Thames after 1851 or thereabouts?—Not to my knowledge.

2588. At the time you are speaking of were there several chemical and other works established near the creek?—No.

2589. What works were there?—I forget the date that Mr. Lawes's factory commenced. Mr. Lawes's was the first that commenced at the creek.

2590. You remember it being commenced?—I remember it being commenced, but I do not recollect the date.

2591. When Mr. Lawes's manure factory got into operation, did you find anything disagreeable from it?—Yes; we used to have a great smell from it at times.

2592. Was your vessel removed from the place where it had been moored, and taken to some other part of the Thames?—Our vessel was removed on the 19th of July 1866, and placed on the opposite side of the Thames, on account of Mr. Lawes's factory.

2593. That was the reason why it was removed?—That was the reason why it was removed; but not from the smell from Mr. Lawes's factory, but Mr. Lawes extended his premises so far that we could have no view down the Thames whatever. Our station extended six miles in length, and the extension of those

premises shut us out of the observation of four miles; we could not see that portion at all.

2594. Four miles of sight?—Four miles of sight.

2595. Were those the grounds on which the vessel was removed?—Those were the grounds on which it was removed.

2596. I suppose from the other side you could see the river better than you could from the north side?—We had a splendid view from the opposite side of the whole range of the station.

2597. Was the smell at times from Mr. Lawes's factory very bad indeed?—It was very bad indeed when the wind blew from south-east right over the ship; it was then very bad. Such a lot of soots used also to come from the shaft that I have seen the watchman go and sweep up very nearly a shovel full of dirt.

2598. In 1848 can you tell me about how many boats or smacks there were in the fleet that used to ply to Barking?—Between 300 and 400 sail of smacks and cutters.

2599. They used to sail I think from the North Seas fishing grounds, and go to Barking quay?—Yes.

2600. Did they go up at that time to refit?—They went up to refit.

2601. Did you ever know at that time of their going into Barking Creek with fish?—I have never known them to do so.

2602. What used they to do with the fish?—Discharge it for conveyance to London outside in the Thames.

2603. Then as far as you know, the only object of their going up was to refit their vessels?—That was all.

2604. Did they send off their fish in what are called hatch boats for the London market?—They sent off their fish in hatchboats or barrows; a barrow is as large as a London sculler is.

2605. There were well-boats at one time, but they were discontinued?—They were discontinued.

2606. Before you left the station had pretty nearly all those smacks gone off to other fishing grounds?—Very nearly all.

2607. What time did they go away?—I cannot recollect. Some of them went away in 1850.

2608. Were any left at the time you left?—Yes; Mr. Morgan's fleet was left, and some of the small owners; but they were all dry bottom vessels that used to bring fish to Billingsgate.

2609. They were not fishing boats?—They were fishing boats at sea, but they used to come home to bring the fish to market.

2610. Those boats used to lie at Barking and the fish was taken off there?—No; they never took the fish off at Barking.

2611. What did they do?—They came direct from the sea to Billingsgate.

2612. Did you know the Shelf as it is called outside Barking Creek, all the time you were there?—Yes.

2613. Do you remember it in the year 1848, when you went?—I remember it in 1848.

2614. And when you left?—And when I left.

2615. Was there any difference between its condition as far as you can remember in 1848 and 1866?—Not the least.

2616. It was dry at low water, was not it?—It was dry at low water spring tides, and it consisted of shingle and sand.

2617. And you could walk upon it?—Yes, I have been on it.

2618. You took off a considerable quantity of gravel yourself, I believe, for the purpose of making a walk on the shore?—I have taken off many a score of boat loads of gravel to make a walk along the bank of the Thames, and a causeway to the ship.

2619. From 1848 you have known Barking town itself?—Yes.

2620. Was there, when first you knew it, any discharge of sewage from Barking town into the creek?—There was a sluice up at the town quay that ran into the creek.

2621. That was there in 1848?—Yes.

2622. And we know it is there now?—I believe it is there now.

2623. Were dung barges in the habit of plying from 1848 to the quay frequently?—Yes, and they discharged their manure on the top of the quay.

2624. You were there at the time the metropolitan northern outfall sewer was opened?—Yes.

2625. And you were pretty near it?—Yes, close to it.

2626. Did that cause you any annoyance to speak of when you were in the ship?—Very little; sometimes when the wind was blowing from the westward we had a smell from it; but nothing to speak of.

2627. Could you see the London sewage going down the river Thames from where you were?—Yes.

2628. Was it the practice all the time you were there to let it out on the ebb tide?—They used to open the sluices at a certain time on the ebb tide and close them again on the flood.

2629. From the year 1866 you have been at Woolwich Arsenal?—From the year 1866 I have been at Woolwich Arsenal.

Cross-examined by Mr. Lloyd.

2630. What was your exact duty?—Our duty was to protect the revenue.

2631. You were on the look-out?—We were on the look-out.

2632. You had nothing to do of course with the state of the Thames itself?—Not the least.

2633. That was no part of your business?—No.

2634. Do you know whether coal barges still continue to go up Barking Creek?—Yes; there used to be coal barges come down from London and go up the creek.

2635. And there are still coal barges there, are there not?—That I do not know; I left in 1866. I do not know what the trade of the town has been since 1866.

2636. They were occasionally going up in 1866?—Yes.

2637. You remember before 1862 what sized coal barges did go up the creek?—Do you mean coal barges or coal ships?

2638. Coal barges, a vessel that takes coal up to the wharves.

(*Sir J. Karslake.*) He draws a distinction between a barge and a ship.

2639. (*Mr. Lloyd.*) What do you mean by a barge?—I mean a barge that plies on the Thames to and fro, but a ship is a vessel from the north that brings coal to Barking.

2640. I mean a large river vessel?—I have seen barges carry about 100 tons, but they do not usually draw more than 4 or 5 feet of water.

2641. Have you seen vessels of as much as 300 or 350 tons?—Not barges that ply on the river. I have formerly seen sea-going craft going up the creek with a burden of 250 to 300 tons.

2642. You have seen sea-going craft go up the creek of from 250 to 300 tons?—Yes.

2643. Do you remember that they went straight up from the river Thames up Barking Creek though not up to the quay?—They used to ride in the Thames outside till a certain time of the tide, until there was water enough for them to put into the creek so that they would make the journey up to the town, if they possibly could.

2644. Do you know whether they are able to do that now, or whether they were able to do it in 1866?—I have not been there above twice since 1866.

2645. Up to that time—up to 1866?—Before I left in 1866 they could go up as well as ever they could.

2646. Are you quite sure of that?—Yes, before 1866.

2647. You speak of that from your own personal observation, do you?—Yes, I speak of that from my own personal observation.

2648. You mean to state that positively?—Yes.

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2649. That vessels, drawing the same number of feet of water, could go up when you left in 1866 as always went up?—Yes.

2650. And not have to wait longer outside?—No.

2651. And there was no bar formed, no deposit at all, at that time, by the side of the Horse End?—Not in 1866.

2652. Are you quite sure of that?—Yes.

2653. When did you go to that shelf last before you left?—The last time was about four or five months before I left, in 1866. I was on the shelf then.

2654. Did you see any difference at all then?—No.

2655. There was no mud there?—No.

2656. None whatever?—No.

2657. Are you quite certain of that?—Yes.

2658. There was not a mud bank formed at all in front of the shelf and opposite the creek's mouth?—No, there was no mud bank. There was the same depth of water, so far as I could see; and there was only the shelf and the Horse End shoal.

2659. Just the same as ever?—The same as ever.

2660. You have not observed any formation of deposit to the extent of six or seven feet, or anything of that kind beyond what there was?—Not in 1866.

2661. Nor up to that time at all?—No.

2662. There was no tendency, apparently, to any accumulation of mud there?—No.

2663. Have you seen it since 1866?—I have been once there; at least, I have been twice down there since 1866. I was down there on the 15th of July, about an hour before low water.

2664. This July?—Yes.

2665. What did you go for?—I went down the creek to come to Barking on this inquiry.

2666. Who took you there?—I went down in a waterman's boat, along with Mr. McDougall.

2667. Did you examine that shelf then?—No.

2668. When did you last examine the shelf to see what state the bank was in?—About four or five months before I left in 1866.

2669. Not since that time?—No.

2670. As to Mr. Lawes's manure factory, you cannot tell us when it was first put up?—No, I forget the date.

2671. Can you give us any approximate idea when it was?—No, I cannot exactly say.

2672. When did the smell from Mr. Lawes's factory begin to annoy you?

(*The Commissioner*). Will you ask him whether he was one of the persons who walked down the creek?

2673. (*Mr. Lloyd*). Were you one of the persons who walked down the creek?—No.

2674. When did the smell begin to annoy you?—From Mr. Lawes's manure factory, 18 months or so after it commenced.

2675. That was before the London sewage was poured into the Thames?—Before the sewage commenced.

2676. Did you perceive any addition to the offence at all at a later period?—Yes; on account of their extending their premises there was more smell, because there was more acid to make.

2677. How did you know it came from Lawes's works?—From the smell of the different acids.

2678. You smelt nothing else?—No.

2679. You say you have seen the London sewage going down the river?—I have seen the sewage matter going down the river Thames of a different colour to the river water.

(*The Commissioner.*) Will you allow me to point out before you pass away from Lawes's manure factory (because it has been neglected to be stated up to this time), Mr. Lawes has been repeatedly talked of as a manure manufacturer only, but he also manufactures very largely sulphuric acid, which occasionally gives off very strong fumes.

2680. (*Mr. Lloyd.*) That is what I understand—that it was the acid you smelt, pyroligneous acid and sulphuric acid?—Yes.

(*Mr. Philbrick.*) Mr. Lawes also uses coprolites.

(*The Commissioner.*) But he also makes sulphuric acid to a large extent.

(*Sir J. Karslake.*) I daresay you have the report made by Dr. Letheby upon this factory.

(*The Commissioner.*) Yes. I know as a fact that Mr. Lawes has added to his artificial manure manufactory the manufacture of sulphuric acid. He uses it in his trade, but manufactures it largely for sale as well.

2681. (*Mr. Lloyd.*) When was it that the premises were extended?—Mr. Lawes has been extending them every year since they were first commenced. They were very small when they first commenced, but have got to an enormous size now.

2682. Have you traced the London sewage matter going down the river and discolouring the Thames, water?—I have not traced it, only as it passed the creek.

2683. In what direction was it going then?—It was going down the Thames.

2684. On what side?—As it was let out from the reservoir it was going about half stream across.

2685. And then what became of it?—It was going away down the Thames. We did not take any particular notice of it, no more than seeing it go past the station.

2686. (*The Commissioner.*) Did you ever row down in the stream upon the line of the sewage current after it was liberated?—No.

2687. (*Mr. Lloyd.*) Do you know at all the report or certificate Dr. Davidson gave?—I know Dr. Davidson.

2688. He was attending to the health of the men in the ship, was he not?—Yes.

2689. Do you know that he made a report that the London sewage was unhealthy.

(*Sir J. Karslake.*) If you are going into that you must produce the report.

2690. (*Mr. Lloyd.*) Do you know that such a report was made of your own knowledge?—I do not understand.

2691. Do you know that Dr. Davidson made a report or gave a certificate that the matter from the London sewage was unhealthy, and that it was necessary to remove the vessel?—I never knew that Dr. Davidson made such a report.

2692. You never heard of it at all?—No.

2693. Was it the fact that there was anything at all perceivable from the sewage when Dr. Davidson was attending you?—Not to my knowledge.

2694. You never heard a word of it?—No.

2695. Your notion is, that the vessel was removed in order to give you a better view of the river?—That was what the ship was removed for.

2696. How do you know that?—Because I made a report.

2697. Have you got it with you?—No.

2698. To whom did you make it?—To the inspecting commander.

2699. Then upon that report it was removed?—Yes.

2700. You know that?—Yes.

2701. Who told you so?—The inspecting commander told me it was removed in consequence of that.

2702. What is his name?—Captain Cockcraft.

2703. That is all you know about it?—Yes.

2704. Are you quite sure then that there was no offensive smell from the London sewage matter?—There was no offensive smell to us from the London sewage matter.

2705. Where were you lying at the time?—We were hauled on the Thames bank, in the entrance to Brking creek.

2706. At that time there was nothing offensive at all?—There was nothing at all offensive to us; to the crew there was nothing offensive from the London sewage.

2707. That you are positively able to state?—Yes.

2708. And no complaint of anything calculated to affect the crew's health, or anything of that kind?—Nothing to my knowledge.

2709. Who has brought you here?—I have been brought here by the Metropolitan Board of Works I believe.

2710. When did they apply to you first?—I will show you the first letter I got——

2711. Let me look at it?

(*Witness.*) May I let him see it?

(*Sir J. Karslake.*) Let him see it by all means. What is the date?

(*Mr. Philbrick.*) It is in evidence now.

2712. (*Mr. Lloyd.*) This is from Mr. Smith, the solicitor?—Yes.

2713. Who pays your expenses?—I do not know yet who is to pay them. I suppose some one will pay me when I have done. I have been walking about and lost five days' work.

2714. What is your work now; what are you working at?—Sometimes I am painting; sometimes one thing and sometimes the other; different things.

2715. Do you know anything of chemistry?—No.

2716. You never tried the mud at all, I suppose?—No.

2717. There was no mud to try?—There was always mud on the banks of the Thames.

2718. You never tried any mud at the mouth of Barking Creek?—Yes; there was always mud on the Horse End.

2719. What sort of mud?—The general sort of mud you see floating in the Thames and on the Thames banks.

2720. Not black at all?—Yes, it was black.

2721. Did you ever try any of it?—No, I never tasted any of it, because it was rather too offensive to taste.

2722. Did you ever smell any of it?—No; no more than what I would from any other part.

2723. Did you see anything floating about on the surface at all?—Yes, at times.

2724. What was it?—I have seen a little bit of nature floating about at times.

2725. Whereabouts?—In different places.

2726. Do you know that bight or bit of bay opposite Barking Creek's mouth?—There is no bight opposite Barking Creek's mouth.

2727. On the same side of the river?—On the same side of the river cannot be opposite the creek's mouth. It must be either higher up or below.

2728. Is there a bight there at all?—I do not know any bay, without you go up to Gallions, above the sewer, there is a bay there.

2729. There is none below the jumping station?—If you go below, you must go below Mr. Lawes's factory to get into another bight or bay.

2730. Just answer my question. Is there not a bight or bay in which there is an eddy of water?—Yes, above the sewer.

2731. None below?—No.

2732. And that you state positively?—Yes.

2733. You never saw any mud floating about there?—No.

2734. Are you sure there never was any?—I never saw any.

2735. You never saw anything like an acre of corks or anything of that kind?—No; I do not remember ever having seen an acre of corks. I have seen a few corks floating about.

2736. Where?—In the different sets of the tide way.

2737. Was not one set near Barking Creek?—I have seen a few of them coming into Barking Creek.

2738. You have seen a few of them coming up with the tide into Barking Creek?—Yes.

2739. Did you ever see anything but corks, any grease or scum?—I have seen a few children's toys of all descriptions.

2740. Dolls and all sorts of things?—Yes.

2741. And something of nature you said also?—Something of that along with it.

2742. And great quantities of paper?—I never saw much paper floating about.

2743. Any dead dogs or cats?—Dead dogs and cats you will see about the Thames in any part of it.

2744. There were none particularly in that bight?—No more than you would see in any other part of the Thames.

(*Sir J. Karslake.*) This letter fixes the date at which he was applied to, (the 25th of June 1869); perhaps you will take the date, because you will see there is a reason for it.

2745. (*Mr. Lloyd.*) You never lived at Barking town?—No.

2746. You never were nearer to Barking to live than your vessel; you lived on board the vessel?—I always lived on board.

2747. (*Sir J. Karslake.*) What other men lived on board with you?—There was one man there of the name of William Dean, commission boatman, he lived with me.

2748. (*Mr. Lloyd.*) Is the captain you spoke of alive?—I believe he is.

2749. When did you see him last?—I have not seen him since 1862 or 1863, or 1864.

2750. Give me his name again?—Commander Cockcraft.

Re-examined by Sir J. Karslake.

2751. You lived on board this coast-guard vessel?—Yes.

2752. From 1848 till 1866?—From 1848 till 1866

2753. When the vessel was moored off Barking Creek, how far from the shore at high water was she moored?—She was not moored off the creek; she was hauled in so that she would ride. Sometimes she did not float at all. She was hauled on to the Thames bank, so that there was a stage from the ship to the shore.

(*The Commissioner.*) Will you point out on the chart where the vessel was?—(*The witness pointed it out between Mr. Lawes's factory and the "Crooked Billet."*)

2754. (*Sir J. Karslake.*) She was moored with her head towards the manure factory?—Yes, right in to the bank.

2755. The mooring post was on the bank?—Her anchors were ashore in the "Crooked Billet" public-house yard.

2756. You were just out of the channel up which vessels would go, were you?—Yes.

2757. Did you remain there all the time till you were removed by Captain Cockcraft?—All the time.

2758. Did you see Captain Cockcraft personally about moving the vessel?—Yes.

2759. I suppose he came round from time to time and inspected you?—He visited us four times a month.

2760. Was your complaint about not being able to see up the river made to him personally?—Yes.

2761. And he told you that that was the ground upon which you were removed?—Yes.

2762. (*Mr. Lloyd.*) When did he tell you that?—The last time he made the inspection.

2763. When was that?—I do not recollect the date when it was.

2764. Tell us as near as you can?—

2765. (*Sir J. Karslake to the witness.*) Did Captain Cockcraft state this to you, or did you state to him that you wished the vessel removed on the grounds you stated?—I stated to him that we wished to be removed on that account.

(*Mr. Lloyd.*) You have not answered the other part of the question.

2766. (*Sir J. Karslake.*) What did he say to you in answer to that?—The answer he made to me was,

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that he had made that report, and that was the reason the ship was removed.

2767. (*Mr. Lloyd.*) When was that?—It was just before the ship was removed.

2768. What date was that?—I do not recollect the date.

2769. What year was it?—It might have been 1863.

2770. (*Sir J. Karslake.*) Do you recollect the year when the ship was removed?—In 1866. The complaint was made several years before the removal of the ship.

2771. (*The Commissioner.*) You say it was in 1863?—In 1863 I made the report.

2772. (*Sir J. Karslake.*) How long before the vessel was actually removed was the last complaint made by you—the conversation between you and Captain Cockcraft?—I think between 1864 and 1865.

(*Mr. Lloyd.*) He said just now he had not seen him since 1864.

2773. (*Sir J. Karslake.*) When was your vessel removed?—The vessel was removed in June 1866.

2774. Had you heard anything about the cause of her removal between the time you spoke to Captain Cockcraft and the time of the vessel being removed?—Yes, that was the cause of the removal.

(*Mr. Lloyd.*) You do not answer the question.

2775. (*Sir J. Karslake.*) Did you hear anything more from Captain Cockcraft between the time you spoke to him, about 1864, and the time of the removal of the vessel in 1866?—No.

2776. You only knew she was removed?—I only knew she was removed.

2777. Have you yourself made any complaint at all to Captain Cockcraft about the London sewage coming from the outfall?—None whatever.

(*The Commissioner.*) What date did they open their sluices?

(*Sir J. Karslake.*) In August 1864.

(*The Commissioner.*) The vessel was removed in 1864.

(*Sir J. Karslake.*) No; 1866. He said he had made several complaints about being shut out of the sight, and the last complaint was in 1864, and they were removed in 1866.

2778. (*The Commissioner.*) When did Mr. Lawes begin to extend his works?—He has been extending his works every year from the first time he commenced. He is extending his premises now.

2779. As well as blocking you out in 1866, did not you suffer any inconvenience from the smell that came from Mr. Lawes' works?—Yes.

2780. Then there might have been that representation as well as blocking out the view?—There might have been that representation as to the manure factory as well as what was said as to shutting out the view.

2781. The captain may have stated to the Conservancy Board that he wished to remove the vessel, both on account of the view being blocked and on account of the bad smell from the manure factory?—Yes.

2782. (*Sir J. Karslake.*) Had you to go on the bank for the purpose of looking out down the river?—Yes.

2783. It was when you were on the bank that the extension of the factory buildings prevented your view?—Yes; and from the ship as well.

2784. That would be only at high water, from the ship?—Yes, low water and all; because it was very seldom the ship floated, unless it was a lofty spring tide.

2785. She was high, and aground on the bank?—She was so high on the bank.

2786. Did you know, not only the shoal, but what is called the Horse End bank all the time?—Yes.

2787. Did you observe in 1866 whether the Horse End bank had materially increased?—No.

2788. Do you believe it had?—No; I did not see any difference in it from what it was.

2789. It was always mud?—It was always mud.

(*Mr. Lloyd.*) He said it was shingle.

2790. (*Sir J. Karslake.*) That was a totally different thing. The shoal and the Horse End are two totally different things. How far from you was this shelf—this hard bank you speak of?—That was off in the Thames.

2791. How far from the mouth of the creek?—I do not know.

2792. Is it rightly put on that plan?

(*The Commissioner.*) It is just opposite Mr. Laws's works.

2793. (*Sir J. Karslake.*) Would that be about the position in which it was in your time?—That is about the distance.

2794. That you say was always hard shingle?—It was always hard shingle.

2795. You said that in 1866 vessels went up the creek as well, in your judgment, as they did at any time since you have known the place, from 1848?—Yes.

2796. Do you adhere to that; did you see any difference whatever in the size of the vessels?—I did not see any difference in the size of the vessels, nor in the navigation.

2797. When you saw it the other day, on the 15th of July, did you see any difference or any considerable difference between the state of things in 1866 and what they are now?—Yes, the creek since then has made a different entrance.

2798. Between 1866 and now?—Yes.

2799. In what way is that, where was the entrance?—The creek ran out straight, instead of that there is an angle formed now. It has taken off nearly 20 feet from the Horse End.

2800. (*The Commissioner.*) The Horse End has shoaled further out across the creek's mouth, has it not, down stream?—No; I do not know that it has gone out further down stream than before. The creek has taken a different turn, the creek, instead of running out straight has taken an angle.

2801. And the Horse End shoal has turned it in that angle?—I do not know that the Horse End shoal has turned it in that angle.

2802. (*Sir J. Karslake.*) At all events you see a difference between what you describe now, and what it was in 1866?—Yes.

2803. What were the craft chiefly that went up before 1866, when you were there?—Fishing smacks and colliers.

2804. Were the fishing smacks you speak of going up to refit?—To refit.

(*Mr. Lloyd.*) I did not cross-examine upon that.

2805. (*Sir J. Karslake.*) And the colliers, what did they go up with?—They took up coals.

2806. Were those sea-going vessels?—They were sea-going vessels.

2807. Just a question about your interest. Have you any interest whatever in this inquiry?—No.

2808. Did you go up to Mr. Smith's office when he asked you to come up?—Yes.

2809. How are you paid now, by the day; I mean when you are engaged at Woolwich Arsenal?—Yes, by the day.

2810. You are a pensioner and you work by the day, and are paid by the day?—Yes.

2811. You say you have lost five days' work by this inquiry already?—Yes.

2812. (*Mr. Lloyd.*) Do you know how they came to find you out?—Some gentleman went aboard the ship to inquire, I suppose.

(*Sir J. Karslake.*) Dr. Davidson's evidence was on the 21st of June, and this letter was written on the 25th.

2813. (*The Commissioner.*) Did the berthing of your vessel at all inconvenience the entrance of craft into Barking Creek?—Not in the least.

2814. You were not removed on that account?—No.

Mr. William Deay called; examined by Mr. Philbrick.

2815. Are you on the coastguard station at Plumstead?—Yes.

2816. Where you in the coastguard vessel when she was moored in Barking Creek?—Yes.

2817. How many years were you there?—I came there the 4th of April 1860.

2818. You left with her when she went across the river?—No, I did not go across the river with her; this is a new vessel, the old one is condemned.

2819. You went on the same station in the new vessel across the river?—Yes.

2820. Mr. Tobey was your superior officer?—Yes.

2821. When you were there?—Yes.

2822. During the time you were there did you experience any nuisance or annoyance from the London outfall sewage works?—Not at all—not to annoy me; there was a little smell; when the wind was from the westward we had a little smell.

2823. Were there any other smells there?—No smell from the westward, only Mr. Lawes's manure factory; that would smell when the wind was from southward and eastward.

2824. Was that a strong smell at times?—It was a very strong smell; it affected my eyes, and if you were talking at the time you would have some acid falling on your tongue that would affect your mouth.

2825. The fumes of the acid did not suit your sight?—No.

2826. Had you any medical advice, or did any doctor attend you for that?—I never applied to anyone for that, but I asked Dr. Davidson if he could see any difference in my eyes, and he told me my right eye was getting very bad.

2827. You spoke to Dr. Davidson about it?—Yes; but that is since we have been over on the other side.

2828. Do you still feel the fumes on the other side at times?—We can smell it, but not so bad, because we are further distant.

2829. Do you remember Mr. Lawes's works being extended and increased?—They have been extended greatly since I have been there.

2830. During the last nine years?—Yes.

2831. Do you remember their being so extended as to impede the view down the station?—Yes.

2832. Did you ever make any complaint of that?—No, I never made any complaint.

2833. Was any complaint ever made by you or to your knowledge of the effects of the London sewage discharge upon yourself or the men in the coastguard station?—None at all that I am aware of.

2834. Was Dr. Davidson ever consulted by you or by any of the men there to your knowledge upon any nuisance supposed to arise from the London sewage works?—No.

(*Mr. Lloyd.*) Dr. Davidson is alive, is not he?

(*Mr. Philbrick.*) You had him once.

(*Sir J. Karslake.*) You called him and we have called these men in consequence.

2835. (*Mr. Philbrick.*) As long as the coastguard ship remained in Barking Creek, to your observation, was there any difference in the navigation of the creek by the vessels that went up it, barges and other craft?—No; it is, I believe, within these last 18 months or two years that there has been an alteration at the entrance of the creek's mouth.

2836. What alteration is it you have noticed?—The alteration is this. Say this is the wall: I could go in there at low water and lay our boat and step out on the stones on that wall. Now, in consequence of the entrance of the creek being I do not know how many feet, but I should say 16 to 18 feet further this way, it is impossible for you to land at low water.

2837. Are you speaking of the Horse End or the shelf?—The Horse End, at the entrance to the creek.

2838. Does that appear to be mud?—It is all mud.

2839. The same kind as there is up the creek?—I have not seen any difference.

Cross-examined by Mr. Lloyd.

2840. Can you tell what has caused the current to be diverted so that the creek flows out at a different angle from what it did before?—At the creek's mouth?

2841. Yes.—My opinion is there has not been so much backwater from the creek as there used to be.

2842. Is not there something prevents it going straight out now?—Not that I am aware of.

2843. Why should it have turned in that way, do you think; why should it make an angle?—If now there was as much backwater came out of the creek as there used to be two or three years ago, all this mud alongside this wall would be continually swept away, and the entrance would be the same as ever it was—that is my opinion.

2844. There is nothing formed in front that would turn it aside; there is no bank formed?—Not that I am aware of.

2845. When did you see the bank last?—In fact I see that every spring tide; of course when there is a spring tide at low water it is left dry; but unless it is a spring tide it does not dry.

2846. Is it the same as it always has been?—I have not seen any difference.

2847. Either in situation or addition to it?—I have not been there to make inspection of it, but I am looking about the river all day when on duty, and I can take my glass and look at the shelf, and I see it just the same as ever.

2848. You look at it through a glass?—Yes, and if I happen to be there in a boat at low water of spring tides at the time it is dry I can see it without a glass.

2849. Is there any mud on the shelf?—Not that I am aware of.

(*The Commissioner.*) There is no allegation about the shelf having been affected by anything done.

(*Mr. Lloyd.*) There is a bar formed.

(*The Commissioner.*) Not upon the shelf.

2850. (*Mr. Lloyd.*) Perhaps I am mistaking the position of things. Is there no bar of mud at all formed at the mouth of the creek now?—Not that I am aware of.

2851. You never saw any?—No.

(*The Commissioner.*) I think the "shelf" and the "shoal," both of which are in the Thames, are admitted to be in the condition they were in formerly; the accumulation of mud spoken to is more inshore.

2852. (*Mr. Lloyd.*) What I want to ascertain is this: Is not there a bank of mud formed more inshore?—Not that I am aware of. It always was the same ever since I knew it at low-water spring tides. If you went there at dead low-water spring tides you would get your boat aground outside the creek's mouth 50 or 60 yards distant.

2853. Have you lately seen that part?—I have not visited it at low water.

2854. Are you able to say positively one way or the other whether there is or is not a bank of mud formed?—I do not know that there is.

2855. Are you able to say that there is not?—I have never seen any, therefore I cannot say that there is.

2856. If there had been you must have seen it, I suppose?—I do not know, it is seldom we go over there at low water now, it is not the same as it was when I was stationed on that side; we were always there then from low water to high water. Now, being stationed on the opposite side, very likely we do not go afloat till it is half an hour or an hour's flood, and when we get over there it might be an hour's flood.

2857. Then you do not know whether there is a bank of mud formed there or not?—No; I do not know whether a bank of mud is formed or no.

2858. What did you mean when you said within the last 18 months or two years there was a bank of mud formed?—That is not outside the creek.

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2859. What did you mean by that then; what had formed within the last 18 months or two years?—I tell you this is the wall (*indicating the position by his finger*); here is the entrance of the creek. This goes in the creek; this is the wall or river bank; we formerly could put our boat in here at low water and step out on the stones. Now the mud has accumulated here some 12, 14, or 16 feet; I cannot say exactly how much; and now it would be impossible for you to step out in consequence of the entrance of the creek being *here*, whereas it used to be *here*.

2860. Did you ever try to step out at low water from near the creek's mouth on to the bank?—Not lately; not since we have been removed on to the other side.

(*The Commissioner.*) That accumulation of mud is within the creek, and parallel with the creek wall, opposite Mr. Lawes's works.

(*The witness.*) That is in the creek, opposite Mr. Lawes's works.

(*The Commissoner.*) And parallel with that wall, he says, they used to land there high and dry. The witnesses from Barking said the same, that they could put their boat on shore and step out on to hard bottom where now they say there is an accumulation of two or three feet of mud.

2861. (*Mr. Lloyd.*) I only want to know whether you could say that there is two or three feet of mud directly you get on to the bank?—It would prevent a person getting on to the bank now at low water.

2862. Do you know the difference of smell between sewage and acid; I mean acid such as you get from Mr. Lawes's factory?—Yes, any person can tell the difference. I can tell the difference in smell of any factory right down the river.

2863. You have smelt something at times besides the acid from Mr. Lawes's factory?—Of course, I have smelt the London sewage. I do not deny that; but not to annoy me.

2864. Was it pleasant to smell?—I should not say it was.

2865. Did you ever try to sound it at all?—No.

2866. Did you ever try the depth of it by bringing it up with your oar or anything of that kind?—No, I did nothing of that kind.

2867. When did you first perceive this sewage smell?—I cannot tell you the date; but it was not long after the London sewage commenced running.

2868. Did it increase in intensity and get worse?—No; I did not take notice of any difference from the time it commenced till I left.

2869. It continued to smell?—We never smelt it, only when the wind was from the westward which blew it over our ship, and then we never smelt it running out into the river; it was when the ventilators were up on the top of the sewage reservoir; then if the wind was in the right direction we could smell the sewage.

2870. Did you ever send for the doctor at all about it?—No.

2871. Any of you?—No.

2872. You know nothing about the coal barges that go up the creek?—I have seen several coal barges go up.

2873. Have you seen coal vessels of 250 or 300 tons go up the creek?—The largest barge I ever saw go up the creek was one of 105 tons register.

2874. Sea-going vessels I am asking you?—She was a sea-going vessel.

2875. A collier?—A collier.

2876. That was the largest you ever saw go up?—Yes, a vessel of 105 tons register.

2877. You are sure that was the largest?—That was the largest barge I ever saw go up.

2878. I asked you the largest sea-going vessel you have seen go up?—She was a sea-going vessel.

2879. I ask you now of colliers—not barges?—It is no use to have any altercation about it, it was a barge.

2880. Is that the largest coal vessel you have ever seen go up?—No.

2881. What was the largest coal vessel you have seen go up?—I cannot tell you her tonnage; I know some have gone up of 180 or 200 tons, and they might be more.

2882. They might be 250 or 300?—I should not think they were 300, but I do not know exactly.

2883. Have you seen one such vessel come up lately?—There was one the week before last.

2884. Was her name the "Abdiel?"—I do not know her name.

2885. What did she draw?—I do not know.

2886. What was her tonnage?—I do not know; I did not happen to be there at the time. I could have answered all these questions if I had known what you were going to ask me.

2887. How did you know she went up?—Because I could see her.

2888. How was it you saw her if you were not there?—I could see her from our station go up the creek.

2889. You did not know what vessel she was or what her tonnage was?—No.

Re-examined by Sir JOHN KARSLAKE.

2890. Part of your duty is to watch these vessels?—Our duty is, to protect the revenue. We have to be afloat on the flood-tide, to board any vessels we think proper. If we have any suspicion of any kind we can board vessels.

2891. If you thought a vessel was going up into Barking with a little tobacco you would soon be after her?—We should soon be after her; I should like to find one with five tons of tobacco in her.

2892. As I understand you, it was not when the London sewage was going down the river that it annoyed you, but when the ventilators were open?—That was the most we smelt.

2893. Have you been on the sewage outlet works yourself?—I have, and in the sewage reservoir.

2894. When you were talking of a barge, you meant a barge-rigged vessel?—She was barge-rigged and barge built.

2895. However, she could go to sea?—She did; she came from Newcastle with coals.

2896. Let us get right as to these different banks. Has what is called the Shelf, which is outside Barking Creek, and in the Thames, been in the same state as far as you know ever since you recollect it?—It has.

2897. It is hard gravel and shingle?—It is hard gravel and shingle.

2898. Did you assist the last witness in making the path which he referred to?—No, the path was made before I come there.

2899. When first you remember the place, was there a Horse End bank?—Yes; just the same as there is now.

2900. Has an alteration taken place in the course of that bank of late?—I believe the Horse End has extended a little further out; it has got larger.

2901. You used to lie, as we know, on Mr. Lawes's side of the creek?—Yes.

2902. Was it there where you say you could land from a boat at low water?—Not quite abreast of our vessel, before we got to our vessel.

2903. Before you got to your vessel you could land upon that which was clean?—It was the wall; there was a lot of stones, and you could step out on the stones.

2904. Is it in the same state now as it used to be?—It is in the same state as it used to be, except this mud.

2905. So far as stones are concerned?—Yes.

2906. It was banked up with large stones as now?—Yes.

2907. You say lately there has been more mud upon that side than there was in your time?—Yes.

2908. What do you attribute that to yourself, as far as you can judge?—On account of there not being so much backwater coming out of the creek.

2909. Was the vessel in which you used to lie in Barking Creek done away with, and another put on when you went across to the other side of the Thames?—Yes.

2910. A new vessel?—Yes.

2911. What became of the old vessel?—She was sold to Mr. Myers, of Southend, and he broke her up.

JAMES BROWN called.

2912. (*Sir J. Karslake.*) I think you live at Fisher Street, Barking?—Yes.

2913. Are you a barge owner?—No.

2914. What are you?—A waterman and lighterman.

(*Mr. Lloyd.*) If there is no objection we should like to have these witnesses sworn.

(*Mr. Philbrick.*) I thought we agreed not to do it.

(*Mr Lloyd.*) At any rate, I should like to have this witness sworn.

(*Sir J. Karslake.*) I have not the least objection.

(*A Testament was sent for.*)

Mr. ANDREW WISE called; examined by Sir JOHN KARSLAKE.

2915. I believe you are a surgeon and physician?—Yes.

2916. Where do you live?—In Plumstead.

2917. Do you attend the workpeople living at the outfall?—I do.

2918. How long have you attended them?—Three years.

2919. About how many are there there?—54 men; in all I think about 160 persons.

2920. Many of them children?—Yes.

2921. Have you found, since you have been in attendance upon those people, that they have experienced any ill effects from the discharge of the London sewage at the southern outfall?

(*Mr. Lloyd.*) I thought the question of the sanitary effect of the discharge of the sewage was not to be gone into upon the present inquiry.

(*The Commissioner.*) Yes; I have stated that I am shut out from going into the health question.

(*Sir J. Karslake.*) But this is not with reference to Barking town.

(*The Commissioner.*) No, but I have decided not to go into the health question. If this health question arises after my report, the Secretary of State is under a promise to investigate it by a medical officer.

(*Sir J. Karslake.*) I only hope it will be remembered that we have tendered this evidence at this time; it does not refer to Barking town. It is in the immediate vicinity. Questions have been asked of the last witness as to whether he did not suffer annoyance from the sewage smell, and so forth, and this is a witness from the immediate vicinity.

(*The Commissioner.*) I do not think it would have any weight in this case. I do not think it is anything to the point. With regard to smells, and with regard to nuisances affecting human health, I could get you evidence from places twenty times worse affected than Barking is alleged to be where persons enjoy, or say they enjoy, good health.

(*Sir J. Karslake.*) All I would point out is this, that one of the main questions, as I understand, that is referred to you arising out of this memorial is, whether these main sewerage works are a nuisance. It is not a question whether there is a smell; the question is whether it is a nuisance injurious to health, as in point of law it is a very different thing whether a smell comes from particular works, or whether the smell is of that character as to create a public nuisance.

(*The Commissioner.*) I am expressly shut out from going into the health question. The Secretary of State is under a promise, if the persons who sent this memorial to him are not satisfied that the matter has been fully inquired into as regards the health portion of the subject, to institute another inquiry upon that special question.

(*Sir J. Karslake.*) I do not propose to call people from Barking itself.

(*The Commissioner.*) The Home Secretary declined to nominate a medical officer to sit with me.

(*Sir J. Karslake.*) That person, whoever he might be, if subsequently nominated, would go down to Barking, and would not go into any inquiry beyond Barking itself. I do not propose to offer any evidence to you upon that subject, but the evidence I propose to offer is that of people living at the main sewer outfall itself.

(*The Commissioner.*) In the fourth allegation the memorialists say "The filth and refuse of the largest "city in the world is concentrated in all its horrors "and abominations in the immediate vicinity of the "dwellings of your memorialists." That goes to the dwellings of the Barking town memorialists. Now you are going to give evidence as regards the dwellings and health of the servants of, if I may so call them, the defendants. Why they should defend in this manner I do not know.

(*Sir J. Karslake.*) Defend what?

(*The Commissioner.*) That is to say, I do not know why they should attempt to show that the sewage smell does not affect the health of their own servants. I do not see what direct bearing it has on the question I have to inquire into as regards the residents in the town of Barking.

(*Sir J. Karslake.*) It has not yet been pointed out where those dwellings are, in the immediate vicinity of which the "filth and refuse is concentrated in all its "horrors and abominations."

(*Mr. Lloyd.*) Yes, it has.

2922. (*Sir J. Karslake.*) It was said generally that they were not in Barking town, but away from Barking. (*To the witness.*) Is the southern outfall in the parish of Barking?—No, I believe not, I believe it is in the parish of Erith.

(*Sir J. Karslake.*) This gentleman is from the other side. We have already given some evidence from Mr. Barnes and others as to the state of things on the northern side. This is from the southern side. If you think it is not evidence which you ought to take, we will not press it.

(*The Commissioner.*) I would rather keep free from evidence on the health question altogether.

JAMES BROWN again called, and now sworn; examined by Sir J. KARSLAKE.

2923. You say you are a lighterman and boat-owner?—No, not an owner; I am a waterman and a lighterman, and occasionally I pilot into Barking Creek.

2924. Have you known Barking and the neighbourhood for many years?—Yes, for about 15 or 16 years I have been at work on the river.

2925. First of all, let me ask you a question about the shelf; you know that "shelf" in the Thames, outside Barking Creek?—Yes.

2926. Has that been in the same state ever since you have known it?—Yes, always a hard bottom.

2927. Have you and others in your presence used it for berthing and cleaning boats upon?—Yes, not longer ago than a fortnight.

2928. At low water?—Yes.

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2929. Spring tides ?—No, we used it when the tide was ebbing about 4 o'clock.

2930. There was sufficient dry space left to enable you to haul up your boat and clean it ?—Yes.

2931. Has it been always of that character ever since you have known it ?—Yes.

2932. Have you lately brought a vessel into Barking ?—I have not brought a large vessel in for three months.

2933. What was the largest vessel you brought in three months ago ?—272 tons.

2934. What was the name of that vessel ?—It was a vessel called the "Impetuous."

2935. What was she laden with ?—Coals.

2936. (*The Commissioner.*) Drawing how many feet of water ?—12 feet 8.

2937. What tide was it upon ; was it a spring tide ?—Yes.

2938. (*Sir J. Karslake.*) That was the "Impetuous ?—Yes.

2939. (*The Commissioner.*) What was the date ?—I could not tell you the date within a week. I never kept account of the date.

2940. (*Sir J. Karslake.*) About how long ago ?—About three months ago. If I had known that you wanted to know the date I could have brought it up with me from Barking.

2941. Did you get her up to Barking ?—Yes, within about 60 yards of Mr. Davis's wharf, where I lightened her about 92 tons.

2942. Did she then come up to the quay ?—Yes, alongside the quay.

2943. Have you brought other vessels up there ?—Yes, I have brought both square-rigged craft and fore and aft-rigged craft.

2944. When did you first begin bringing them up ?—Do you mean sailing vessels ?

2945. Yes, any sort of sailing vessels ?—I took charge of a barge 12 years ago.

2946. That was the first time you took charge of a barge ?—Yes, Mr. Clarke was the owner of that barge.

2947. Have you been in the habit of bringing vessels up from time to time ever since ?—Yes.

2948. Every year ?—Yes, both for Mr. Hewitt's firm and Mr. Morgan's firm too.

2949. The vessel you referred to, the "Impetuous," was laden with coals ?—Yes.

2950. For whom was she ?—Mr. Davis.

2951. (*Mr. Lloyd.*) Davis or Davison ?—Davis.

2952. (*Sir J. Karslake.*) Who owned the vessel ?—I cannot say.

2953. It was a cargo of coals that was bought afloat, I suppose ?—Yes.

2954. Where did you first take charge of the vessel ?—Outside the mouth of the creek.

2955. Do you remember when the Essex Reclamation Company were carrying out their works, that there was a timber dam in the creek ?—Yes, a coffer dam.

2956. First on one side, half over the waterway, and then on the other, I believe ?—Yes.

2957. Did you observe whether that produced any effect on the creek ?—Yes.

2958. What effect did it produce ?—I believe that was the instigation of the mud gathering on the Horse End, and likewise at the lower part of the creek.

2959. Had you observed the mud before that time ?—Yes.

2960. Had you observed the mud gathering before the coffer dam was put there ?—No, not on the lower side of the creek, but ever since I can remember, the Horse End shoal has been growing up.

2961. Increasing ?—Yes.

2962. Do you see any alteration in the mouth of the channel now from what it used to be ?—There is a little mud in the mouth of the creek where a barge at one time could shove in at low water, but now they cannot shove in until half an hour after low water I should say.

2963. How long has that mud been accumulating ?—I should think for the last three years, but within the last 18 months a deal of mud has washed away again some hundreds of tons.

2964. It has decreased within the last 18 months ?—Yes.

2965. Can you form any judgment as to what caused it originally ?—The dam placed in the creek above, I should consider.

2966. You think so ?—Yes.

2967. At all events, are you prepared to say that within the last 18 months the mud has decreased ?—Yes.

2968. When was the dam removed ; can you fix the date at all ?—I should think the dam has been removed about 18 months, according to the best of my recollection.

2969. Did you know the system of fishing which was adopted when you were first there ?—No, I never knew the system of fishing, but I used to wait on all the vessels that came to London—Hewitts' and Morgan's.

2970. When you say you used to wait on them, what do you mean ?—I used to wait on them with provisions, ice, and stores.

2971. Where from ?—From Barking ; outside Barking Creek.

2972. Did they ever come up into Barking with their cargoes ?—No, they never did.

2973. Are you speaking of 15 years ago ?—No ; I am speaking now of four years ago.

2974. When did you first know the fleet there ?—Do you mean when I first knew the fleet at the creek's mouth ?

2975. Yes.—About 18 years back.

2976. At that time did they bring the fish to the mouth of the creek, or did they go direct to Barking town ?—They never brought a cargo of fish up expressly for market. They used to bring a few fish home to give away, such as oysters, skate, and so on.

2977. Was that when they came up to refit ?—Yes.

2978. I believe the system now is different ; the fish are collected in steamers from the vessels that go to the North Sea ?—Yes, they have four steamers for the express purpose.

2979. To pick up the fish from different vessels, and take it up to Billingsgate ?—Yes.

2980. Mr. Hewitt was a large smack owner, was he not ?—Yes.

2981. What became of his vessels ?—I believe they have all gone to Goldstone.

2982. Do you know whether a company took them ?—Yes.

2983. How long ago was that ?—Some have been away the last 12 years. I think the last of the fleet has been gone away three years, or three and a half years.

2984. Do you remember when the paper mills on the river Roding were established ?—Yes.

2985. Above Barking ?—Yes, at Ilford.

2986. And when they got into work ?—Yes.

2987. Do you know whether that caused any decrease in the number of fish in the creek ?—Yes, I should say it did by some bushels.

2988. What fish were there caught in the creek before the paper mills came there ?—Chiefly dace.

2989. White fish ?—Yes.

2990. Did you ever know of any shrimps being there ?—There were very few shrimps ; I have seen shrimps in the creek.

2991. Were there enough to make it worth anybody's while to fish for them ?—Not shrimps.

2992. What did they fish for ?—Dace, flounders, and roach I have seen there.

2993. After the paper mills were opened, what effect was produced upon those fish ?—Whenever I saw any go through the lock, I always considered that they were going there to die, as soon as they got through the lock into the back river.

2994. Why did you so consider, have you seen them dead there ?—I noticed that they were dead ; I have seen bushels of fish turn up there.

2995. What do you call the lock?—I mean the lock at the mill above Barking town, on the way to Ilford.

2996. You used to see fish dead there?—Yes.

2997. How many years ago was it that you observed that?—As lately as three years ago.

2998. How long ago is it that you observed that first?—About 10 years ago.

2999. What number of vessels do you suppose that you have taken up the creek from first to last?—Do you mean that belonged to Barking?

3000. Yes?—From 300 to 400.

3001. Whereabouts did these ships lie, outside the creek?—Just outside the Horse End, in the Thames, just above.

3002. Do they lie in the same place now?—No.

3003. Why not?—We have not had a ship lie in the creek's mouth a good while.

3004. For how many years, about?—Not more than a twelvemonth, I suppose.

3005. Is it true that a vessel of 200 tons or 250 tons cannot be brought up the Creek at the present time?—No, I would guarantee to get one up of 500 tons.

3006. Drawing what water?—12 feet. I have taken a vessel up there just under 300 tons, drawing 12 feet 8.

3007. When was that?—About three months ago.

3008. That was the "Impetuous"?—Yes.

3009. What is the next largest vessel to that that you have taken up?—The "Jesse Allandale."

3010. What tonage was she?—205 tons.

3011. What water did she draw?—11 feet 3.

3012. Since you have known the creek has it been a common thing for a vessel of that size to come up?—Yes.

3013. Vessels of 200 and what tons?—250, 255, 270, and 272; 272 tons is the largest that I ever took up.

3014. Generally speaking, have the vessels that have come up been smaller?—I have known vessels come in there recently of 150 tons, and a vessel of 139 tons, and a vessel of 140 tons.

3015. Where do those vessels belong to?—Two belong to Grays and the other belongs to Sandwich.

3016. I understand that you were engaged to take those vessels up when they came there?—Not all those vessels.

3017. But the particular vessels you have mentioned?—Yes.

Cross-examined by Mr. Lloyd.

3018. Whose vessel was the "Impetuous"?—I do not know the owner's name.

3019. Where was she consigned to?—To Mr. Davis.

3020. How far is his wharf up the creek?—Right up against the town quay.

3021. When you went on board was she lying off the mouth of the creek?—Yes.

3022. Do you know how long she had been lying there?—One ebb.

3023. Did you come up with the first of the flood?—Yes.

3024. The first of the flood?—Yes.

3025. A very young flood?—Yes, just at the top of the tide.

3026. Was it with the young flood, or had it been setting some time?—About three quarters flood.

3027. When you went on board what was the state of the tide?—About half flood.

3028. And you took her up at three quarters flood?—Yes.

3029. She had been lying you say one tide?—One ebb.

3030. Is that the only vessel that you have brought up lately?—I have had the "Look Out" since then.

3031. What do you mean by that?—A vessel named the "Look Out."

3032. What draught had she?—11 feet.

3033. Did she lay off the mouth of the creek?—Yes; till I went on board.

3034. How long had she been lying off there?—She came up on the flood.

3035. On what flood?—On the flood tide.

3036. What state of flood tide?—Just before high water.

3037. How long she had been lying outside you do not know?—She had only come up the same tide that I went on board her.

3038. How do you know?—Because the captain came up to Barking for me.

(*The Commissioner.*) Ask him what the tonnage was.

3039. (*Mr. Lloyd.*) What was the tonnage of that vessel?—150 tons.

3040. What was her draught of water?—11 feet.

3041. When was that?—About seven weeks back.

3042. You have been so much in the habit of bringing vessels up, have you ever found any difficulty in bringing them up?—No, not more than usual.

3043. You have never had to stop outside for water?—We never had to stop outside with a ship. I never put in to the creek with a ship till the tide gets a certain height in the reach by Horse End.

3044. There is a delay then?—There is more delay for a barge than there is for a ship, because a barge we always expected formerly to get under weigh when the tide began to flow.

3045. There is a little delay now?—Yes, there is now a little delay for a barge.

3046. About an hour or two?—About half an hour.

3047. No more?—No.

3048. You are quite sure of that?—Quite sure.

3049. You have never felt any difficulty in bringing up a barge?—No.

3050. Nor a vessel?—No.

3051. You had not to wait in the Thames outside?—Not if I had sufficient water, a good tide, and fair wind.

3052. Have you ever observed the mud bank between the shelf and the mouth of the creek?—No, there is none to my knowledge, and I think I would have been as likely to find it as anybody if there had been one there.

3053. There is no mud deposit; no bank formed?—I will not say there is not a little mud deposit there.

3054. There is no bank of mud, no shoal of mud deposited there?—Not that I know of.

3055. You must have known it of course if there had been?—I say there is no mud that I am aware of.

3056. You must have known it if there had been?—I should think I should.

3057. Are you able to say positively that there is not?—I say there is a little.

3058. What do you mean by a little?—There is not so much as there was by hundreds of tons, in the mouth of the creek.

3059. As there was when?—18 months ago.

3060. Then it is diminishing?—Yes.

3061. What was it at the highest, when it was at its worst?—Do you mean what was the accumulation of mud?

3062. Yes.—I should say the mud was from four to five feet deep.

3063. Sometimes seven?—I would not exaggerate if I knew it.

3064. You mean to say it is less than that now?—Yes, much less.

3065. Much less than what now?—I could not say exactly.

3066. What do you think it is now?—I could not say exactly; I should say from two to three feet deep.

3067. (*The Commissioner.*) Did you ever stick a pole down?—I cannot say that I have, only by poking a barge along in the creek, but never to take notice about it.

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3068. What you say about the depth is all guess, because you did not put a pole down to measure it?—Not to take the exact measurement, only by poking in the creek with a barge.

3069. (*Mr. Lloyd.*) You attribute the accumulation of mud to the coffer dam, I understand?—Yes.

3070. And not to the diminished flow of the backwater or scour coming from the sluices?—I am not going to say but what there is some settlement from the London outfall sewer.

3071. I am asking you about the sluices at the town of Barking?—I did not understand.

3072. Does not twice as much water come down now as used to come down?—Backwater?

3073. Yes, from the sluices?—No, we have had very little rain lately. You are, I suppose, talking about the slack of the mill above Barking.

3074. You know that a large area, including Hainhault Forest, and all that district, has been drained of late years?—Yes.

3075. Has that brought down more water do you think?—I cannot say that it has, because we have not had such sudden flushes as used to be, since the land has been thoroughly drained.

3076. Whose employ are you generally in?—I am in general a pilot. I just work for anybody who hires me.

3077. Have you ever been in the employ of Mr. Burrell, or Mr. Davidson?—Very little.

3078. You have been, have you not?—Yes, a little; I might have been till now if I liked to work for their price.

3079. You were regularly on with them at one time, were you not?—Never in my life.

3080. What do you mean by saying you might have been?—I used to do jobbing work for them.

3081. What sort of jobbing work?—Such as taking a barge out of the creek down to the derrick, or taking a load of coals for Mr. Cory.

3082. Have you ever found any difficulty in navigating in or out of the creek?—Never in my life.

3083. You state that positively?—I state that positively.

3084. You never heard any complaint, or anything of that kind?—I have heard Mr. Davidson make use of a good many words that I thought improper.

3085. Mr. Davidson turned you away, did he not?—Never.

3086. Are you sure of that?—I am positive of that.

3087. You mean to say that on your oath?—Yes, I am on my oath.

3088. Did you voluntarily go away yourself?—Yes.

3089. You mean to state that positively?—I do.

3090. You had no quarrel with Mr. Davidson at all; you had no words with him?—Oh yes, we had words.

3091. What was that about?—What was it about?

3092. Yes?—We had a dispute about a shilling. I had to take a barge from Barking to creek's mouth to load a freight of coals out of a ship at the creek. It was to be 11*s.* to take it to Ilford. I saw a schooner come up, and the captain came alongside of me and wanted me to take it to Barking. I did not know that I could get anybody to go to Ilford with this barge, but I told the captain if I could get anybody to take the barge to Ilford, I would take his schooner. I saw young Barrett, who had been at work for Mr. Burrell, but Mr. Davidson had taken a great dislike to him, and he told me not to have him on board the craft if I could possibly get anybody else.

3093. Had you a quarrel with Davidson?—I am going to explain it to you. This job was to be 11*s.* I hired this man to take her in, and I was to give him 6*s.* if he took her to Ilford. He did not get her in at the same tide that I expected he would to Ilford. When he gets her up he goes to Mr. Davidson for his money, which I who had hired him ought to have paid him, and should have done if he had come to me. Mr. Davidson only pays him 4*s.*, and I go and I want 7*s.*, but he would only pay me 6*s.*, and we had a dispute about the other shilling. That is all the row which me and Mr. Davidson ever had.

3094. It was a considerable row, was it not?—I do not know about a considerable row.

3095. Did not he tell you you should never be employed again?—No.

3096. Are you sure of that?—I am.

3097. Are you positive?—Yes.

3098. He has never employed you since?—No, but I could have employed myself.

3099. There?—Yes.

3100. Do you mean to state that positively?—Yes.

3101. Mind, you are upon your oath?—I am on my oath; I am aware of it.

3102. Just tell me another thing. Who found you out?—Who found me out?

3103. Yes, to bring you here?—Barnes.

3104. Who is Barnes?—He is the managing man, I believe, for the Metropolitan Board.

3105. (*Sir J. Karslake.*) The man who lives at the outfall?—Yes.

3106. (*Mr. Lloyd.*) When was it?—I think this is the fourth or fifth meeting I have been to. I could not say exactly the day of the month.

3107. Were you one of the men who went about with straws in their shoes?—I do not know that I have got any now.

3108. Did you go about with straw in your shoes?—No.

3109. Do you mean to say that nothing of the kind took place. Now mind what your about?—I cannot understand what you mean.

3110. Just answer my question?—No, sir, I never did in my life to my knowledge.

3111. You could not be ignorant of it if you did. What do you mean to say upon your oath? There are plenty of people at Barking, remember?—I am aware of it.

3112. Did you not go about with straw in your shoes?—Never that I am aware of.

3113. Come, come, don't tell us that. You must know whether you did or not?—Well, I will say I did not.

3114. Did not you offer yourself to be hired to give evidence for the Metropolitan Board?—I offer myself?

3115. Yes. Did you not offer yourself to give evidence for the Metropolitan Board, if they would pay you?—No.

3116. Will you swear that?—I will swear it.

3117. You did not influence other men to do the same?—No.

3118. Do you know Powell, the lighterman?—Yes.

3119. Did you say anything to him about giving evidence here?—No.

3120. Are you sure?—We have been in company together.

3121. Now tell me, you must mind what you are about, did you not ask Powell to come and give evidence for the Metropolitan Board?—No.

3122. You did not?—No.

3123. Nothing of that kind never passed?—No.

3124. Nothing?—No.

3125. Do you know a man of the name of Hallett?—Yes.

3126. Did you speak to him about it?—No.

3127. Never?—No.

3128. You state that positively, do you?—I state that positively.

3129. When was it that Barnes first came to you? (*Sir J. Karslake.*) He says he cannot recollect. He says there have been four of five meetings.

3130. (*Mr. Lloyd.*) Have you not offered yourself to the people of Barking to give evidence if they would pay you?—Never.

3131. Never in your life?—No.

3132. Nor said anything about it?—No.

3133. Did you not say, "There is no money stirring here?"—No.

3134. What have you got from the Metropolitan Board?—Am I bound to answer you?

3135. Yes?—I have had a sovereign to pay my expenses.

3136. When was that?—At the last meeting at Barking.

3137. Is that all you have had?—Yes.

3138. Is that so?—Yes.

3139. What are you to have?—I am sure I don't know.

3140. Have you never made any bargain at all?—No.

3141. Did you not say, "There is more money stirring from the Metropolitan Board"?—No.

3142. Nothing of that kind?—No.

3143. You are quite sure?—I am quite certain of it.

3144. Or anything to that effect?—Nothing of the kind.

3145. You never offered yourself to give evidence to the people at Barking if they would pay you, or anything of that sort?—No.

3146. You never said to anybody that there was more money to be had from the Metropolitan Board?—No.

3147. You positively state then that the navigation at the mouth of the creek is the same as it has always been in your time?—No, it is not.

3148. What is the difference?—The mouth of the creek at one time used to run down alongside the stones, so that at low water we could step off the barge on to the stones, now I say we cannot get nearer the stones than about 30 feet.

3149. Did you ever try the deposit there to see what it consisted of?—No.

3150. You never smelt anything there?—There is a little smell.

3151. What do you call a little smell?—It is not so strong as it would choke you.

3152. But it is tolerably strong, is it not?—It is stronger sometimes than it is at others.

3153. Sometimes it is very strong, is it not?—Not so very strong.

3154. What do you mean by not so very strong?—It is not so strong but what I can put up with it.

3155. By holding your nose, I suppose?—No.

3156. Without that?—Without that.

3157. Do you know what has turned the channel aside at the mouth?—Yes, I laid it to the coffer dam.

3158. You laid it to the coffer dam?—Yes.

3159. Do you know how long that was down?—18 months, to the best of my knowledge; it has been removed 18 months, and I believe it was standing 18 months.

3160. Was it across the creek altogether?—No; about one-third I should think was drove first, then rather more on the south side.

3161. Then that was removed?—That was removed; then another was driven on the north side. They drove the south side first.

3162. How long did each of those remain?—The two were down about 18 months.

3163. I want to know how long each was down?—I could not say. They were longer on one side than on the other.

Re-examined by Sir J. Karslake.

3164. You have had a sovereign, have you?—Yes.

3165. How many times have you attended before the Commissioner at these meetings?—This is the fifth time.

3166. Do you get your living by jobs, or have you any day work as well?—Most of mine is job work, piloting, and barge work.

3167. You were asked whether you told the people of Barking that you would give evidence for them; who are the people of Barking?—I don't know.

3168. You were asked about Powell and Hallet. Powell is here to give evidence?—Yes.

3169. Did he come up with you?—Yes.

3170. Has Hallet been with you?—Yes.

3171. Have you talked about this matter together?—No, we have had a few words about it, but nothing to induce one another to come.

3172. You stated that there used to be sudden flushes in this river Roding?—Yes, on account of the heavy rains.

3173. Have those been discontinued in consequence of penning the water back, or something of that kind?—I believe the land has been more thoroughly drained.

3174. So that you do not get that scouring body of water that used to come down?—No.

3175. You were asked about a mud bank between the shelf and the creek's mouth. Was there ever since you have known it anything which you would call a hard bank there?—Yes; there is what we term the hill.

3176. Is that what you say has decreased materially within the 18 months?—No; the mud in the creek.

3177. Where is the hill then?—The hill is there now.

3178. The shelf?—No; not the shelf; the hill is between the shelf and the ridge.

3179. What do you call the ridge, the Horse End?—No, the ridge comes out from the lower part of the reservoir; it runs off into the river Thames for about 100 yards.

3180. I am talking of the mouth of the creek?—The hill you are talking about that is between the shelf and the ridge.

3181. So far as ships are concerned, you say barges expect to go in earlier than ships do?—Yes.

3182. You think the barges do not now go in as quickly as they used to do?—No.

3183. With that exception, is there any impediment to the navigation?—Only that; that a barge cannot shove in at dead low water.

3184. Is that in consequence of the mud which you say there is in the creek?—Yes.

3185. As far as getting up to Barking on the flood tide goes, is there any difficulty in doing that now?—Not at all. I would undertake to turn in a vessel there drawing 11 feet of water at any spring tide.

3186. (*The Commissioner.*) What tonnage?—Such as fishing smacks.

3187. Of what tonnage?—Do you mean builder's measurements?

3188. One of the allegations in the memorial says: "In former days it was no uncommon thing for a "vessel of 200 tons to 250 tons burthen to be brought "up the creek to the port of Barking; the port is "now closed to all such vessels." Do you say you can bring in vessels of from 200 to 250 tons, or about that at any spring tide?—Yes.

(*Sir J. Karslake.*) There are eminent gentlemen who are much more accustomed to shipping and navigation than I am who tell me that 200 tons gives you no notion at all; it is a question of the draught of water, not a question of how many tons. And I do not know whether the memorial means the registered tonnage or the capacity.

(*The Commissioner.*) We have had it in evidence previously that one vessel carrying 150 tons, and another vessel carrying 300 tons may each draw 11 feet of water. That has been given in evidence by barge owners before. It is not the number of tons carried, but the depth of water required.

(*Sir J. Karslake.*) Yes, that is obvious.

Further cross-examined by Mr. Lloyd.

3189. There is one question which I forgot to ask you. Do you know the "Abdiel" at all?—Yes.

3190. That was the vessel that was brought up the creek some little time ago?—Yes, she came up the creek last Sunday week.

3191. Do you know what happened to her?—Yes.

3192. What did happen to her?—I believe she got on the causeway in the creek.

3193. (*Sir J. Karslake.*) Were you there?—I walked down afterwards, I was not on board of her.

FIFTH DAY.

J. Brown.

31 July 1869.

3194. Did you see her on the causeway ?—Yes.

3195. Whereabouts in the creek is the causeway ?—Just below where the coffer dam was.

3196. Are those the steps that go up to the bank ?—Yes.

3197. The stone steps ?—No, the wooden steps.

3198. (*Mr. Lloyd.*) She was ashore on what ?—Ashore on the causeway stones.

3199. Just point out where it is ?—I do not understand the chart much.

(*Sir J. Karslake.*) I think the Commissioner knows the place perfectly well.

3200. (*Mr. Philbrick.*) Are those the steps which were made by the Reclamation Company ?—Yes, to get from one side of the creek to the other.

3201. (*Mr. Lloyd.*) What was the tonnage ?—I believe 210 tons.

3202. What was her draught ?—Ten feet, I believe.

3203. Do you know what has happened to her ?—They say she is strained. I do not know whether she is or not.

3204. She is on the stocks at present under repair ?—I believe so, she was yesterday.

3205. Did you see her when she came up to Barking ?—Yes.

3206. Did you see the water running out of her ?—There was a little dripping out of her.

3207. What they call a leak, she was strained and the water was running through her sides ?—No.

3208. Where was the water running ?—Running from her keel, according to what I could see ; I could not see exactly under her bottom, I was on the wharf, and she lay in the dock.

Further re-examined by Sir J. Karslake.

3209. You say she was on the steps when you saw her ?—Yes.

3210. Do the steps go to the bottom of the river or are there steps on either side ?—The steps are on either side ; they do not run right across.

3211. Was she out of her channel then ?—Yes.

3212. What is the channel there ; do you know what it is by the steps ?—A hard bottom ; it is mud where the ship got ashore.

3213. You say she was on the steps, and not on the hard bottom ?—Not on the hard bottom where she was.

3214. On what side was she ?—On the north side.

3215. What was her cargo ?—Coals.

3216. What did she draw, do you know ?—10 feet I believe.

3217. That is when she is laden ?—Yes.

3218. (*The Commissioner.*) Was she resting on what you term the causeway ?—Yes, her afterbody.

3219. Is that a paved way for crossing the river at low water ?—No, it was built at the time that the sewage conduit was going on for the accommodation of the men getting across the creek.

3220. And it has never been removed ?—No.

(*Sir. J. Karslake.*) You will see a chimney immediately above it, on the shore.

(*Mr. Philbrick.*) It is where the sewage syphon is ?—Yes.

3221. (*Sir J. Karslake.*) You have told us a long story for one shilling about Mr. Davidson. As I understand you, you were never in Mr. Davidson's employ regularly, but you used to do odd jobs for him from time to time ?—Yes, but never regularly.

Mr. C. Clark.

Mr. Charles Clark called ; examined by Mr. Philbrick.

3222. I think you live at Barking town ?—Yes.

3223. Have you known Barking for upwards of 30 years or thereabouts ?—Thereabouts.

3224. Do you own barges ?—Yes.

3225. Are you a lighterman also ?—Yes.

3226. Then you are acquainted with it from an owner's point of view, and with reference to the navigation ?—Yes.

3227. How many years is it since you first navigated a barge up the creek ?—25 years ago.

3228. More or less have you continued to do that ?—Yes.

3229. Till how lately have you done such a thing, or been on a barge when she has been navigated up ?—To within a week ago.

3230. So long as you remember the creek there has always been the shelf in the Thames that has been talked of ?—Yes.

3231. And the shoal at the Horse End ?—Yes.

3232. Or the point at the Horse End, rather ?—Yes.

3233. Is there substantially any difference between the navigation of the creek now and what you remember it years and years ago ?—There is a settlement of mud at the creek's mouth, a little settlement of mud.

3234. When first did you notice that ?—I should think somewhere about two years ago.

3235. Where is it you noticed it ?—From the magazine down to the steps at Laws's factory.

3236. Can you yourself account for that ? What do you attribute that deposit of mud to ?—I consider it is nothing else than the drift caused by the coffer dam being formed there, and it would have been a breach if it had continued to this time on account of the washing of the wall away so much.

3237. Do you mean the coffer dam which they made for the purpose of constructing the syphon of the sewage company across the creek ?—Yes.

3238. With that exception you have mentioned, is the creek apparently the same as ever ?—Every bit, except that difference.

3239. Do you know whether the channel comes out in precisely the same way that it did before, or is it turned a little ?—It is turned a little, that is the only difference that is caused by it.

3240. As to the navigation, so far as getting ships up the creek goes, do you think there is any detriment to that ?—I think there has been an improvement.

3241. Tell us your reason why you think there has been an improvement ?—We had to cut the stones so very close that it was very dangerous, when we had to get a vessel under weigh with her canvas on, and keep way on her, on account of putting into the creek.

3242. Now the course is further away from the wall and from the stones ?—Yes ; it is much better in my opinion.

3243. So far as regards the draught of water of the vessels that could navigate up there has there been any diminution in the usefulness of the creek for the purpose of navigation ?—We must not start now till the water is up a certain height.

3244. That has always been so, has it not ?—Yes.

3245. As I understand you, you have to wait till a certain time of the tide ?—We always did so, and shall do so now if we require to navigate the creek with a vessel.

3246. Is there any difference between the time of the tide you now take, and the time of the tide that you used to take ?—None whatever.

3247. Neither with regard to the navigation of the creek by vessels nor by barges and craft of that description ?—There is a little difference there.

3248. Is that owing to the mud ?

(*Mr. Lloyd.*) Do not lead him quite so much ; ask him what it is owing to.

(*The witness.*) To the mud.

3249. (*Mr. Philbrick.*) To this mud that you have been speaking of ?—Yes.

3250. What is the difference ; to what extent is it affected ?—I should think there is about half an hour difference in getting in.

3251. Is it the fact, as was mentioned by Brown, that a barge expects to get off sooner than a vessel with the tide?—Yes.

3252. Did you hear what Brown told us?

(*Mr. Lloyd.*) Pray do not do that.

(*Mr. Philbrick.*) I am going to ask the question.

(*Mr. Lloyd.*) Do not refer to Brown.

(*Mr. Philbrick.*) I am going to ask what question I please, Mr. Lloyd.

(*Mr. Lloyd.*) You are not going to ask an irregular question.

3253. (*Mr. Philbrick.*) If you have any objection to make, make the objection to the Commissioner, but hear my question first. (*To the witness.*) Did you hear the evidence which Brown gave with regard to the fish trade?—I did.

3254. What is your own opinion with regard to the fish trade. Is there any variation between that and the evidence that Brown gave?—Not the least that I know of.

Cross-examined by Mr. Lloyd.

3255. Do you say, or do you not, that there is a bank of mud between the shelf and the mouth of the creek?—Yes; there is a swell of mud there.

3256. Has that increased of late years?—It has.

3257. To a considerable extent?—Oh no, not such a great deal.

3258. What was it when you first knew it?—There were stones on which you could step alongside.

3259. What is the depth of the mud now upon which there were stones before?

(*The Commissioner.*) I am really afraid that you are at cross-purposes again in the question and answer. The shelf is in the Thames. Evidence has been given over and over again that there is no bank between the shelf and the shore opposite Laws's factory, but that the mud is in the creek.

(*Sir J. Karslake.*) It is washed up on the bank of Laws's works.

(*The witness.*) Formed by the dam.

3260. (*The Commissioner.*) But you are telling Mr. Lloyd that there is a bank in the Thames itself?—No.

3261. Between the shelf and the shore?—Certainly not; it is the shelf there.

3262. (*Mr. Lloyd.*) Where is the bank of mud you are speaking of?—There is no bank; it is a mere settlement of mud.

3263. In the creek?—In the creek's mouth.

(*The Commissioner.*) In the creek, and parallel with Mr. Laws's wall.

(*Mr. Philbrick.*) Just put your finger on the plan where it is. (*The witness pointed it out on the plan.*)

(*Mr. Lloyd.*) There was a bank spoken to by Mr. Leach, and by other witnesses, to the depth of six or seven feet.

(*The Commissioner.*) I think that mud bank is on the other side of the creek's mouth, is it not, Mr. Leach?

(*Mr. Leach.*) Yes.

3264. (*Mr. Lloyd.*) Do you know that bank? Do you know of any bank of mud on the opposite side of the creek's mouth?—There is the Horse End.

3265. Off the Horse End?—No.

3266. (*Sir J. Karslake.*) It is the Horse End itself, is it?—Yes.

3267. (*Mr. Lloyd.*) Is there any mud formed there?—Not that I know of; there may be a little settlement. There may be a little difference; I think there is.

3268. An inch or two?—There may be a few more; I have not taken particular notice.

3269. (*The Commissioner.*) Just look at this map. There is the river Thames; there is Barking town; there is the creek; there are Mr. Laws's works. The shelf is where my finger is. Now do you mean that the mud is in the creek *there*?—Yes.

3270. Is there any mud on that bend there?—There is at the Horse End, and there may be a little settlement, but very trifling outside.

3271. (*Mr. Lloyd.*) What do you say is the depth of that last settlement you speak of?—I cannot say; I never took particular notice of it.

3272. Did you ever go up the creek with a sea-going vessel?—I have taken schooners up there,

3273. Of what draught?—About 9 feet.

3274. Have you taken any lately?—No, I have not.

3275. Within how many years?—Well, I should say seven or eight years.

3276. You have taken barges up?—Yes.

3277. Now you have to lie longer outside before you can get up with the tide than you used to do?—Yes.

3278. What do you attribute that to?—I suppose it is the coffer dam washing the bank away.

3279. What prevents your getting up?—The mud caused by this dam.

3280. Did you ever examine the mud itself?—Yes; it is about the same as usual.

3281. Is it not dark-coloured?—It always was black.

3282. Have you ever tried it lately?—I have not taken particular notice of it.

3283. You never dipped your oar in it?—No.

3284. Is it the same as it always was?—About the same.

3285. Ever since you have known it?—Yes.

3286. Is there no smell from it?—There is a smell; all mud is very disagreeable at any time, and shore mud is.

3287. There is no smell but the smell of shore mud?—A very nasty, disagreeable smell is shore mud, very rank.

3288. The smell of the mud you find is a nasty, disagreeable smell?—Yes.

3289. Such as you find from all mud, is it?—Just so.

3290. So that if you stirred up the mud in the street it would be the same, would it?—Yes.

3291. Nothing more than that?—There is nothing more of which I took particular notice.

Re-examined by Sir J. Karslake.

3292. You have known Barking Creek, you say, 25 years?—Yes, I have.

3293. Do you find any difference between the smell of the mud now, and the smell of the mud all the 25 years you have known it?—There is a little disagreeable smell sometimes from the sewage.

3294. Whereabouts is that?—You can smell it as you come down the river when you bring it up outside.

3295. Let me understand you about these barges. Used the barges to go in at low water, flat-bottomed barges?—Yes.

3296. They forced their way in at low water?—Yes, directly the tide made.

3297. Directly the tide made they began to go up the creek?—Yes.

3298. You cannot get them in now so early after the tide makes as you used to do?—No, not quite.

3299. What prevents you doing that?—The Horse End has washed away from one side, you may say, to the other.

3300. You say the effect of that is that there is some accumulation of mud there, and you cannot get the barges in so early as you used to do?—No.

3301. Now, as regards vessels other than barges, was it always the practice to let the tide make some time before bringing them in?—It always was so.

FIFTH DAY.

Mr. C. Clark.

31 July 1869.

3302. You have not taken in a schooner for six or seven years?—No.

3303. Have you seen them come up?—Yes, many a time.

3304. Do you see any difference in the size of the schooners on the average that come in now to those that used to come in?—I never heard any complaints.

3305. Do they appear to you to be the same size and tonnage as before?—Somewhere thereabout.

3306. What I understand you to say, although I did not see you point it out upon the map was, that it was on that rough, artificial bank or wall below Mr. Laws's factory where this mud has settled?—No, it is rather above Mr. Laws's factory.

(*The Commissioner.*) A little above, inside the creek.

3307. (*Sir J. Karslake.*) That wall was built for Mr. Laws's factory to keep up the bank?—Yes. That mud was a grand job for Mr. Laws, for if the tide had continued to wash, there is not the least doubt that it would have affected the foundations, and all the place would have fallen in.

3308. You think the mud keeps up the wall?—Yes, there is no mistake about it.

Examined by the COMMISSIONER.

3309. Have you ever recently, within the last three or four months, or within the last 12 months, watched the tidal water flowing into the creek from the Thames up to Barking?—I have, and I have taken samples of it. I have got samples here now if you like to have them.

3310. No, I do not think we care about those samples. Have you ever seen material from the outfall sewer floating in with the tide on the top of the water?—I have a little, but it is a mere trifle; just about a couple of reaches in you will find a few straws, corks, and tops, and one thing and another.

3311. Flowing how far up the creek?—About two reaches in, not more.

3312. How many hundred yards would that be?—You may say 200 or 300 yards.

3313. Not half a mile?—Thereabouts.

3314. Did you ever see the London sewage floating up the creek and above Barking Quay, and so on, and up into the river Roding above?—No, I never did.

3315. Have you heard persons at Barking say that they have seen it come up in that way?—I have heard so, but I contradicted them long enough ago; long before this question came up.

3316. You say that you yourself have not seen such a thing as the sewage from the Thames floating up as far as Barking?—No, certainly not. I have some samples here which I took from the factory at Barking to prove the fact.

F. Powell.

FREDERICK POWELL called; examined by Mr. PHILBRICK.

3317. Are you a lighterman?—I am.

3318. You reside at Barking?—I do.

3319. How many years have you resided there?—I have resided there for the last 15 years.

3320. How long have you known Barking Creek?—It is from 32 to 33 years since I first worked up the creek.

3321. Since you first knew the creek to work up it?—Yes; I have resided in Barking 15 years continuously.

3322. During the whole of the 30 odd years since you have known the creek have you been used, more or less, to the navigation of it?—Yes.

3323. As occasion required?—Yes.

3324. So far as the creek itself is concerned, how is the navigation now as compared with the navigation formerly?—I do not think the navigation is impeded one iota.

3325. You say that from your practical experience of working craft and from seeing other craft going up?—I am sure of it.

3326. As to this mud which has been spoken of, which is said to have been accumulated and to have washed up at the side of Mr. Laws's factory, inside the creek's mouth, have you noticed that?—I have.

3327. Can you form any judgment at all as to what occasioned it?—I believe that the cause of the mud forming itself there comes from the inner source of the creek—from the coffer dam that was erected for the Essex Reclamation Company, the reason why I think so is, I think the creek is so self-cleansing that it would force outside anything that was deposited; it must do so.

3328. Was your attention at all called to the formation of any deposit of mud near the part where it now is until the coffer dam had been put across the creek, and so impeded the natural flow of the water to some extent in it?—Not to any extent with the exception of dry seasons, in which, more or less in Barking Creek mud will grow up, and will wash out again in the wet season when the freshes come down.

3329. Of course the quantity of water that comes down the river Roding would vary with the season?—Yes.

Cross-examined by Mr. LLOYD.

3330. You live at Barking town?—Yes.

3331. How long have you lived there?—15 years.

3332. You have not heard any complaint from the people of Barking about this London sewage, have you?—A deal.

3333. You never believed it yourself?—I have had a deal more to do with it, for I have been more or less every day connected with it, being closer to it than people generally are who serve tapes and buttons over the counters in Barking shops.

3334. You do not believe anything they have said about this nuisance?—I never found it affect me to any extent; in fact, the smells that surround the London sewer outfall rather kill the smell that comes from the sewer.

3335. You have heard complaints from people?—Yes, I have; for instance, there is the sewage deposited on the land of Mr. Hope. I have been over his farm (in fact, there is a road through it), where sewage is continually being deposited day by day. You cannot detect it there, and I do not see how the Barking people can detect the smell of sewage at the creek's mouth, which is 2½ miles away.

3336. You have never perceived any smell of sewage at all?—Decidedly yes, similar to what you might perceive if you were passing along one of the London streets and they opened one of the gullies when they were in the act of cleansing the sewers; and that at times only.

3337. You only perceive it occasionally; now and then?—Only now and then.

3338. Where are you speaking of as being the place where you can perceive a smell if they had opened a trap?—When the tide is over the culverts.

3339. Where have you been when you perceived this smell?—About as far as you can throw a stone from the culverts of the outfall.

3340. Not in the creek itself?—Not in the creek itself.

3341. You never smelt it there?—Not to detect it, perhaps my olfactory nerves are not so strong as some peoples.

3342. Did you ever try the mud you have spoken of near Mr. Laws's factory?—Yes, I have; when I am at work I am in the general habit of poking barges in by what we call setting booms, hitchers, or oars; ever

since I have known the creek's mouth the mud has always been of a very extreme depth, and sometimes when the flood-tide has come we have had to shove very hard, and we have had to force the oars and hitches a long way in, and could not withdraw them, and naturally enough they would break; that has been before the sewer came; the mud was always black, and like all mud that is disturbed, it has always smelt, but on the surface, without you stirred it up with the express purpose, you could not detect any smell.

3343. At low water when it happens to be exposed have you ever tried it then?—I say you cannot smell it without you stir it.

3344. You have smelt it pretty often?—If I shoved the oar in of course the mud would smell; if you were jumping across a ditch, and if you fell in, and pulled your boot off the boot would naturally smell.

3345. This is only a mud smell?—I believe mud always smells.

3346. This is nothing more than the ordinary mud smell?—I only say I cannot see any difference; you do not want me to say something else, do you.

3347. No; do you perceive any difference between the smell of that mud and any other mud?—If you give me the grounds of what I am to say I will oblige you.

3348. Have you been talking to people about your coming up to give evidence for the Metropolitan Board?—It is such a matter of notoriety in Barking, it forms a means of passing the time in railway trains, et cetera, in fact sometimes at the station.

3349. It forms the general subject of conversation?—Yes.

3350. The conversation always is how very agreeable it is, is not it?—There is a question; if they all sided on one side of course there would not be any argument; you cannot find two of one opinion.

3351. You have taken the other side of the view?—I do not think I have; I leave you to judge.

3352. I believe there are a good many people who do complain?—Of course there are.

3353. Is it not a general complaint at Barking?—As far as domestic circles are to be spoken of, I have not heard either man, woman, or child speak of the ill effects of the London sewage.

3354. Then whom have you heard speak of them?—Those who go into railway carriages from Barking to London to attend to their business and have not got anything else to occupy their time.

3355. What do they talk about?—The subject at issue.

3356. The smells at Barking?—I do not rightly know; I suppose so.

3357. Is it not the fact that there is a very general complaint on the part of the inhabitants of Barking?—I have not heard it amongst the inhabitants, only amongst those who travel by rail.

3358. Are they not inhabitants of Barking?—I suppose yes. But understand me, that is only one class; when you ask me about the inhabitants of Barking I expect you mean the whole of them.

3359. What is the class who complain?—Some of them who pass 10 hours out of 12 in London, and some who never see the outside of their door with the exception when they go out in the evening and have a glass of grog, and have a hand at whist, and so forth; they consider themselves the intelligent class of the community, and they want to have a bit of a show off.

3360. Is the vicar of Barking one of those?—I do not really know.

3361. Does he go out and take his glass?—No, I do not say that.

3362. And the churchwardens?—The churchwardens are merely on a par with the rest of the men. One of our churchwardens who has lately vacated is only a working man, but fortune has shined upon him, and although he has got a few more of the Queen's effigies in gold to chink in his pocket than other people, he cannot sign his own name.

3363. I suppose, whether he can sign his own name or not his olfactory nerves that you speak of, and his sight are in full operation. Now, answer this question, Is not it a very general complaint, and has not it been so for some months, in fact for more than a year, a very general complaint in Barking that the London sewage is an abominable nuisance?—I really have not heard it so spoken of, if I speak truthfully, within houses or homes; but I have heard it at the railway station.

3364. You never heard it at Barking?—Not in homes or houses of resort. I never heard persons who were sitting in the "Ship" parlour say, "How beastly the London sewage smells! Let us drink up and go." I have heard them hold forth on other matters to any extent.

3365. Where?—In Homes' parlour, et cetera; but I never heard of the smell of the London sewage being so bad as to make them finish their drink and get off.

3366. Now about the navigation of the creek, you say it is exactly the same as it has always been?—Decidedly yes.

3367. There is no difference at all?—Not any whatever.

3368. Not an iota you said?—I say so.

3369. What have you done in the way of navigating, are you a barge navigator?—Yes, I am a barge navigator.

3370. Do you find that you have not to lay off at all at the creek's mouth before you can come up?—That question has been answered so truthfully that it is almost superfluous for me to give you my ideas on the subject. We are perfectly well aware that there is a little accumulation of mud at the creek's mouth. What is the question you want to arrive at? You want to imply that it is the emanation from the London sewer. I think, if you will look closely into it, it principally comes from inside the house not the outside. I think it emanates from the creek itself, because since the coffer dam has been removed the creek is cleansing itself, the gut-way is washing more open.

3371. You say the mud bank is diminishing within the last two years?—Where the grand scour of the creek is intact, of course there would be no difference in the navigation there; it is only where the mud accumulates.

3372. You say the evidence which has been given is so truthful that it is superfluous for you to add anything; the witnesses have said that there is half an hour or more delay?—There is half an hour.

3373. I thought you said there was not an iota of difference?—Not in the navigation, that is only the question of the time of admission at the entrance.

3374. You mean when you get in you can go up as before?—Originally in the navigation of the creek when you went into the creek's mouth it was at low water. There is about 21 feet rise in the spring-tide at Barking Creek's mouth, and at Barking Quay there is a good height to get, say 12 or 13 feet lift, so that you have got an up hill flow, 10 feet of ground to rise; if you came in at low water, of course, the rise of the creek would stop you until you obtained sufficient water to float you further along.

3375. What is the rise of the creek caused by?—The rise of the creek is the gravel bottom.

3376. And not the mud that you have spoken of?—Not the mud.

3377. That does not delay you at all?—No, because when you have water over the mud there is no delay. This little accumulation of mud, whether it emanates from the inner source or the outer source I cannot determine; but after the rise of the tide when you get over that, instead of being stopped here, you can arrive here, before being stopped there (*illustrating it*).

3378. Has the channel altered at the creek's mouth?—Yes.

3379. What do you attribute that to?—I do not know; it is a freak of nature, I suppose. There are

FIFTH DAY.

F. Powell.

31 July 1869.

many creeks' mouths which deviate in the course of years: you can see the effect, but you cannot tell the reason.

3380. Have you spoken to any people advising them to come and give evidence for the Metropolitan Board?—How am I to understand you?

3381. Have you advised any people to come forward to give evidence for the board?—Decidedly no.

3382. You never recommended anybody to come and give evidence for the board?—Decidedly no.

3383. Are you sure of it?—I am sure of it.

3384. Do you know Mr. Brown who is here?—I do.

3385. You have never talked with him, I suppose?—I have.

3386. Who was it recommended the others to come?—There was no recommendation whatever.

3387. What was it you said to him?—This thing was on foot, and when part of the Barking memorial was depicted, and that it was got up by persons who did not understand what they were doing of, he says, "Is this true, Fred?" I said, "No, it is not." He said, "They are getting it up on the other side; why should we not get it up on ours?"

3388. Did not you laugh and say, "If we go up "and give evidence for the Metropolitan Board we "shall have better paymasters"?—Decidedly no.

3389. Nothing like it?—Decidedly not.

3390. You thought it, though?—I do not suppose any of you legal gentlemen will come here without getting remuneration.

(*Sir J. Karslake.*) Do not assume that.

(*The witness.*) If time is occupied it must be paid for.

3391. (*Mr. Lloyd.*) You knew that you would not be paid oy the Barking people?—I did not know. They have Holmes on the memorial side. He said to me, "Fred, if you will come up on our side, of what "I am going to receive you shall have half." He said, "I cannot guarantee to give you anything myself."

3392. Did you you think that you would get better paid by the Metropolitan Board of Works?—I did not think any way, and do not think any way, but of course if I were to say to you I do not expect to get remuneration for my daily pay, I should tell you a falsity. When I first came to give my evidence it was clearly depicted to me before the examination took place, "What are you going to state, state only "what you know." I believe that is the gentleman (*pointing to Mr. Smith*); he turned round to Barnes and says, "Have you promised these men anything?" he said, "No, I have not." Then he said, "You "will get no remuneration from here whatever, only "what we think proper to award you." He says, "What evidence you give is voluntary, and you get "no remuneration."

3393. "Except what we think proper"?—Only in the way to pay expenses.

Re-examined by Sir JOHN KARSLAKE.

3394. You get your living by your daily work?—Yes.

3395. How many times have you had to attend this inquiry already?—Four meetings and one day's examination.

3396. When you went up to be examined?—Yes.

3397. As I understand you work from Barking tawn?—I do.

3398. In taking up barges and so on?—Yes.

3399. Your interest is to have the creek in the best possible order?—My interest would be to see the creek go down to about where Captain Burstall enumerated.

3400. If you got the creek made 60 feet wider and 20 feet deeper it would be all the better for you?—I do not think that it would make any difference to me.

3401. Let me understand about these barges. In the transit of a barge from the mouth of the creek to Barking itself does that mud which you say is there hinder you in any degree?—Not the least in the world.

3402. As I understand you, before that mud was there you would be able to get over the place where the mud now is, but then you would have to stop a little in the creek?—Certainly.

3403. Now you go over the mud when there is water enough, which is half an hour later than you used to do, and you get up considerably higher than you used to do?—Yes.

3404. Is it on that ground that you say, to use your own expression, "I do not think the navigation is impeded one iota"?—Yes.

3405. You say there has been a good deal of talk both ways about this in Barking; can you tell me at all, for I am very curious to know if I can get at it, who got up the Barking memorial?—I cannot.

3406. Nobody seems to know; did the man in the moon come down there?—I do not know; there were these class meetings.

3407. Can you tell me the man who wrote it in a "clerklike hand"?—I do not know.

3408. Nobody does know?—I cannot give you any information about it.

3409. My learned friend talks about the vicar; we have not seen the vicar?—No.

3410. The vicar is the Rev. Mr. Seymour?—Yes.

Mr. JOHN HALL called; examined by Mr. PHILBRICK.

Mr. J. Hall.

3411. Do you live at Charlton?—Yes.

3412. I believe you are a bargeowner and lighterman?—Yes.

3413. Have you known this part of the river Thames, both on the Essex side and the Kent side, for many years?—About 10 years.

3414. Have you been practically acquainted with the navigation of Barking Creek during that time, more or less?—During the formation of the London sewage reservoir, I was for about four years.

3415. I think at that time your barges supplied the sand for the brickwork?—Yes, we supplied all the materials.

3416. In going up and down the river Thames there would be no need to go near the shelf unless you wanted to go into the creek?—No.

3417. In the general course of the navigation the craft in the river would leave the Shelf altogether?—Yes, considerably.

3418. Before the metropolitan main sewerage works began we know there was a shelf there. Could a barge get into the creek if it arrived outside at low water until the tide had risen to some extent?—It would get in at low water, but could not get along, and it would have to remain nearly an hour before it could get through the second reach.

3419. That is on account of the rise in the bottom of the creek that we have heard of?—Yes.

3420. You heard the matter explained by Powell?—Yes.

3421. Is the way he explained it consistent with your experience?—Yes; during the time that I was at work there.

3422. So far as your experience and knowledge goes, do you think there is any impediment or any detriment occasioned to the navigation of the creek at the present time from any cause?—There is a sediment of mud alongside the stones, a little rise in the entrance of the creek which has been explained, but I do not think at present there is any impediment whatever to the navigation.

3423. From whatever cause that mud might come,

you do not think it is any impediment to the navigation?—No, I would rather have the mud there than not, because if it is a hard bottom the men drag the barges along the ground until they can get sufficient water.

3424. Therefore you prefer to have the mud?—I prefer the mud for the sake of my own barges, but the men do not, because I have often seen them go scratching along the bottom, and dragging the barges along the ground.

3425. Of course that injures the craft?—That injures the craft very much.

3426. Can you form any opinion at all as to what caused the deposit of mud in the creek or in the creek's mouth?—I have watched it gathering at the time the coffer dam was there, very much.

3427. You actually saw it gather?—I could see it gather there at that time. I think there was more mud 18 months ago that at the present time.

Cross-examined by Mr. LLOYD.

3428. You have never tried it by sounding it?—I put the hitcher down there the other morning. I never tried it; I go by my ideas.

3429. By your eye?—I only go by my eye, by what I can see.

3430. You have never taken a sea-going vessel up?—No, I have never taken any up myself, I employ men to take them up.

3431. You do not know anything about such vessels going up?—No, I only know about barges going up.

3432. You have never smelt anything from that mud I suppose?—Of course we have smelt something from it.

3433. What was it you smelt?—An offensive smell, the same as you get from all the other mud on the banks of the Thames.

3434. Was there no difference between that mud and any other mud on the banks of the Thames?—In some places I have smelt it equally as bad on other parts of the Thames.

3435. What is the kind of smell?—It was an offensive smell; the smell was a little offensive.

3436. You know the smell of sewage?—Yes.

3437. The deposit is fermenting; sometimes it is dry, and sometimes wet. Did you ever stir it up?—Yes, but it never has had the smell that I have perceived from sewage. I have seen sewage from the Scotland Yard sewer, and it was very much worse there than it is here.

3438. It is, however, a sewage smell?—No, it is not to me.

3439. What do you think it is then; is it the smell of mere mud?—I should say there was an amalgamation of sewage with the mud; no doubt of it.

3440. Have you any idea where that sewage comes from?—I have seen it accumulate here about two years back; at the time the coffer dam was in the creek it kept on accumulating.

3441. You said "There is sewage in the mud." Have you any idea where that sewage comes from?—I should suppose it would come in on the ebbing tide; or on a small flood, a little might flow back on that point.

3442. Which would deposit itself there?—It would not deposit itself, it would amalgamate with the mud and create a smell.

3443. That seems to be the natural course of things?—Yes.

3444. What you would naturally expect from the formation of the shore?—Yes.

3445. You have seen signs of sewage matter being upon the surface?—I have seen corks float up and down on the surface.

3446. A good many of them?—Yes, a considerable quantity all up the river.

3447. All sorts of things that come down the sewers?—I do not know that; I have seen there what you are alluding to.

3448. You have seen children's toys, such as tops, and so on?—Yes.

3449. A great number of those things?—Yes.

3450. Much more than they used to have at Barking town?—Yes, I should think so. They would not all come from Barking town.

Re-examined by Sir J. KARSLAKE.

3451. You say you have smelt a smell of mud, and so on; do you smell the mud whenever you go on the Thames where these mud banks are formed?—At certain seasons of the year, at low water and summer time for instance, if you stir up the mud it will smell.

3452. As far as you can judge it all smells pretty much alike?—In some places the mud smells much more than in others. If you stir up the mud in the docks and at Millwall it smells very bad; much more than it will at other places.

Mr. SAMUEL HALLETT called; examined by Mr. PHILBRICK.

Mr. S. Hallett.

3453. Do you live at Vauxhall, and have you known Barking Creek for 20 years?—Yes.

3454. Have you been a master lighterman for about 10 years?—Yes.

3455. Before that time were you working at the trade?—Yes; and I have been generally working at it since.

3456. We have heard about how the fishing-smacks have left Barking, and how the trade has altered in consequence of the steamers, railways, and so forth, with regard to the navigation of the creek by craft. Have you taken craft up yourself?—Yes.

3457. Has that been before the London sewage works were commenced, and since?—Before and since.

3458. Have you taken up ships, sea-going craft as well as river craft, or only river craft?—Only river craft.

3459. They would be barges?—Yes.

3460. Have you noticed any perceptible impediment to the navigation of the creek by the craft which you have been in the habit of lightering up?—No, not an impediment; I have noticed a settlement at the mouth of the creek.

3461. Near Laws's factory?—Yes.

3462. Has that impeded the navigation?—No.

3463. So long as you remember the creek, was there always some mud about there?—Yes, there was always some mud in the mouth of the creek.

3464. Has it always remained in the same position, or has it altered?—It has altered. The gut of the creek has altered. The gut of the creek is 50 feet further up the river than it previously was up from the stones.

3465. Up from the river Thames?—Yes.

3466. Is that in your judgment, an impediment to the navigation of the creek?—No, none whatever.

3467. To what do you attribute that, can you from any opinion how that arises?—We, as working men, and lightermen, concluded that it was caused by the coffer dam at the time.

3468. You mean the coffer dam which was made for the purposes of the Essex Reclamation Company?—Yes, causing a different set of the ebb tide.

3469. As you were in the habit of going up and down the creek, did you notice whether it did cause a different set?—Coming down it did, but not going up.

3470. Of course if there were mud in the creek or near the creek's mouth, that would have a tendency to alter the place where that mud would lie?—Yes.

3471. Was the set such as would cause the mud to settle in the place where you noticed it?—Yes, in different bights, as the tide came down the creek.

3472. Since the coffer dam has been removed altogether, has the mud there increased or not?—No, it has not increased. It gradually goes away, because there the tide goes round to its old position.

FIFTH DAY.

Mr. S. Hallett.

31 July 1869.

Cross-examined by Mr. LLOYD.

3473. Are you able to say positively that the mud bank has decreased?—Yes, it has decreased since the coffer dam has been away.

3474. You have observed that yourself?—Yes; we can tell by the barge, when we go in and out.

3475. You are quite sure that it is not more, but rather less than it was before?—Since the coffer dam has been removed.

3476. When did you first observe the formation of that bank?—When the coffer dam was first driven across the lower side.

3477. Not before that time?—No.

3478. Where do you think the mud that forms it came from?—I cannot exactly say.

3479. Did you ever smell it?—I have not tried it. I do not know anything about the smell of it.

3480. You do not know anything about it?—No; nothing about the smell of the mud. We do not take much notice about the smell of mud on the river, we are so used to it.

3481. You never noticed anything particular about it?—No, not the mud.

3482. Were you at Barking that day when they produced the kettle of stuff?—No, I was not there then.

3483. You have never seen that?—No, I have never seen it.

3484. What is the kind of mud that there is on that bank?—At the creek's mouth?

3485. Yes.—There was a kind of a white scum on the top of it. I did not try it underneath. I should mention that last Sunday I spoke to two or three of the farmers about getting them this stuff, as people seem to say it is good stuff for manure; so I thought probably I might make a pound or two over selling this mud. So I went out last Sunday morning in a boat to obtain a sample. I could not find anything sufficiently good enough for the farmers without going close up to the main sewers outfall.

3486. Not quite strong enough?—No.

3487. What colour was that which you tried?—At the outfall?

3488. That which you did not think good enough for the farmers' use. Was it black?—Not exactly black; it was dark; of course mud is dark.

3489. Very dark, was not it?—Certainly.

3490. Was it at all like that that you found near the main sewers pumping station?—No.

3491. You went outside though, and up towards the pumping station?—Yes.

3492. You found plenty of very good stuff there for the farmers?—There is rather a doubt about it; we have not taken a freight yet. I am rather afraid if we take it up that we shall have to bring it back again; it would not be good enough. It is too much washed.

3493. You went and tried that?—Yes, I thought it would be a benefit to me.

3494. That is sewage?—That close to the outfall do you mean?

3495. Yes.—No.

3496. What is it then?—It is more of a kind of macadam grit and mud, and all the sewage settlements together.

3497. Macadam grit and mud, and something else?—Yes, sewage well washed.

3498. How far does that sort of deposit extend up the river?—You mean down the river?

3499. I mean up from Barking Creek, but down from the sewer?—We will say there is the outfall here, we commence downwards. If this stuff comes down on the ebb tide, it must go down there.

3500. We are not so sure about that?—It would not go in there.

3501. It is between the mouth of Barking Creek and the outfall of the sewage?—Yes.

3502. You know that bank?—Yes.

3503. You have tried that?—No, on the shore I am speaking about, and not on the river, because we are going to shovel this stuff in.

3504. You could shovel it off that bank, could not you?—Yes.

3505. You could have got a good many shovelfulls, in fact a good many boats full?—We have not tried it yet.

3506. But could not you?—Yes, if it was found good enough by the farmers to put on their land.

3507. You could get plenty of it?—Yes, all up and down the river Thames..

3508. On that side where you went up for it?—Yes, and close up to the outfall.

3509. And below that down towards Barking Creek?—It did not run to the creek within about 150 yards.

3510. What depth was it?—About 18 inches.

3511. That was on the bank?—On the shore from the outfall.

3512. You could have shovelled 18 inches from the bank and put it in the boats if it had been good enough to lay on the farm?—Yes.

3513. You thought you would make a good thing of it; you thought it would be good stuff to lay on the farm?—I expected so, in fact I am going to try it.

3514. You never heard any complaints from Barking about this?—We have heard complaints of course.

3515. Why of course?—People will talk about things.

3516. They do not talk about things that do not exist?—Some of them will be wanting to know to-night how they have been getting on here to-day.

3517. It makes a bit of a stir in Barking?—Yes.

3518. What is it they complain of in Barking?—I do not know I am sure. Of course they complain about the London sewage.

3519. What do they say is the effect of it?—They seem to think the drift from the main outlet sewer comes up the creek.

3520. They complain of the stench?—They do not smell that.

3521. They never complain of that?—No.

3522. You never heard anybody complain of that?—No; but you may smell it a quarter of a mile from the outfall when they have got the reservoir ventilators open.

3523. You never heard anybody complain of the stench from this sewage matter deposited?—Not in Barking town, as that is about 2½ miles from the main sewer outlet.

3524. Perhaps nearer the creek's mouth people would smell it more?—Of course you might smell it more at the creek's mouth.

3525. You have heard complaints there?—Yes, when the wind lay that way.

3526. Which way?—Down the river towards the factory.

3527. What do you think the stench proceeds from there?—Of course from the main sewers outfall, when the sluices are open.

3528. That is when it is in a state of liquid?—Yes.

3529. But when it is deposited and lies on the bank and is left dry for the sun to act upon, do you think it is any worse or better?—The tide so soon flows over it that it does not leave time for the sun to lay hold of it. Perhaps if you shovelled some of it on to a bank away from the action of the tide, it might make a little difference.

3530. You have never smelt it yourself at the creek's mouth?—Yes, I have, when the sewage reservoir sluices have been open.

3531. I mean the mud that has been deposited there?—No. It would have to be pretty strong before I should take much notice of it, because I generally supply farmers with manure, and the more it smells, the better I like it.

3532. The more it stinks the better for you?—Yes; but there is no particular smell from the sewage outfalls. There may be when the sluice is open, perhaps for a short time.

3533. You never tried that mud?—No, I never tried that mud.

3534. As to the navigation, you say it is just the same as it ever was?—There is no difference but at the creek's mouth?—There is a little delay in getting up the creek, from half an hour to an hour.

3535. What do you attribute that to?—This bank of mud at the creek's mouth, and the alteration of the gut of the creek.

Re-examined by Sir J. KARSLAKE.

3536. I understand you to say that that mud prevents your barges going in quite so soon, but it does not prevent your getting up to Barking as soon as you used to do?—No, we get up to Barking just exactly the same. We should have to stop higher up the creek.

3537. Can you give me the depth of water at high spring tides at the mouth of the creek?—21 feet.

3538. What is the depth of water at Barking Quay then?—12 feet, spring tides.

3539. And that regulates the largest ship that could get in?—Yes.

3540. What is it safe to have under the bottom of a ship, half a foot or a foot?—If there are three inches that is quite sufficient. The sooner they are done with the sooner they are moored. As long as they get up to their destination, that is all you want.

3541. If a vessel drawing 12 feet of water came up when the tide was ebbing she would have to lie in the channel till the next tide. However, what you say is this, 12 feet is the shallowest part, and that is at the quay?—That is at the town quay.

(*Mr. Lloyd.*) That is at springs?

(*Sir J. Karslake.*) That he assumed.

(*The witness.*) If a vessel draws 12 feet, she only requires very little more than 12 feet to get through. She does not require 13 feet; 12 feet 3 inches would be quite sufficient, as long as there is an inch of water under the vessel's bottom that is enough.

3542. (*Sir J. Karslake.*) What is the draught of the largest barge which you ever took up to Barking yourself?—Five feet six inches.

3543. What is the largest vessel you ever saw up there?—I never take any notice of vessels, that is not my business.

Sir J. Karslake stated that that closed the evidence on the part of the Metropolitan Board of Works, and handed in the following documents: viz. The correspondence between the Thames Conservancy and the Metropolitan Board of Works, and also between the Home Office and the Metropolitan Board of Works.

Mr. Lloyd handed in the following documents: viz. Correspondence in return to an order of the House of Commons, 26th November 1867; Blue Book on the Metropolitan Main Drainage; Report to the Metropolitan Board of Works on the main drainage of the metropolis, presented by Messrs. Bidder, Hawkesley, Bazalgette, in accordance with a resolution of the Board, dated 23d November 1857; Report from Captain Galton, and Mr. Simpson with their observations on that report and the plans in connexion therewith; Report of select committee and minutes of evidence upon sewage (metropolis).

(*Mr. Lloyd.*) Then there is a pamphlet published by Mr. Bazalgette in 1865, containing the particulars of the main drainage scheme, in fact, a verbatim copy of a paper read by him at the Institution of Civil Engineers. I did not know of it at the time that Mr. Bazalgette was under cross-examination. It is published by the Institution of Civil Engineers, and if I had had it I should have asked questions of Mr. Bazalgette about it. If it is necessary I must ask to recall him for the purpose.

(*Sir J. Karslake.*) Rather than have Mr. Bazalgette recalled the pamphlet may be before you as far as I am concerned, but if there is anything inconsistent with Mr. Bazalgette's opinion, as given in evidence here in that pamphlet, he not having been asked anything about it, it must not be taken to contradict any evidence which he has given here.

(*Mr. Lloyd.*) Then I must ask to have him recalled, because there are certain statements in this pamphlet as to the experiments made with the floats which are utterly inconsistent with, and in fact altogether contradictory of, the evidence which he gave as to the observations made with the floats.

(*Sir J. Karslake.*) That of course gives rise to this observation at once. Every one of those gentlemen who have been called, Mr. Bidder, Mr. Hawkesley, Mr. Bazalgette, and others, were all parties to those experiments, and they have all deposed to them; therefore everyone of them ought to have been asked what explanation he had to give.

(*The Commissioner.*) I really think, without recalling Mr. Bazalgette, as I must make my report on the evidence submitted to me here, you may leave that question with me.

(*Mr. Lloyd.*) I just want to observe what this is that I am pointing to specially. He states before the Institution of Civil Engineers what were the actual experiments made, and the results of them, and it is that portion of his pamphlet which I particularly wish to call attention to, because it certainly seems to me that there is an extraordinary inconsistency between that and his evidence.

(*The Commissioner.*) I do not know what course Parliament may take when it has my report before it, but we know very well that there is in existence a Royal Commission to inquire into the pollution of rivers generally, and we also know that that Commission is very speedily going to make its report, and therefore I think we may take it for granted that Parliament before long will legislate generally upon the question of the pollution of rivers.

(*Mr. Lloyd.*) This was a question simply as to the reflux of sewage matter tested by those experiments with the float. The result of those experiments I do not like to mention now, but it is stated by Mr. Bazalgette in the paper which he read before the Institution of Civil Engineers in 1865. If I had been aware of it at the time I cross-examined him I certainly should have put this pamphlet into his hand and asked him whether he adhered to those conclusions, or not. If there is no objection to it, I would rather put the pamphlet in.

(*Sir J. Karslake.*) I will only make the observation which I made before, that you have had Messrs. Bidder, Hawkesley, and Bazalgette before you, who were all parties to this scheme as to the site for the metropolitan main sewers outfall.

(*The Commissioner.*) And also Mr. Haywood.

(*Sir J. Karslake.*) And Mr. Haywood, who has also given evidence on the subject. You have also had Mr. Heman's. You have had the best engineers we could call for the purpose of giving you their opinions as to the effect of this discharge of sewage into the Thames; and they have also told you that they were parties to approving of the present site for these main sewerage outlet works.

(*Mr. Lloyd.*) That is not what I am talking about. This is a report of experiments made by Mr. Frank Forster, and then subsequently repeated by Captain Burstal and the author of the pamphlet, who is Mr. Bazalgette.

(*Sir J. Karslake.* Then I object to it still more,

FIFTH DAY.
31 July 1869.

because it obviously refers to experiments made of a different character and at a different time to those which were made in conjunction with Mr. Bidder and Mr. Hawkesley.

(*Mr. Lloyd*). They only adopted these results.

(*Sir J. Karslake.*) They have all told us in their evidence what they did.

(*Mr. Philbrick.*) They adopted this plan, knowing the experiments that had been made.

(*Mr. Lloyd.*) Here are the experiments themselves.

(*Sir J. Karslake.*) I do not know that.

(*Mr. Philbrick.*) If the result of the experiments militates against the plan that was adopted it shows that they did it designedly.

(*Mr. Lloyd.*) That has nothing to do with it. The question is, whether Mr. Bazalgette is right in his statement that not a drop of sewage can come up, but that it must all flow out to sea. Here is the damning contradiction of that statement from his own lips.

(*Sir. J. Karslake.*) I deny that there is any contradiction at all, more especially if it relates to the float experiments.

(*Mr. Lloyd.*) I shall make use of that.

(*Sir J. Karslake.*) I shall object to it if you do.

(*The Commissioner.*) Do you wish that Mr. Bazalgette should be recalled at our next meeting ?

(*Mr. Lloyd.*) I should like to have him in attendance.

(*The Commissioner.*) Will you have him in attendance on Wednesday ?

(*Mr. Smith.*) Yes.

(*The Commissioner.*) Will you close the inquiry to-day ?

(*Sir J. Karslake.*) All the evidence has been given, as I understand, which either party wishes to put in.

(*Mr. Lloyd.*) This question arises, whether when we meet again it may not be necessary to call some evidence in contradiction of what has been stated on behalf of the Metropolitan Board.

(*Sir J. Karslake.*) I do not see how my learned friend is entitled to do that.

(*The Commissioner.*) I do not think it necessary.

(*Sir J. Karslake.*) You may remember the peculiar position we were in when my learned friend Mr. Lloyd closed his case long ago. Then you took up the case with the conservator's evidence, and then Mr. Hope was called for one particular purpose, in connexion with the Essex Reclamation Company, which has nothing on earth to do with this Barking memorial case, although there is no doubt that the Essex Reclamation Company are prominent parties in the case as far as I can judge.

(*Mr. Lloyd.*) I wish they were. We cannot get them to move unfortunately.

(*Sir J. Karslake.*) As I always thought, it was an entirely collateral issue, but it is an issue which has raised a great deal of prejudice. I believe you have already before you the special report and the evidence taken before the Committee on the Essex Reclamation Company's Bill. I shall have occasion to call your attention to that, in order to show you how far we assisted them in getting their bill.

(*Mr. Lloyd.*) You have done nothing since, unfortunately, to help them.

(*Sir J. Karslake.*) We have done nothing to hurt them.

(*The Commissioner.*) When shall you be able to reply, Mr. Lloyd ?

(*Mr. Lloyd.*) I cannot reply before next Saturday.

(*Sir J. Karslake.*) Then, sir, I propose, as we must have an adjournment for my learned friend's reply, that I should defer addressing you till the next meeting, because before doing so I should like to have an opportunity of looking through the notes.

(*The Commissioner.*) Very well then, as we cannot come to a conclusion to-day. It does not much matter, because I cannot now report so that such report may be laid before Parliament this session.

(*Sir J. Karslake.*) I think not.

(*The Commissioner.*) It is not to be expected that I can gallop through a report upon a subject like this.

(*Mr. Smith.*) I am afraid if it is adjourned till Saturday that Mr. Bazalgette's duties will preclude him from attending.

(*Mr. Lloyd.*) Oh, I daresay he will be able to come.

(*Mr. Smith.*) I am afraid not ; I will do my best, but I cannot promise that he will be in attendance.

Adjourned till Saturday, August the 7th, at 11 o'clock.

SIXTH DAY.

No. 6, Committee Room, House of Commons, Saturday, 7th August 1869.

Mr. Lloyd asked to be allowed to call a witness to speak to the time of the tide at which the sewage was observed to be flowing out of the outfall of the sewers last Tuesday.

Sir John Karslake stated that he had no objection to the witness being called, though he was sorry the Metropolitan Board of Works had not had notice that the witness was going to be called, so that they might have had somebody present to explain the circumstances.

SIXTH DAY.
Mr. R. C. Driver.
7 Aug 1869.

Mr. Robert Collier Driver called ; examined by Mr. Lloyd.

3544. You are a surveyor, as we know, carrying on business in Whitehall ?—Yes.

3545. I believe on Tuesday last (3rd inst.), in company with a number of other persons, you went down to the creek at Barking ?—Yes.

3546. You went across the creek where the stairs are ?—Yes. I went across the creek, and then along the side of the Thames.

3547. I will not ask you any questions about the creek or its state. You went across it, however, and down to the metropolitan main sewers outfall ?—We did.

3548. A large party of you ?—Yes.

3549. You examined the metropolitan outfall sewers, I believe ?—We did.

3550. At what time of the day were you there ?—As near 6 o'clock p.m. as possible ; it was either five minutes to or five minutes after ; it was as near as possible 6 o'clock.

3551. Were the sewage reservoir sluices open, and was the sewage pouring out ?—Yes, the sluices were open and the sewage was pouring out. The rising tide was up to within a mere trifle of the top of the arches ; we could just see the curve of the arches.

3552. Was the sewage coming out in a considerable volume ?—Yes, it was pouring out.

3553. Did you ascertain from the smell that it was sewage matter that was coming out ?—I was not near enough for that, but it had a dark look, and a

very different look to that of the adjoining Thames water; and there was a line of demarcation outside, in the stream of the Thames, all the way (if I had a plan I could show it) evidently there it was all seething up. This sewage was pouring out at a great pace, and the tide was flowing; it was ascending; and seemed to me as if it was all stirring up and then gradually deposited itself on both sides.

3554. There is no doubt about the fact of the tide being on the flood then?—None whatever.

(*Sir John Karslake.*) You may assume that?

(*Witness.*) The tide was ascending.

Cross-examined by Sir J. Karslake.

3555. Do you know what the rainfall had been in the 24 hours preceding?—There had been a good deal of rain.

3556. Did you examine the main sewerage works sufficiently to see the outfall provided for the surplus water?—I do not quite understand the question.

3557. I do not know whether you ever read these reports, which proceed on the assumption that 12 days in the year there may be an overflow of sewage into the Thames?—No; I have not gone into this question at all. I saw this fact, and I have been asked to prove it; I know nothing more about it.

3558. You saw the letter in the "Times" the next day advertising the fact?—I saw it this morning.

(*The Commissioner.*) Sir John Karslake has asked you if you know under what conditions an overflow of the main sewers may have taken place, and as to the periods at which they must necessarily discharge storm water.

(*Sir J. Karslake.*) I think we need not go into that, sir, if you will allow me to say so. I saw that letter in the "Times," and I made inquiries about it, and I have been informed that an overflow of sewage would have taken place if the sluice had not been pulled up. Mr. Barnes, contrary to his orders, had pulled up the sluice, so that it is true that sewage was going from the sluice, and it was not merely the overflow on that occasion.

(*Mr. Lloyd.*) It was not pouring out at one sluice only?

(*Witness.*) I can say that it was not one individual sluice; there were six or seven, or more, all in action. What I know is, that I saw it pouring out of several. I did not know that I should be called here to prove this, or I should have made a more careful inspection.

(*Sir J. Karslake.*) I beg your pardon, sir, for interrupting you, but I thought I might save you going into a needless inquiry.

(*Witness.*) I am not prepared to go into anything more than what I saw.

3559. (*The Commissioner.*) You do not know what was the depth of rainfall that day?—No, but I should hardly think that the rain would have produced such an early effect as that, but I do not know.

(*Sir J. Karslake.*) If I could have called Mr. Bazalgette he would have given the whole statistics, but if you will take them from Mr. Bidder, he has them from Mr. Bazalgette, and I suppose it is a fact easily ascertained.

(*The Commissioner.*) Is Mr. Bazalgette to be here to-day?

(*Sir J. Karslake.*) He is so unwell that he cannot be here. Mr. Bidder will give the facts from the instructions of Mr. Bazalgette. I only ask you to take it in order to enable you to make an inquiry whether what he will give you is correct or not.

Mr. George Parker Bidder recalled.

Mr. G. P. Bidder.

3560. (*Sir J. Karslake.*) Will you be good enough to give the figures furnished to you by Mr. Bazalgette as to the recent fall of rain?—Thirty-five hundredths in 12 hours.

(*The Commissioner.*) That is a little more than a third of an inch; or at the rate of two thirds of an inch in 24 hours.

(*Witness.*) Twenty-nine hundredths fell in 4½ hours; and that is at the rate of an inch and a half a day.

3561. (*The Commissioner.*) Do you happen to remember at what rate rain of that character comes off the surface of the London streets?—I cannot tell from recollection. I think you will find facts in our report bearing on it. What is stated there I think is that in the same day a third of the rainfall always went off.

(*The Commissioner.*) I have it from other sources that the rainfall over the metropolis is very quickly down the metropolitan sewers.

(*Witness.*) It is about a third in the day. Certainly a third of the rain falling flows off in the 24 hours.

Mr. Lloyd tendered Professor Way as a witness who could give the chemical constituents of the mud spoken to by the witnesses who had been already examined.

The Commissioner stated that, as the inquiry had been virtually closed, he could only receive the evidence of Professor Way if Sir John Karslake assented.

Sir J. Karslake objected to the reception of the evidence, the Metropolitan Board of Works not having had notice that Professor Way was going to be called, and Dr. Miller and Dr. Odling not being in attendance.

Sir J. Karslake was then heard in support of the case of the Metropolitan Board of Works.

Mr. Lloyd was heard in reply.

APPENDIX.

I.—Copies of Letters and Notice preliminary to the Inquiry.

I.—Copies of Letters preliminary to the Inquiry.

Northern Metropolitan Sewage Outfall, River Thames Pollution.

Local Government Act Office,
May 8, 1869.

Sir,

In reply to a memorial from the Thames Conservancy Board to the Home Secretary, asking that there may be inquiry under the powers of the 31st section of the Metropolis Local Management Act (Amendment Act, 1858), as to reputed obstructions and pollutions in the river by the discharge of sediment from the northern outfall, I have to inform the Board of Conservators that Mr. R. Rawlinson, having been directed to make such inquiry it will be advisable that he should be placed in communication with your engineer as also with any other person in the employment of the Conservancy with whom it may be considered useful that he should communicate for the purposes of his inquiry.

Returns or complaints of a recent date with which you think Mr. Rawlinson should be furnished I shall be glad to have copies of.

I am, &c.
(Signed) T. Taylor.

Capt. E. Burstal, R.N.

Metropolitan Northern Main Sewerage Outfall.

Local Government Act Office,
May 8, 1869.

Sir,

In consequence of a memorial from the Thames Conservators, asking for an inquiry under the powers of the 31st section of the Metropolis Local Management Amendment Act, 1858, on complaint by memorialists resident in Barking of obstructions and pollutions in the river Thames and Barking Creek said to be caused by the discharge of sewage from the works of the Metropolitan Board of Works at Barking Creek, I am to inform the Board that the Home Secretary has directed inquiry to be made under the section by Mr. Robert Rawlinson, one of the inspectors of this office.

I have therefore to request that he may be placed in communication with your engineer, and that he may be allowed access to such plans, sections, estimates, or other available information in possession of the Metropolitan Board as he may require for the purpose of his inquiry.

I am, &c.
(Signed) T. Taylor.

John Pollard, Esq.,
Metropolitan Board of Works.

No. 2033.
B. 14.5.69.

Metropolitan Board of Works,
Spring Gardens, S.W., May 25, 1869.

Sir,

The Metropolitan Board of Works have had before them your letter of the 8th instant, requesting that Mr. Robert Rawlinson may be placed in communication with their engineer, and allowed access to such plans, sections, &c., as he may require for the purpose of an inquiry which he has been directed to make, with reference to a complaint from residents in Barking of obstructions and pollutions in the river, alleged to be caused by the discharge of sewage from the board's works.

The board have directed me to acquaint you that instructions have been issued to their engineer to place himself in communication with Mr. Rawlinson accordingly, and that every facility will be afforded to him to enable him to make the inquiry referred to.

I am, &c.
John Pollard,
Clerk of the Board.

T. Taylor, Esq.,
Local Government Act Office.

Thames Conservancy Offices,
May 13, 1869.

Sir,

I have to acknowledge the receipt of your letter of the 6th instant, on the subject of the proposed inquiry by Mr. Rawlinson relative to the obstructions in the river off the northern main drainage outfalls, and beg to inform you that the conservators of the river Thames have directed Mr. Leach to communicate with Mr. Rawlinson and supply him with such plans and information as may be required.

I am &c.
E. Burstal,
Secretary.

T. Taylor, Esq.,
Local Government Act Office.

Whitehall, June 14, 1869.

Sir,

I am directed by Mr. Secretary Bruce to acknowledge the receipt of your letter of the 12th inst., and to inform you that he sanctions the employment of a shorthand writer to attend the inquiry to be held before R. Rawlinson, Esq., at Barking on 21st inst. to inquire as to the discharge of the sewage of London into the river Thames.

I am, &c.
A. F. O. Liddell.

Tom Taylor, Esq.

Whitehall, July 8, 1869.

Sir,

I am directed by Mr. Secretary Bruce to acknowledge the receipt of your letter of 5 inst., and to inform you that the Comptroller of the Stationery Office has been instructed to print the evidence taken at the Barking inquiry into the pollution of the river Thames, and to request that you will communicate with him on the subject.

I am, &c.
A. F. O. Liddell.

Robt. Rawlinson, Esq.,
Local Government Act Office.

Notice published prior to the Inquiry.

Metropolis Management Amendment Act, 1858.
21 & 22 Vict. cap. 104.

Whereas, in pursuance of the 31st section of the Metropolis Management Amendment Act, 1858, and of a Memorial addressed to the Right Honourable Gathorne Hardy, M.P., as one of Her Majesty's Principal Secretaries of State, from the vicar, churchwardens, medical practitioners, smack owners, and other inhabitants and landowners of Barking, in the county of Essex, praying him to take proceedings to restrain the Metropolitan Board of Works from discharging the sewage of London into the river Thames, inquiry has been directed as to the subject matter of such Memorial.

Notice is hereby given, that on Monday, the 21st day of June 1869, at 12 o'clock at noon, at the Town Hall, Barking, Robert Rawlinson, Esq., C.B., the Inspector appointed for the purpose, will proceed upon the said inquiry, and will then and there be prepared to hear all persons entitled to be heard before him upon the subject thereof.

Dated this 10th day of June 1869.

II.—Return from the Borough Engineer of Birmingham.

II.—Return from the Borough Engineer of Birmingham as to the Amount of Sewage Sludge and Road Detritus annually brought down by the Main Sewers of Birmingham, deposited in the Outfall Sewage Reservoirs situate on the River Tame and removed from them.

To W. S. Till, Esq. Local Government Act Office, May 11, 1869.

My dear Sir,

Can you let me have answers to the questions as put below?

1. Present population of Birmingham, draining to the sewage works on the river Tame.	About 360,000.
2. The area sewered in acres	,, 7,320.
3. The weight of material used per annum to repair and maintain the streets and roads over the district sewered.	,, 45,000 tons.
4. Cross-sectional dimensions of the outfall sewers	Two egg-shaped mains, each 5 ft. 9 in. by 4 ft.
5. Dry weather, volume of sewage per day	About 17,000,000 gallons.
6. Area of land used for the outfall works, and space for deposit	,, 12 acres.
7. Number, area, and capacity of the depositing tanks used	Two tanks, each 330 ft. by 90 ft., and averaging 6 ft. deep.
8. Engine power used	The engine is 13-horse power, but is much more than is required.
9. Height the sludge is lifted	The sludge is lifted about 14 feet.
10. Weight per annum of grit and sludge removed	About 142,000 cube yards from the tanks.
11. Area of land usually occupied by this sludge	,, 7 acres.
12. Depth to which the sludge is usually stored	,, 4 feet.
13. Length of time it usually remains on the ground	,, 9 to 12 months.
14. Is any material used to cover and deodorise the refuse	Gypsum, at 16*s.* per ton.
If so, what, and at what cost	Average cost, 100*l.* per annum.
15. Is the refuse sold and removed	About 11,615 sold in 1868, being 3,228 tons over 1867. Price 9*d.* per ton.
16. About what weight or cube quantity of solid refuse have you on the ground.	About 25,000 cube yards.
17. The cost of such works as you have now for abstraction of solids	25,000*l.*
Details.	
18. Land	15,000*l.*
19. Works, tanks, engine, &c.	10,000*l.*
20. Labour in working same per annum	2,000*l.*
21. What is about the least day or weeks deposit	Average about 120 cube yards per day.
22. What is about the greatest do. do.	Cannot give other information.
23. Area used for irrigation at present	120 acres.
24. Area purposed to be used for irrigation	Cannot say.
25. Rateable value of the entire municipal borough	1,040,000*l.*

William S. Till, May 12, 1869.

III.—Return as to the Metropolitan Outfall Sewers.

III.—Return as to the Metropolitan Outfall Sewers at Barking.

Metropolitan Northern Outfall Sewers into the Thames at Barking.

To J. W. Bazalgette, Esq.

Dear Sir, Local Government Act Office, May 13, 1869.

To enable me to report to the Home Secretary on the question of (reputed) river Thames pollution by the metropolitan northern outfall sewers, can you fill in answers (in general terms) to the following questions?

Yours truly,
Robert Rawlinson.

1. Area in square miles sewered by the northern outfalls	About 50 square miles.
2. Population sewered	,, 2,300,000 persons.
3. Gross rateable value of the property sewered	,, 12,500,000*l.* this year, 1869.
4. The ordinary daily flow of 24 hours of sewage into the Thames at the outfalls at Barking.	,, 32,743,000 gallons.
5. The ordinary daily flow of sewage into the Thames from any other sewers, as at Victoria Street, &c.	,, 3,000,000 cubic feet.
6. The amount of refuse (tons or cube yards) removed from the northern metropolitan sewers by hand labour or otherwise, and the cost.	Returns not available.
7. The date of opening the northern outfalls into the Thames.	July 1863.
8. The regulations under which the sewage is admitted to the Thames.	The sewage is pumped and stowed in the covered reservoir near Barking Creek until after high water, and when the sewage in the reservoir and the water in the river Thames become upon a level, the sewage commences discharging into the river, it being then ebb tide. This occurs on ordinary occasions from one to one hour and a half after high water, and the discharge of sewage is (usually) complete in about two hours, when the sluices in the reservoir wall are closed, and no further discharge takes place into the river until after high water of the following tide.
9. The date of commencing steam pumping into the northern outfall.	8th May 1868.
10. The daily or average daily volume pumped	About 7,000,000 gallons in 24 hours at the Abbey Mills Pumping Station.
11. The area drained by pumping	About 17 square miles, *i.e.*, when the main drainage system shall be complete.

APPENDIX.

12.	The population drained by pumping - -	About 980,000 persons, *i.e.*, present number, 1869, on the 17 square miles.
13.	The annual cost of pumping at the Abbey Mills Pumping Station.	3,500*l.* per annum.
14.	The annual cost of working the northern outfall sewage tank and sluices.	1,500*l.* „ „
15.	The area of land at the northern outfall belonging to the metropolitan board.	61 acres of land and 15 of reedshore, river wall and embankment. A part of the 61 acres is in the occupation of the Essex Reclamation Company, and a portion is occupied by the Chartered Gas Company.
16.	Is the contract with the company for the utilization of the northern sewage being effectively carried out? Or will it be carried out?	The contract required the company to make a culvert not less than 9' 6" diameter to Rawreth (Essex) and continuation to Foulness (Maplin) Sands, and at option of company to Dengie Sands also, and to make embankment works to reclaim foreshore at Foulness (Maplin) Sands to the extent of 7,000 acres. The works done comprise about half a mile, principally, of 10 ft. barrel brick culvert complete. Also about a quarter of a mile of similar culvert nearly complete. Also fully half a mile of works for 10 ft. barrel in various stages; also various pen-stock chambers and buildings, and about two miles of 15" iron pipe, and steam-engine at Barking Creek for pumping to company's farm land at Rippleside. As to latter part of question, the works are suspended, but the 10 years allowed for completion of culverts has not expired, and the time for the embankment works at Foulness is not limited.
17.	Approximate estimate of the volume of sewage used by the company in irrigation per day, week, month, or year.	The quantity of sewage taken by the Reclamation Company for the year ending 31st December 1868, was about 466,000 tons.

June 22, 1869.

IV.—Report to the Thames Conservancy Board, on Thames Water and Thames Mud, by Dr. Letheby.

IV.—Report by Dr. Letheby.

Dear Sir, July 6, 1868.

In accordance with your request I have to report to you the results of the examination of the various samples of Thames water and Thames mud collected and forwarded to me by Mr. Leach during the present year (1868).

The samples of Thames water were obtained on each occasion at the following places, and in the following states of the tide:—

At Woolwich, two hours of flood tide.
At Greenwich, three hours of do.
At London Bridge, on flood tide.
At London Bridge, on ebb tide.
At Greenwich, two hours of ebb tide.
At Woolwich, three hours of do.

The first series of samples were obtained on the 11th of January last, and as will be seen from table No. 1 they contained from 46·2 to 261·6 grains of soluble matter per gallon, of which from 2·1 to 6·6 grains were organic, and they also furnished from 4·2 to 53·3 grains of suspended matter of which from 0·9 to 7·4 grains were organic.

The second series of samples were received by me on the 1st of February of this year, and it is evident from the results shown in the table that they were taken from the river (Thames) when it contained a large amount of flood water, for the dissolved matter ranged from 19·2 to only 23·2 grains per gallon, and of this from 1·2 to 3·1 grains were organic; the suspended matter amounted to from 6·1 to 25·4 grains per gallon of which from one to 3·2 grains were organic.

The third series were received on the 19th of February, and they also show a considerable proportion of flood-water in the river, for excepting the sample which was taken at Woolwich three hours after the ebb-tide, the maximum amount of dissolved matter was but 45·2 grains per gallon, and the minimum only 24·2. The soluble organic matter ranging from 1·3 to 8 grains per gallon, and with respect to the suspended matters they ranged from 3·4 to 31·3 grains per gallon, of which from 0·3 to 5·1 grains were organic.

Other samples of water were taken from the river Roding, and from Barking Creek,* but as will be seen from the table they were so largely impregnated with sewage as to leave no doubt of their nature.

In all cases the suspended matter was carefully examined under the microscope for the purpose of ascertaining its precise quality, and in most instances it was found that it consisted of amorphous matter of the nature of clay, of crystalline particles of carbonate of lime, and of the tissues of vegetables made use of as food, as hairs and cuticle of wheat, spiral vessels, &c., besides the fibres of cotton (sometimes dyed), and swarms of diatomaceous remains. The vegetable tissues are indicative of the presence of sewage, most of them being precisely like those which are found in human excreta.

The proportions of suspended matter are undoubtedly high, and do not differ to any considerable extent from those which I found in the river (Thames) water in the months of June and July of 1858. In fact by taking the mean of the several analyses at high and low tide at London bridge, and at Greenwich, in the years 1858 and 1868, the results may be thus expressed.

Proportions of Suspended Matter per Gallon.

	At London Bridge.		At Greenwich.	
	1858.	1868.	1858.	1868.
	Grs.	Grs.	Grs.	Grs.
Organic matter -	3·32	5·22	1·65	2·00
Mineral do. -	13·60	13·37	6·68	11·13
Total - -	16·92	18·59	8·33	13·13

And contrary to what was observed in 1858, the flowing tide contains more suspended matter than the ebbing. This is evident from the following table:—

Proportions of Suspended Matter per Gallon.

	Inflowing Tide.			Ebbing Tide.		
	Woolwich two hours flood.	Greenwich three hours flood.	London Bridge on flood.	London Bridge on ebb.	Greenwich two hours ebb.	Woolwich three hours ebb.
	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.
Organic matter -	3·4	2·5	3·8	1·3	1·5	3·9
Mineral do. -	17·9	14·3	21·2	5·6	8·0	21·4
Total -	21·3	16·8	25·0	6·9	9·5	25·3

So that, excepting the Woolwich samples, which appear to be nearly alike in both states of the tide, it may be said that the average amount of solid matter in the flowing tide at Greenwich and London Bridge, is nearly 21 grains per gallon, while that in the ebbing tide is only 8·2 grains. The effect of this is obvious: matters are carried upward by the stream, and during the lull of high tide, when the water is comparatively quiet, they are precipitated in the form of mud. It is therefore in the highest degree important that the solid constituents of sewage should not be discharged into the river during the upward movement of the tide. It

* The "river Roding" embraces "Barking Creek." Above Barking town the proper name of the river (Roding) is used. Below Barking, and to the Thames, the terms "Barking Creek" are used.

is necessary indeed that the greatest precautions should be taken in this respect.

I have also to report that the several samples of mud which have been forwarded to me, were in a very offensive condition. They were black and putrescent, and when they were examined under the microscope they presented the appearance of broken up sewage matters, with the remains of animalcules, and a large quantity of carbonate of lime in a partly crystalline state, together with the amorphous matter of the river banks. In these particulars the samples were precisely similar to those obtained from the northern and southern (main sewer) outfalls in 1867, which were the subject of a report by me on the 24th of June last year.

The composition of the mud is shewn in table No. 2, and it will be observed that the proportions of organic matter range from 12·06 to 15·93 per cent. of the dry mud, the average of the first four samples being 14·19 per cent., while that of the mud from Barking Creek is 13·66 per cent. These proportions are very similar to the quantities of organic matter found in the (metropolitan main sewers) outfall mud already alluded to, and which ranged from 14·49 to 15·50 per cent. I have no doubt therefore of their having one common origin, and of their being composed of the river silt with sewage and carbonate of lime. In fact the similarity of their composition to the suspended matters of the several series of waters submitted to me for examination is very striking, as will be seen in the following table:—

PER-CENTAGE COMPOSITION OF THAMES MUD, and the SUSPENDED MATTERS IN THAMES WATERS.

Average Composition.	Organic Matter.	Mineral Matter.
Four samples of mud received June 2 -	14·19	85·81
Three do. from Barking Creek -	13·66	86·34
Mud at southern outfall (1867) - -	14·49	85·51
Do. do. do. - -	15·01	84·99
Do. at northern outfall (1867) -	15·50	84·50
In water at Woolwich two hours flood -	16·00	84·00
Do. Greenwich three hours do. -	17·48	82·52
Do. London Bridge in flood -	15·20	84·80
Do. do do. in ebb -	18·84	81·16
Do. Greenwich two hours ebb -	15·79	84·21
Do. Woolwich three hours do. -	18·18	81·82

It will be further remarked on examining the table No. 2 that all the samples of mud contain a notable proportion of organic nitrogen, for when they are distilled with potash, and its permanganate, they yield from 0·189 to 0·567 per cent. of ammonia. According to my observations and analysis, the dry suspended matters of sewage furnished, when they are thus treated, about three per cent. of ammonia. It would therefore seem that the mud, and the suspended matters of the river, contain from 6·3 to 18·9 per cent. of the solid constituents of sewage. All authorities are agreed that these are the substances which give to Thames mud its offensive properties, for the soluble constituents of sewage are so rapidly oxydised when they are diluted with water as to be insignificant in comparison with the insoluble matters. This was the substance of my report to Messrs. Bidder, Hawksley, and Bazalgette in the month of March 1858, when they requested me to advise them on the matter in respect of the main drainage of the metropolis, and I have always considered that the chief object of the (sewage) reservoirs at the northern and southern outfalls was for the reception of the sewage, and for its defœcation by subsidence, until it shall be discharged during the first hours of the descending tide, and that if necessary they should be used for the additional defœcation of the sewage by means of lime or other chemical agent. This in fact is the description of them by Messrs. Bidder, Hawksley, and Bazalgette, in their report to the metropolitan board of works, upon the main drainage of the metropolis in 1858 (p. 92 and p. 99), and it is evidently contemplated, and provided for in the 24th and following sections of the Metropolis Local Management Amendment Act of 1858 (21st and 22nd of Victoria, chapter 104), which gave power to the Metropolitan Board of Works to undertake the purification of the Thames by improving the main drainage of the metropolis, and it is especially provided in the 24th and 31st sections that this shall be done without being a nuisance.

In conclusion, I beg leave to state that with proper precautions in the defœcation of the sewage in the (sewage) reservoirs at the outfalls, and in the discharge of the defœcated water into the river there would not in my opinion be any cause for complaint, or any injury to the river Thames.

I remain, &c.

To Capt. Burstal. HY. LETHEBY.

TABLE No. 1.—Showing the COMPOSITION of the SAMPLES of WATER taken from the River THAMES at various times of the Tide at WOOLWICH, GREENWICH, and LONDON BRIDGE in the Months of January and February 1858; also of SAMPLES of WATER taking from the River RODING and from BARKING CREEK in May and June 1868.

Constituents per Imperial Gallon.	Taken at Woolwich, 2 hours, flood tide.	Taken at Greenwich, 3 hours, flood tide.	Taken at London Bridge on flood at 1.30 p.m.	Taken at London Bridge on ebb tide at 4 p.m.	Taken at Greenwich, 2 hours, ebb tide.	Taken at Woolwich, 3 hours, ebb tide.	Taken at Woolwich, 2 hours, flood tide.	Taken at Greenwich, 3 hours, flood tide.	Taken at London Bridge on flood tide.	Taken at London Bridge on ebb tide.	Taken at Greenwich, 2 hours, ebb tide.	Taken at Woolwich, 3 hours, ebb tide.	Taken at Woolwich, 2 hours, flood tide.	Taken at Greenwich, 3 hours, flood tide.	Taken at London Bridge on flood tide.	Taken at London Bridge on ebb tide.	Taken at Greenwich, 2 hours, ebb tide.	Taken at Woolwich, 3 hours, ebb tide.	Labelled No. 5.	Labelled No. 6.	Surface water, sewage, &c. half a mile below Barking millpool.	Surface water from river Roding, close to sluice gates.	Taken at 4 hours flood, close to sluice gates in the millpool before mixing with the last.
Date when taken (1868).	January 11th.						Received February 1st.						Received February 19th.						May 30th.	June 1st.	June 5th.		
Dissolved matter. Organic	Grs. 5·6	Grs. 4·3	Grs. 2·1	Grs. 3·8	Grs. 6·0	Grs. 6·6	Grs. 2·6	Grs. 3·1	Grs. 2·8	Grs. 2·2	Grs. 1·2	Grs. 1·4	Grs. 1·9	Grs. 1·4	Grs. 1·3	Grs. 1·6	Grs. 2·9	Grs. 8·0	Grs. 5·4	Grs. 10·2	Grs. 16·9	Grs. 9·3	Grs. 9·8
Dissolved matter. Mineral	199·8	100·8	44·1	79·7	225·2	255·0	16·8	16·5	18·0	18·2	22·0	18·5	40·3	23·2	22·9	22·8	42·3	115·6	83·7	822·0	266·5	127·2	165·8
Total	205·4	105·1	46·2	83·5	231·2	261·6	19·4	19·6	20·8	20·4	23·2	19·9	42·2	24·6	24·2	24·4	45·2	123·6	89·1	832·2	283·4	136·5	175·6
Ammonia per gallon	0·114	0·086	0·016	0·086	0·114	0·114	0·086	0·043	0.029	0·043	0·114	0·086	0·114	0·086	0·086	0·010	0·114	0·114	0·662	0·431	0·166	0·041	0·041
Suspended matter. Organic	5·6	4·1	7·4	2·6	0·9	3·6	2·5	1·5	2·8	1·0	1·7	3·2	2·0	1·8	1·1	0·3	2·0	5·1	1·0	0·6	10·5	1·3	1·7
Suspended matter. Mineral	29·3	23·1	45·9	8·5	3·3	15·7	13·6	8·7	12·7	5·1	10·8	22·2	10·9	11·0	4·9	3·1	9·9	26·2	1·5	2·0	32·7	3 6	2·9
Total	34·9	27·2	53·3	11·1	4·2	19·3	16·1	10·2	15·5	6·1	12·5	25·4	12·9	12·8	6·0	3·4	11·9	31·3	2·5	2·6	43·2	4·9	4·6

All the samples were turbid from the suspended matters, but none of them had a disagreeable odour excepting the samples from the river Roding and from Barking Creek (dated May 30th, June 1st, and June 5th), all of which had a strong odour of sewage, and from the samples dated May 30th and June 1st were emitting much sulphuretted hydrogen.

The *suspended matters* examined under the microscope were found to consist of much amorphous matter, of particles of carbonate of lime, and of vegetable tissues, as hairs and cuticles of wheat, spiral vessels, fibres of cotton, &c. some of which were dyed of various tints, and all of which were characteristic of sewage.

TABLE No. 2.—Showing the COMPOSITION of the SAMPLES of MUD sent by Mr. Leech on the 2d and 6th of June 1868.

Constituents of the Dry Mud.	Received June 2, 1868.				Received June 6, 1868.		
	Labelled No. 1.	Labelled No. 2.	Labelled No. 3.	Labelled No. 4.	June 5, 1868, Entrance to Barking Creek. Depth of mud 7 feet.	June 5, 1868, in Midchannel abreast Warpool's Sluice, 500 yards up from Creek's Mouth. Depth mud 5 feet.	June 5, 1868, 350 yards from Mill-Pool near Hewett's Ice House, formerly hard bottom, now mud 5 feet 3 inches.
Organic matter	12·06	13·73	15·04	15·93	13·75	13·44	13·79
Carbonate of lime and a little peroxide of iron	27·32	28·14	24·96	23·45	25·77	22·19	18·08
Silica, &c.	60·62	58·13	60·00	60·62	60·48	64·37	68·13
Total	100·00	100·00	100·00	100·00	100·00	100·00	100·00
Ammonia obtained by distilling 100 parts of the dry mud with potash and its permanganate.	0·239	0·189	0·268	0·567	0·298	0·268	0·288

All the samples were black and offensive, and they were found on examination under the microscope to consist of amorphous matter, of the disintegrated tissue of vegetables, especially of wheat, and of swarms of diatomaceous remains.

V.—ANALYSIS of THAMES MUD, by the Rev. JAMES C. CLUTTERBUCK, one of the Members of the River Thames Conservancy Board.

V.—Report by the Rev. James C. Clutterbuck.

Long Wittenham,
Abingdon.

DEAR MR. RAWLINSON,

As I see that you are investigating the vexed question of the mud deposit in the Thames, I venture to send you a memorandum on the subject.

I examined the (mud) deposit at Barking, of which I did not keep the analysis, but I found the constituents very much the same as those in the sample taken at Millwall, this being as I thought, due to the fact, that there, or near there, there is an overflow.

The deposits at Battersea and Kew are I consider due to the trifling particles carried up by the tide. But the point most likely to interest you is the presence of the little red worms, as identical with those found in the Leith and Edinbro' sewage deposits.

Yours &c.
J. CLUTTERBUCK.

Robt. Rawlinson, Esq.,
C.B. &c.

ANALYSES.

I have examined the three samples of deposit in the Thames from Millwall No. 1, Battersea No. 2, Kew No. 3. In the No. 1 and 2 I observed a large number of small red worms, in No. 3 a few. Dr. Rolleston of Oxford to whom they were shown pronounced them identical with those described in a report of Dr. Macadam Stevenson on the contamination of the water of Leith by the sewage of Edinburgh and Leith, and published in an appendix to the third report of the Royal Commissioners appointed to inquire as to the best modes of utilizing the sewage of towns (1865), page 27. He says, "In the whole course of the water "of Leith from Coltbridge downwards, not a single fish "could be seen. The animal life which were specially "visible to the naked eye consisted of colonies of small red "worms, which were very abundant in many places, and are "regarded *as the last remnant of animal life which will "exist in water contaminated by sewage*. These minute red "worms are a kind of Nais belonging to the family of "Naidina, and are named Tubifex Rivulorum." No. 1 contained a large portion of sandy grit easily separated from the finer particles. No. 2 and 3 were almost entirely fine silt. The water with which the deposit was covered in the bottles when submitted to nitrate of silver showed No. 1 salt, No. 2 salt and some other ingredients, No. 3 a black precipitate (the salt being white). All three yielded to Condy's fluid. The analysis gives the proximate quantities as under.

100 grains of each dried, burned, and submitted to muriatic acid.

	No. 1.	No. 2.	No. 3.
Loss in fire	9	18	18
Lime	6	7	6
Iron	7	8	7
Alumina	2	4	5
Magnesia	Trace.	1	1
Insoluble	74	59	60
Loss	2	3	3
	100	100	100

Jany. 4, 1868. JAMES C. CLUTTERBUCK.

ABSTRACT OF THE EVIDENCE

AS TO THE

CONDITION OF THE RIVER THAMES AND BARKING CREEK.

EVIDENCE ON BEHALF OF THE BARKING MEMORIALISTS.

I. Of Secretary and Engineer to Thames Conservancy, and other Professional Men.

Burstal, Capt. E., R.N.:

Is secretary to Thames Conservancy Board. Result of second series of float experiments, 956–963. Allegation of memorial as to loss of 11 feet of water in the channel of the river is a misapprehension; the allegation is true as regards the depth of mud on the shore, but is incorrect as to its position. Outside the creek, and three-quarters of a mile above it, a very large accumulation of mud is taking place inshore. The "Talbot" powder hulk, when moored in 1862, had 14 or 15 feet water; now there is not more than four or five feet on the same spot; coastguard vessel was removed in consequence of the silting; there is no accumulation in the main channel of the Thames, but off the sewer outfall a large accumulation is going on, 964, 965. Very little difference between soundings made in 1832 and 1861, but in 1867 a considerable difference was found, 966–968.

Witness's impression was that the London sewage was to subside, and only the clarified water run off into the river; no apparatus for dredging sediment from the reservoirs, 969–974. As to Mr. Leach's estimate of silt in the river generally (*see below*); accumulation seems to have dispersed; no complaints as to the navigation, only as to mud in suspension being carried up the river and deposited on the shores, 975.

Dredging would not get rid of the surplus filth polluting the water and fouling the shores. Witness is still of same opinion, as stated in his evidence before the Rivers Pollution Commission, that the point of discharge should be 10 or 15 miles to seaward, and the sewage poured out by several instead of one outfall, 976–986.

Cross-examination.

General effect of accumulations observed in 1867 was to level up the bed of the river; it is only fair to say that from surveys made between 1867 and 1869 there have not been deposits in the main channel of the Thames opposite to the metropolitan main sewer outfalls to cause serious alarm as to injury to the general navigation of the river Thames; where there are eddies in slack water the sedimentary deposit will increase, as at the entrance to Barking creek, 987–997.

Davidson, Dr. (*Surgeon*):

Roach and dace were seen in the back river lately; chemicals from the paper mills affect the fish, 115–120. Barking Creek used to be a pleasant row; now the stench from the sewage is intolerable. The Government removed the coastguard station because the men complained of the stench; the sewage can be distinctly seen on the surface of the Thames at the time of discharge, 121–136.

Driver, Mr. R. C.:

Is a surveyor. About 6 p.m. on the 3d August 1869 the sluices of the northern outfall were open, and the sewage pouring out in considerable volume. It had a very dark look to that of adjoining Thames water; the tide was flowing, and it seemed as if it was all stirring up, and then gradually deposited itself on both sides, 3544–3554.

Cross-examination.

There had been a good deal of rain the night previously. There were six or seven or more sluices all in action; the rain could hardly have produced such an effect, 3555–3559.

Leach, Mr. S. W. (*Civil Engineer*):

Is engineer to the Thames Conservancy Board. Explanation of tracing, showing soundings opposite the sewer outlet in the Thames. When the "Talbot" powder vessel was berthed on the north side of the river (a short time previous to 1864), there were 12 or 13 feet of water; on account of the silting she was removed to the other side of the Thames, 813–820.

The sluices are open some hours on the ebb; there is a back eddy on the Barking shore, which drifts the silt to the former berth of the "Talbot," where there is a loss of nearly seven feet of water, 821–832. From 1864 to 1867 there had been a deposit of about 700,000 cubic yards in the river generally; to dredge this would cost 1*s.* 9*d.* per cube yard. 70 per cent. of deposit consists of road detritus. If things remain as they are the shoaling will increase, 833–848.

Horse End has extended since opening of northern main sewer; the deposit is soft, but when analyzed gives the same results as other mud; there is also an accumulation on the opposite side to the Horse End; width of entrance to Barking Creek has been reduced from 40 feet to 18 feet, and depth of water 1 foot, 855, 856. Statements by barge owners as to waiting outside are true, and there may be risk in having waited, 857. Does not know of loss of 11 feet of water in the main channel of the river Thames; has detected mud between 7 feet and 8 feet deep, near houses below Barking, 857–864. There is an accumulation of light matters from the sewage in the bight at the creek mouth; there is a deposit on both sides of the lower part of the creek, 865–868.

Outfall at Crossness is injuring the river quite as much as that at Barking, 869–873. Effect of removing metropolitan sewage outfalls 10 or 12 miles lower down would be to shift the evil from one place to another, 874, 875. Points of discharge proposed by Messrs. Simpson, Galton, and Blackwell would, however, have been better than at Barking, 876-884.

Cross-examination.

Plans for outfall works were approved by the Conservancy Board, with the understanding that there were to be settling reservoirs to prevent sediment going into the Thames; the impression of the Board was that only the clarified water would pass out; Board would have objected had they known that the entire volume of sewage and sediment were to pass into the Thames, 887–899, 928–932, 949. Mud of the deposits is not materially different from that in other parts of the river: mud at Kew does not differ much, 900–907. Alteration of shoals by dredging; no dredging on the Shelf and Ridge; deepening of water on south shore 7 or 8 feet would not affect the north shore much, 908–919. Prosecutions for throwing solid matters into the river, 920–927.

Sediment opposite the wharves in London has come up from the main outfall sewers, not by one tide but by a series of tides; neaps do not bear so much silt as springs, nor carry it up so high; tidal water of the Thames is always more or less muddy. Cost of separating the sewage sediment would be something enormous; the only practicable way is to carry it further to sea, or if the sewage can be profitably utilized, then the question is solved, 934–952.

II. Of Sanitary Inspector of Barking.

Horsley, Mr. W.:

Is sanitary inspector under the board of guardians (who constitute the highway authority); salary 20*l.* a year. Reports to the board as he gets the work done; gives notice to the landlords when privies, &c. are full; if tenants do not clean them they are summoned, 267–278. Drains fall into the town main sewer, which ends in the creek, but this does not carry out much sediment; all the sewage from Barking falls into the creek, 279–283, 300–306.

Has seen filth from metropolitan sewer floating up as high as Ilford; it is not from Barking town, which is pretty clean; no nuisance from unloading dung on the quay, 284–293. Has not heard any complaints lately as to sewage farm; smells the sewage when the wind is in a particular direction, 294–299, 315–322. Contents of Barking cesspools are put on the land and ploughed in; some of the Barking drains have been cleaned, but not the main drain, as it does not require cleaning, it having a good outfall, 307–314.

Water in the creek has changed very much since London sewage was poured into the Thames; the filth floats up with the tide, and the ebb leaves the excrement on the banks, 801–808. Health of Barking affected very much in 1868, 809–812.

III. Of Inhabitants of Barking, Smack Owners, Lightermen, and others.

Deveson, Mr. E.:

Has been manager for a coal merchant at Barking for 29 years. Bank on the Horse End caused by London sewage; formerly ships could lie there and unload, now they cannot; barges are not able to reach the ships till some hours after flood. Reads from a memorandum the class of ships which formerly came up the creek; captains will not enter Barking Creek because the insurance offices object since there has been so much obstruction, 333–380. Has no hesitation in saying there are banks of mud on the Horse End near memorialists' houses 8 and 10 feet deep, 401–405.

Witness saw last year excrement floating in the creek; at low water there is a sewage deposit on the banks of filth and mud and slime, which stinks too badly to be mud. He experienced in 1868 the ill effects of this, having to go away for the benefit of his health; nothing of the kind occurred before the London sewer started, 381–394, 397–399. The water at one time was used for drinking purposes; it was very clear, and shrimps were caught alongside the quay, but none can be found now; there is a great change in the creek for the worse, in respect of silting, the character of the deposits, and the effects resulting from it. The state of the creek is both a nuisance and an abomination, 395, 396, 400.

Cross-examination.

Never plumbed the banks of mud; they are visible at low water, and witness judged of the depth from their general appearance, 406–417. There is about 11 feet of water up the creek at spring tides; there is no difficulty in coming up now with vessels of 10½ feet draught, 418–454. Before the sewage, vessels of 14 feet draught came up; cannot remember a specific instance of refusal on part of captains to come. Coal cargoes are bought conditionally; if the captain refuses to come up the bargain is off—this is the regular course of trade, 455–474. There are four steamers continually coming up, belonging to Hewitt and Company, 475–484.

Part of Barking town sewage falls into the creek, part by an outlet into the mill-pool, close to which is witness's counting-house; that is why it affected his health; the town is not wholly drained. Never saw excrement in the river before the sewage was discharged at Barking. Cannot tell the shoalest part of the creek. Has seen vessels ground when trying to get into the creek from the Thames, 485–500.

Re-examination.

Vessels of same draught of water as formerly cannot come up now, 501–503. Creek has never been dredged. Formerly heavy landfloods tended to clear the channel; doing away with Hainault Forest has prevented that, 504–508.

Northern outfall delivers sewage into the Thames some time on the ebb; it would then go down till the rising tide met it; sewage cannot all float, or bank on Horse End would not form. There is a bank outside the creek, and one inside, neither of which were known before the London sewage, 509–528. Witness is annoyed by smells from London sewage at 1½ miles from the creek mouth; is not affected by the wind; it is the mud deposit, 529–537. Sanitary condition of Barking; is only partly sewered. Manure brought to town quay; very likely a foul smell from it; it is not so offensive as excrement from waterclosets, 538–553. No annoyance to witness from nuisance works, 554–559. Is owner of "Barking Barracks," which consist of eight poor houses, without cesspits, drainage, or water supply, and have only one common privy, 560–568.

Hale, Mr. W.:

The only change witness knows of is the soft soil at the creek's mouth, where, before the London sewage came, all was hard ground; a scull can be shoved clean through. There is a kind of backwater from the other side, and the flood sends the filth up the creek. The mouth is fairly choked with this stuff, and the banks have grown up a good bit, 682–703.

Cross-examination.

Not much difference in the creek above the mouth; the old passage out was between the Shelf and the Ridge; the Ridge is the same; nothing else but the soft stuff affects the navigation, 704–711.

Harvey, Mr. E.:

Has known Barking and the creek for 25 years. Has observed a great change since the London sewage came; the banks outside have grown up, and filling up with silt; a great deal of scum is brought into the creek on the flood. There is a continuous mass of floating matter of a very offensive character, both in the creek and in the Thames. Cannot land now at low water for the silt and mud, 712–728. The nuisance is increasing, and likely to increase further when Abbey Mills station is at work, 730–735.

Depth of water in the Thames has diminished between the Ridge and the shore; there is a great deal of mud there, and great loss of water; never measured it, but would say there is a loss of 8 or 9 feet, 736–745.

Cross-examination.

Great deal of silt between the Ridge and the shoal; never sounded outside the shoal, nor inside except by going in with an oar, and such like; where a vessel could be laid ashore to clean her bottom, now is all slime, 747–751. Barking town quay has been kept cleaner lately, 752–754. Has complained of unloading London muck at the town quay, 756–758. Can speak to London sewage going in and out of the creek, and as to less draught of water, 759–761.

Re-examination.

Sanitary arrangements are improving; smells from filth and accumulations were not found formerly, 762–765.

Honey, Mr. J.:

Has resided in Barking for 25 years; is a shipbuilder, having three yards in the town, one of which is near the quay, 603–608.

London sewage has not diminished the depth of water in the creek; vessels cannot get into the creek mouth so early as they used. Vessels could formerly dip water from the creek and take it to sea; now on a flood tide it is more like manure water; hundreds used to bathe in it; not so at present time, 609–616, 625, 626. A foot and a half of sewage mud on the shores; smell and colour plainly indicate what it is; this mud is 3 to 3½ feet deep. A can full of sewage was taken off the bank, 617–632. Coastguard vessel used to lie just inside creek's mouth; it was removed some 1½ or 2 years ago to Charlton, 635–640.

There is an accumulation of foul deposit going on and increasing, which will seriously interfere with the navigation. Large quantities of fat are taken off the shore from the deposit. Part of sewage is held in suspension; other parts float and deposit, 641–648.

Cross-examination.

Specimen of sewage was taken on the Horse End about an hour after flood, 650–652. No better supply of water now than when the smacks took it from the creek; without question this is from the neglect of the town authorities. Vessels have not taken water from the creek since the paper mills at Ilford came, which contaminate the water, 653–655, 662–667, 673, 674. Same class of ships come up to Barking now, but not so many. Fishing smacks never came more than at present; there used to be 300 or 400 sail out of Barking, now only 10 or 12; vessels have gone away because they get nearer the fishing ground, 656–661.

Specimen of sewage deposit was taken off the blade of a scull, 668–674. Banks of mud near houses at the creek's mouth; has heard that here they are from 7½ to 10 feet; never measured; one of witness's barges sunk whale deep in the mud accumulated on the inner side of the Shelf, 675–681.

Marchant, Mr. H.:

Has resided in Barking 50 years, 1, 59. Entrance of the creek is worse than formerly; vessels of 100 to 160 tons formerly came up, now they are of about 130 tons, according to the tide, 2–8. Twenty-five years ago coal ships of probably 300 or 350 tons came up, but for the last six or seven years the largest would be from 70 to 100 tons, 13–20.

The creek is never dredged except by rainwater floods; it is very difficult to take out a vessel of 9 or 10 feet draught, the channel is so narrow; the Horse End has grown up 150 feet since witness was a boy, 21–23, 25. Mud outside the creek has been caused by the London sewage; the water is now very filthy, 24–26.

No increase in house building at Barking, 27. Small paper works at Ilford have been built, but they cause no injury to Barking, 28–30, 36–38.

Would consider himself a madman to bring up a cargo of live fish now; there is no alteration in the trade of hook-caught fish. The fish brought by the steamers from the North Sea smacks are dead fish caught in the net. Formerly vessels with live fish wells could come up, but they cannot now, the water is so bad; four or five years

MARCHANT, Mr. H.—*cont.*

ago live fish could be brought up; now they are taken to Lowestoft and Grimsby, whereas they used to be taken from Barking to Billingsgate; it would not do at present to chance taking the live fish on the Thames past Barking. The town depended upon the North Sea fishery; the vessels have left the town and take the fish to Yarmouth; railways have given better accommodation, 30–35, 43–52, 83, 84, 99–102. There never was much fishing in the creek; a little roach, flounders, and eels, 54–56.

Witness took no part in the proposal to introduce the Local Government Act, 60–62, 68, 69. There is no local authority in Barking; it has a vestry which appoints the surveyor of highways, 70, 109–114. Cost of Barking main drain; sewers empty into the creek; the little sewage of Barking does not hurt the fish, 63–67, 92, 93.

Nuisance caused by dung on the quay is of very little consequence, 71–74.

Barking is a very large parish containing several townships, population between 5,000 and 6,000 in 1861, now between 6,000 and 7,000, principally engaged in agriculture; manufactories include a jute factory, two manure factories, and a malting house, 75–82, 85–91, 107. It has no water supply, the inhabitants obtaining their water from wells and pumps; water is very good, 94–98.

PYNER, EDWARD:

Has known Barking Creek for 50 years, 137–143. Water in the creek used to be taken by vessels for cooking and drinking; now it contains a good deal of dirt and sewage, and the anchors bring up filthy slush, 144–151, 168–170, 171.

Creek's mouth never altered before the London sewage came; the shoal did not change except when people came and took it away, 160–167. There is a great deal of sewage mud outside the Horse End; does not know where the bank of sewage is 10 feet deep, 172–178. Five years ago a barge might have gone out of the creek, but she cannot do so now; there are two folds of mud that stop it, 180–182. No offensive smell from the manure factory; cattle get fat there, 185–188.

Whitebait and bushels of other fish used to be caught off the creek mouth; they cannot catch any now, 189–194. Sewage of Barking was no annoyance in time of rain; the dung on the quay is a complete nuisance, 195–201.

QUASH, Mr. J.:

Is a smack owner, residing in Barking, 202, 203. Witness cannot say whether the main channel of the Thames has been affected to the extent of 11 feet, nor has he ever seen banks of sewage 8 or 10 feet deep near houses of memorialists, 206, 207, 264. There is more difficulty at the entrance of the creek with vessels of 11 feet draught than there was two or three years ago. The water of the river is much more impure since the northern outfall, 213–220. Coal trade at Barking has not changed by introduction of steam, nor has the fishing trade; coal trade is more in extent, but comes by smaller vessels; a vessel lately had to have five bargeloads taken from her before she could be brought to the quay, where there is less water than formerly. Water is not now penned back by millowners more than it used to be; it is penned back by every tide, 221–239. Has seen impurities of the Thames floating as far as Kingsbridge, 243–246, 258–262. People of Barking do not dredge the creek, nor do the Thames Conservators, 247, 253. Never knew of solids being thrown into the creek; there is no authority to prevent it. Rain floods do not deepen the channel, 254–257.

TEMPLEMAN, J.:

Has known Barking and the creek for 51 years, 766–771. Before the sewage there was no delay in getting up the creek; now, from the slush and mud, craft have to wait for an hour or more. In the morning the smell is terrible, and birds come and gobble up the stuff; the water at a certain distance is black as ink; the water forms a dead eddy on the latter part of the ebb, and there the sewage will lie till the flood meets it and brings it up into the creek. Deposit of mud on the Horse End more than two feet; not much difference in the main channel of the Thames, 772–782.

Cross-examination.

Up and down the shore from the sewer and in the creek mouth there is an accumulation; as regards the true tideway of the Thames, as large a vessel can go up now as ever did, 783–800.

WATTS, Mr. H.:

Has known Barking creek for 12 years, and is in the habit of navigating it night and day. There is great difference in the water at the entrance of late years; barges could go out of the mouth at low water; now they must catch the tide; London sewage is the cause, nothing of the kind before the sewage, 569–578. Mud on Horse End so deep that barges must be protected from sinking; when anchors are hauled up sewage filth adheres, 579–582. Creek in the first reach is filling up; the bottom used to be hard and sandy, now it is mud—very unpleasant mud, 583–588.

Cross-examination.

Twelve years ago there was scarcely any mud in the Thames, neither in kind nor quantity as it is now. If the rope was not worked under the barge when on the Horse End the craft would suck down, 589–602.

EVIDENCE ON BEHALF OF THE METROPOLITAN BOARD OF WORKS.

1. OF ENGINEERS AND OTHER PROFESSIONAL MEN.

BAZALGETTE, Mr. J. W.:

Engineer-in-chief to the Metropolitan Board of Works, 1419, 1420. Mr. McDougall is a very careful surveyor; surveys of the river have always been entrusted to his care, and found very accurate, 1421–1425. (*See abstract of his evidence, post.*)

Allegation of the memorial as to the dangerous condition of the Thames is entirely imaginary and contrary to the fact. The scheme for the northern outfall of sewage at Barking was adopted after very mature deliberation and full discussion, and the results of a series of experiments were very carefully studied. The northern outfall was opened in August 1864, and the southern in April 1865. The plans were submitted to the Conservators; certainly there was no undertaking or representation that only clarified water should pass into the river. The plans were also submitted to the Admiralty, and received their sanction, with the condition that the discharge of sewage should not commence until one hour after high water, which condition has been adhered to, the discharge lasting about two hours, 1427–1450. Velocity of sewage from Abbey Mills to point of discharge from a mile, up to a mile and a half per hour; velocity of Thames at a strong ebb three miles an hour; current from the Roding drives the sewage further into the centre of the Thames, 1451–1457, 1699–1702. The character of the sewage is much the same as before the outfall, but the mode of discharge is vastly different, 1458–1461. Road detritus is prevented as far as possible from entering the sewers, 1462–1464. Witness, on comparing Mr. Leach's soundings, and allowing for the shifting character of the beds of tidal rivers, and deducting the decrease of mud, estimates the net increase of mud at 400,000 cubic yards as against 700,000. Taking the whole reach between the points of discharge it is reduced to a net increase of 60,000 cubic yards between 1864 and 1867. Taking two points from above Barking Creek from a quarter of a mile above the point of discharge to three quarters of a mile below, there is now in that part of the Thames 400,000 cubic yards less of mud deposit than when the main drainage works were opened, 1465–1481.

Difference in the river is attributable to many things; one great reason has been the upland floods with particular winds at certain states of the tide. There was a gradual accumulation up to 1867, and there has been a great decrease between 1867 and 1868. Mr. Leach's soundings show an increase of 7 feet 6 only at the "Talbot's" berth. The sewage works can have no effect upon that shore, for after a flow of half or three quarters of a mile below the outfall the sewage cannot be traced, 1482–1484. There is a little mud bar at the creek's mouth (such as is ordinarily met with at the wide mouths of rivers), which at a little cost might have been removed. The creek at Barking town is in a very bad state. No London sewage can get into the creek from the outfall. The further one gets from Barking town the purer the water is. Barking town sewer discharges into the creek; mud near the quay was black and offensive. Dung barge at the quay; odour very offensive in that part of the town, 1485–1496. There are no banks formed of solid sewage anywhere; the mud is like that on any other river or tidal creek, and similar may be seen on the foreshores of the Thames, and even on the sea coast, 1498–1505.

Schemes for carrying the sewage further down the Thames would have involved a cost of 10,000,000*l.* or

12,000,000*l*. The Board thought the best thing in settling the present sites for outfall was to place the sewage in such a position that it might be utilized hereafter; they never contemplated abstracting the sediment; the sediment is very small in proportion to the liquid. Great part of the road detritus is intercepted by catchpits, 1506–1528. If the arrangement with the Metropolis Sewage Company were carried out, the river would be free from sewage. There always will be a large amount of sediment mixing in the waters of the Thames; the embankment must have a beneficial effect in preventing deposits, 1529–1540. Main drainage report of Messrs. Bidder, Hawksley, and Bazalgette; subject of sediment was considered by them; large cost of Birmingham system, 1541–1547.

Cross-examination.

The great bulk of street and road detritus being removed by dust contractors and road sweepers, and it being penal to pass road sweepings into the gullies, a small proportion only can pass into the sewers. The bank of mud which has formed on the old berth of the "Talbot" cannot arise from road grit out of the northern outfall; it is physically impossible, nor can it be accounted for by a backwater or eddy, as there is none from the northern outfall. The mud found in the creek is the same as all other river mud. If it be found to contain matter of precisely the same character as sewage, witness would not be able to account for it. Matter in suspension deposits itself at different stages, according to the velocity of the stream and the gravity of the matter suspended, the heavier settling first, the lighter floating longer, and the lightest for a still longer time. Experiments show that the sewage which floats and oscillates with the tide comes back a mile, and gets further and further down the river until it is ultimately lost altogether, 1548–1595.

It is very probable that grease may be collected near Barking outfall; a great many factories send grease into the river, and some may come from the sewage. Probably corks and things of the kind may float for a short time at certain states of the tide, just at the mouth of the creek, where an eddy washes them into the bight, but they are carried away eventually, and such is the case with heavier matters; as a fact they are not deposited there, 1596–1607. There is no deposit of organic matter off Horse End; witness tried the mud at the mouth and found it similar to that of any muddy river, such as the Lee, and stinks in the same way if disturbed, 1608–1629.

Last soundings taken in the bay above Barking Creek by the Metropolitan Board were taken in 1868, and some are now proceeding on the same spot; the soundings of the Conservancy Board at this place are correct. There is an accumulation in that bay, where, from natural causes, it might be expected, and further, the works for the pier of the Chartered Gas Company tend to increase the silting up which is going on; it is impossible to say what really is the cause, 1630–1650. As to agreement between the Metropolitan Board and the Metropolis Sewage Company; utilization of the sewage formed no part of the Board's plan. The Board felt the duty of diverting the sewage from the river near the metropolis, and of getting rid of it so that no injury might ensue, being ready to encourage any commercial body who should be prepared to take the sewage and apply it to agricultural purposes; they have given assistance to the Essex Reclamation Company; but why the Board have not compelled the company to carry out their agreement is not in witness's province to say, 1651–1669.

The river, taking the whole waterway, has improved between 1864 and the present time, 1670–1678. The bank of mud spoken of by Mr. Leach and Captain Burstal cannot now be removed by river Thames scour; that has been rendered impossible by construction of the gas company's pier. The operations of the Metropolitan Board have not been injurious to the river or the creek, nor is the health of Barking town in any way affected; the Barking memorial is the most poetic thing witness ever read, 1679–1698.

Re-examination.

If organic matter is found at Barking quay, it possibly came from the town originally, 1705. The Metropolitan Board have not discouraged the scheme of the sewage company, quite the contrary; under any circumstances some of the sewage must be diverted into the Thames, 1706–1724. Has watched the flow of sewage from the mouth of the outfall, and tracked it by sight for half or three quarters of mile, and then it has been lost, it is so completely mixed with the large volume of river Thames water. Banks in the Thames have a great deal of sand mixed in them. Precautions taken to prevent road detritus getting into the sewers; if any quantity gets in it would not, however, be injurious to health, 1725–1750.

BIDDER, Mr. G. P.:

Was consulted as to the design of the existing scheme of metropolitan main drainage. Several engineers proposed plans; Barking on the whole is the best place for northern outfall, 1786–1790, 1856, 1857. There is no danger whatever to navigation from the sewage; on the contrary the river has been benefited; old mode of discharge and its effects upon the river, compared with present system, described, 1792–1798, 1853–1855. Having been on the river during the whole time the sewage was being delivered, is surprised how speedily it disappeared; at three quarters of a mile below the outfall all trace of it was lost, and it is doubtful if any comes back; there is a strong smell from Lawes's artificial manure works, 1799–1805, 1813–1816.

The estimate of 700,000 cubic yards of silt is not tenable for a moment; about 90,000 tons discharged annually; the outfall having been open for four years, if the whole of this matter were silt and deposited near Barking the amount would not reach the estimate. If this nook were filled up by a solid embankment it would be an advantage to the navigation; the gas company's pier tends to the accretion of matter at that spot; other causes affecting the flow of water and scour, 1806–1812, 1851–1855. When witness went down the creek he found the water in the inner harbour opaque, the result of refuse from a paper mill, while in the creek below Barking town it was comparatively clear; smell from dung barges at the quay. In going down the creek against the tide no stream of returning sewage was seen, nothing but what might have come out of the town of Barking. It is not impossible that fæcal matter could be found on the sluices; but it is highly improbable, and it is mechanically impossible, from the strong current of the creek, to arise from the northern outfall. Banks of Barking Creek are of ordinary river mud, 1818–1840.

Assertion of Barking memorial as to banks of sewage near the houses of the memorialists is perfectly imaginary; there is nothing to affect the comfort or health of inhabitants, 1841–1846. There is a tendency to accrete matter on the Horse End, which might be dredged at very little expense, 1847–1850.

Cross-examination.

Report recommending Barking for the outfall was made by witness and Messrs. Bazalgette and Hawksley in 1858. The plan suggested by the Government referees was to carry the sewage several miles further down. To this there were many objections, the chief of which was the enormous cost. No proposal of sewage irrigation was made at the time. Whoever can profitably utilize London sewage will be a great national benefactor; even a partially successful scheme would be a great benefit. At present there is no alternative but to throw the sewage into the river; there is only the scheme of the Essex Reclamation Company, the engineering part of which is chimerical, 1858–1883.

The mud shoal is not caused by the northern or southern outfall; solid sewage matter does not go into the creek. The sewage flows in a stream into the Thames at rather more than the velocity of the tide; the confluent streams immediately mix, and after three quarters of a mile the black stream of sewage partakes of the colour of ordinary river water, and cannot be detected at all; it is kept flowing backwards and forwards, and in 30 or 40 days is delivered into the sea. Road grit in sewage discharge is infinitesimal in quantity. At low water, when there is nothing flowing out of the creek but land water, charged with stuff from the mill and drainage from the Roding, the sewage of Barking and Ilford, and the population of the up-country, that may be bringing down matter which is checked by the shoal at the mouth, but it may very easily be remedied by dredging, 1884–1914. Accretion in the creek from the London sewage is a mere bagatelle; scum from Esparto grass in the harbour, 1915–1920*a*.

When witness went down from Barking mill, the boat was put over the outlet at the moment of discharge; the sewage ran partly across the Thames, and beyond a barge moored below the creek, it was lost to sight, taste, and smell, 1921–1934. The proportion of sewage to Thames water is about 1 to 20,000; that which remains mixed with the water becomes oxidized and entirely changed in its nature, and its specific gravity saves it from being deposited. Fæcal matter is decomposed directly, and converted into an innocuous substance; if it deposited it would not be in the form of fæcal matter, but putrescent matter. Causes of shoals in the Thames. The bank spoken to by Mr. Leach and Captain Burstal contains

BIDDER, Mr. G. P.—(*cont.*)

putrescent matter, but the inference that it came from the metropolitan outfall sewers is totally erroneous. There is a quantity of fæcal matter still passing into the Thames, and will continue to do so till the low level intercepting sewer has been completed, but whatever the quantity, it has nothing to do with this mud shoal, 1935–1972.

Re-examination.

Fæcal matter poured into the Thames years ago has all gone to seaward. Assuming that any may be found on the bank of mud referred to, it cannot arise from metropolitan sewage, as before it could arrive there all vestiges of putrescence are taken out of the sewage water. Fæcal matter is exceedingly flocculent, and being quickly broken up is more likely to become oxidized and to disappear, and that part which oxidizes and dissipates into the atmosphere contains the most offensive part of the discharge from the sewers. Velocity of liquid in the sewer is less than that of the Thames, which is favourable to a speedy getting rid of the sewage. Confluent streams, 1973–1998. Sewage farms would be of great advantage; the Maplin sands scheme will not answer commercially, 1999–2005.

Having regard to all the circumstances, no better scheme could have been adopted for discharging the sewage of London away from the population than the works which are now in operation; if the main sewers had been carried down very much lower the expense would have been enormous, and the sewage would have been retained for a time in tidal sewers, unless the expense of pumping had been incurred; it is a question of cost without any advantage; if sewage is to be utilized the sooner it is taken up the better, 2004–2015. Relative volume of sewage to tidal water; basis of estimate of total amount of sediment from the sewers per annum. Velocity of discharge differs with the rise and fall of the tide; maximum velocity of river in mid-channel at springs from 3 to 3½ knots per hour, 2006–2025.

[*See also Evidence of Mr. Hemans in explanation.*]

Rainfall prior to discharge of sewage on 3rd August 1869, was thirty-five hundredths of an inch in 12 hours. A third of the London rainfall flows off in 24 hours, 3560, 3561.

COOPER, Mr. E.:

Is a district engineer to the Metropolitan Board of Works on the north of the Thames, and superintended the outfall works at Barking, 2525–2529. At from 100 to 150 yards from the place of discharge there is no disagreeable smell perceivable. The discharge (32,500,000 gallons or 4,500,000 cubic feet in 24 hours) takes place according to the tide, the reservoir being emptied in about three hours after high water. Population near the reservoir have not been affected in health. Not the slightest foundation in the memorial as to fear of disease or danger to health from the sewage, 2530–2550.

GRANT, Mr. J.:

An assistant engineer to the Metropolitan Board of Works, superintending the southern main sewers and the outfall at Crossness. No nuisance is caused by the southern outfall either to the river or to the inhabitants, nor to the workmen on the works and their families; knows nothing as to the statement in the memorial as to a vessel being stranded on a sewage mud bank in the Thames, 2505–2524.

GREGORY, Mr. C. H.:

Is a member of the Institute of Civil Engineers, and has examined the northern outfall, the Thames at the creek and its neighbourhood, for the purpose of considering how far the statements in the Barking memorial are well founded, 2048–2051.

Generally the shoals in the Thames near the creek are of the same sort of material as may be found to a large extent on the banks of the Thames; at the point of discharge there is some very black and strong smelling mud. Describes the bottom of the creek up to Barking, which as a rule consists of hard gravel. At Barking itself, close to the town, there was a good deal of offensively smelling mud, which it would be perfectly impossible to trace to the metropolitan sewage. A gravelly bottom principally shows that there has been no diminution of depth in the creek by reason of deposit of sewage matter: *pro tanto* the bottom has not deteriorated as alleged in the memorial. Mr. McDougall's evidence seems to prove this view, 2048–2063. Does not believe any injury has arisen to the navigation; will not deny the possibility of an increase of the Horse End shoal, although finding that just at the point it was gravel would seem rather to show that if any increase has taken place the metropolitan sewage could have had nothing to do with it, but that it arose from natural changes that always will take place in such a river as the Thames, 2052–2066.

Any matter brought down by the London sewer must be carried out and mixed with the enormously greater volume of Thames water, as shown by Mr. Bidder in his evidence. There is no impediment to the navigation; the condition of the river has been improved by the operation of natural causes, such as the ordinary flow of the river, nor is there anything in the mode of the London sewage discharge which tends to impair the usefulness or the condition of the river, 2067–2073.

Cross-examination.

Bottom of creek could not have been raised by reason of the northern outfall sewer; if the channel were made practically worse that possibly might affect insurances, but the channel now is as good as before; mud immediately in front of the outfall did not smell disagreeably; colour of the mud, 2074–2104.

Re-examination.

Mud on Horse End might possibly be caused by the gas company's pier; cost of dredging would be very small, 2105–2110. Distinction between smell of different samples of mud, 2112–2116.

HAWKSHAW, Mr. J.:

Detritus from London sewage must form a very small part of the mud bank above the outfall; the only way of dealing with such a river as the Thames is to take the soundings over a given reach, and to see what the effect has been on that reach. In certain places the banks will diminish, but the one the subject of the inquiry is not likely to be diminished through the construction of the gas company's pier, 1754–1763. Having regard to all circumstances, the present position of the outfall is the best, 1764–1769.

Cross-examination.

If it were possible, it would be preferable to keep sewage matter out of the river; injunctions have been granted restraining towns from pouring sewage into rivers, but it is difficult in all cases to carry out these views, 1770–1779. From various causes it is difficult to say where deposits in tidal rivers come from, 1781–1785.

HAWKSLEY, Mr. T.:

Is a civil engineer. The Thames has not been injured by the outfall works. There is a small deposit of mud at the creek's mouth, which is explainable on natural grounds. Previously all the road drift went into the river, whereas now a very large proportion is removed before the sewage matter proper goes into the river; hence there is less solid matter going into the Thames than formerly, and the river is in a better state by diminution in the quantity of road drift discharged, and the more favourable conditions of its discharge. About $\frac{1}{2000}$ part (or 35 grains in a gallon) only of sewage is solid matter, nearly the whole of which is organic; organic matter speedily decomposes, and ceases to be solid when mixed with a sufficient volume of water, 2117–2133. Three quarters of a mile below the outfall all trace of sewage is lost. As regards Barking Creek, there is nothing injurious attributable to the outfall works. At the Horse End there is a little mud, which is attributable to the diminished velocity of the outflow consequent on the enlargement of the mouth of the creek; this might be remedied by artificially contracting the mouth. The Shelf has existed time out of mind; it is clean shingle. Metropolitan sewage matter does not and cannot enter the creek; this is not theoretical, but from actual observation; the tendency of the stream from the Roding is to deflect the sewage across the river, 2134–2143. Outfall does not affect either the navigation of the Thames or the creek. It is important to bear in mind that a very large quantity of sewage is sent down from above Barking, and meets a portion of the Barking sewage, which deposit a reddish clayey mud on the banks, such as is found in every pond. Barking is the best point of outfall; cannot suggest any improvement in the mode of discharge, 2144–2147.

Cross-examination.

Population of Wanstead discharge the sewage into the Roding, 2148–2152. Not much road drift in the sewage reservoir; the process of emptying, if there is any considerable stream about the outlet, would tend to carry off a great deal of detritus, but some would remain in the upper part; quantity of road drift varies with the weather; when witness visited the reservoir the weather was dry, 2156–2163. The proportion of solid matter ($\frac{1}{2000}$) in sewage is sufficient to very slightly discolour and thicken the water, 2164–2167. Explanation as to action of confluence of the Roding and Thames in carrying away the

sewage; effect of acceleration, 2168–2197. The extension of the Horse End shoal may arise from a variety of causes, but is principally attributable to the Roding and to diminished velocity of the water, 2198–2205.

Re-examination.

Plan produced accurately corresponds with and represents the facts, 2206, 2207.

HAYWOOD, Mr. W:

Is surveyor to the Commissioners of Sewers of the city of London, and was associated with Mr. Frank Forster in the preparation of a scheme for the interception of the northern portion of the metropolitan sewage; Barking as the place of outfall was frequently considered, and finally adopted as the best position; it fulfils well the requirements of the metropolitan population, as well of those who live near the point of outfall, 2429–2443. Undoubtedly an accumulation of mud took place in the river, but it is now falling away; the navigation has not been impeded by it. The deposit at the mouth of the Roding might be cleared away by an expenditure of 250*l.*; it cannot be attributed to the metropolitan outfall. The Chartered Gas Company's pier (being out of the main channel of the Thames) is not a matter of importance, 2444–2449. Mud in Barking Creek is like ordinary Thames mud; the deposit of 700,000 cubic yards in four years is a simple impossibility, 2450–2454.

Cross-examination.

Mud in the Roding had on the whole the characteristics of the usual Thames mud; it had no smell of sewage, and might be produced by vegetable matter brought down by the Roding, 2455–2460. Barking was selected as the place of outfall with the belief, firstly, that the sewage would all go away to the sea, and secondly, that it would do so without creating any nuisance to the inhabitants on its way seaward, nor has it created any nuisance. Under certain conditions sewage may be brought up the river, but the probability is, that immediately afterwards storms would arise, and great upland floods would combine to cause it to disappear very rapidly, as was the case a few years ago, 2461–2472.

Re-examination.

The question of utilization was left for further consideration, 2473–2476. Road detritus which comes down is diminishing year by year; if it does get into the sewers the average current is not sufficient to carry the heavy drift into the reservoirs. Reasons why there should be more detritus in Birmingham sewers than those of London; in nearly the whole metropolis any material that got down from the roads into the sewers would lie in the sewers. The estimate of 700,000 tons of solid matter is entirely assumption. Total voidance of solids is about 1½ lbs. for every individual, but by desiccation a great deal of the excreted matter is destroyed, 2477–2498. Flood flow of sewage varies with the weather, as it may be wet or dry; a considerable quantity of organic matter is brought down after heavy rains from the highly manured agricultural lands in the drainage area of the Thames, 2499–2504.

HEMANS, Mr. G. W. (*Civil Engineer*):

Allegations of the memorialists, as far as the navigation of the Thames and of the creek are concerned, are not founded on fact; it is impossible that the amount of solid material delivered from the London outfall can get into the creek, it is so small in comparison with the volume of Thames water with which it is mixed. With regard to the foreshore near the main outfall, where a mud shoal has evidently formed, there is nothing traceable to sewage from the outfall; if there be sewage, it must be attributed to the sewage which, for the present, must come down the Thames, and not to the Barking or Crossness outfalls 2363–2372.

Explanation as to Mr. Bidder's statement of quantity of solid matter delivered daily; only 70 tons from northern outfall, which is diluted in the proportion of 1 ton to about 60,000 tons of water, 2373–2375. If any of the discharged sewage returns to Barking, it is contrary to all laws of hydraulics and mechanics. Explanation as to Sewage Utilization Company. Shoal of mud near the creek is to be attributed to the tidal action of the water, which comes up with a great quantity of mud, and when this spreads out there must be a certain amount of deposit. The artificial manure works at the mouth of the creek are extremely offensive, 2376–2386.

Cross-examination.

Theory of the float experiments (which were very carefully conducted) may be wrong, but witness still relies upon it, and unless there be some extraordinary eddy it is impossible to see how the London sewage can return to Barking. The most natural way to account for any sewage deposit above the main outfall is that it finds its way down, not having been intercepted by the low-level sewer, 2387–2401. Cross-examined as to the Sewage Utilization Company, 2402–2419.

Re-examination.

Sewage being subject to disintegration, the particles more readily follow the current; during the whole time the sewage is flowing up or down it is in contact and mixing with the water, 2420–2428.

MCDOUGALL, Mr. J.:

Is surveyor and assistant to Metropolitan Board of Works; produces plans and sections of different parts of the Thames and of Barking Creek, 1067–1078. Bed at mouth of creek is lightish mud 3 or 3½ feet deep; depth of water in mid-channel at spring tides between 20 and 21 feet; width of channel 250 feet, 1082–1097. Bed 1 mile 1,080 yards from the quay has but little mud; the true bed is composed of shingle; depth of water 20 feet 6 inches; width of channel 240 feet, 1098–1105. Bed 1 mile 856 yards from the quay consists of gravel, chalk, and a little soft river mud; depth of water about 19 feet, width of channel 280 feet, 1106–1112. Description of other sections below the quay, 1125–1171. The creek has improved since 1858, 1113–1121. No offensive smell in the creek; the mud accumulated may be accounted for by protection from the wind, and from no steamers passing up and down, as in the Thames; sewage deposit from Thames water has no chance of remaining on the slopes, as it is washed away at low water; no difference in the mud now and before the opening of the main sewers outfall, 1177–1196. Mouth of creek has been deepened by the removal of coffer dam of Reclamation Company; deposit of mud was only temporary, 1200–1202. In June 1869 the water, on the turn of the tide, was of a brown chocolate colour; it looked worse below the tidal sluice, 1204–1211. From the bottom of the basin to below the Reclamation Works there was no mud in 1868, 1225–1233. Describes soundings made in 1864, 1234–1262.

Cross-examination.

There are back sluices just above Barking quay which flush into the creek, the scour of which, with the backwater, keeps the bottom clear of deposit when the tide is out, 1263–1266. Mode adopted in taking soundings in the creek; the men walked along the middle; depth of mud was tried with poles when the tide was up. Has known the creek 20 years, and finds very little difference in it. Mud brought up on the poles did not smell particularly offensively; it consisted of loam with very fine sand; some of the mud was black, such as is found in inland ditches, 1267–1293, 1354–1367. There is a deposit of mud on the Horse End 3 feet 6 inches deep at the deepest part; the sections show a decrease in mud there since 1864; the soundings were not taken across the creek but across the Thames; explains the positions of the soundings on the plan as taken in 1864, 1867, 1868, and 1869, 1294–1339. The Horse End was in as bad a condition in 1864 as it is now; in 1867 and 1868 there was an accumulation of mud, which has nearly disappeared, 1340–1347. Does not think sewage is so injurious to fish as is generally supposed, 1368–1370.

Re-examination.

Sewage now discharged at the main outlet is of the same character as that formerly discharged into the Thames; sewage is not so fatal to fish as chemical stuff, 1371–1374. Has known the creek and Horse End for 20 years; never could walk down the banks free from mud, nor get to a boat at half tide. Horse End was rather flat at first; it has worn down to a point, 1375–1406. Soundings taken in 1867 were compared with those of the Conservancy Board, and were found to agree pretty nearly, 1407–1411. River surveying requires special practice and special knowledge to take soundings, 1417, 1418.

MILLEE, Dr. W. A., F.R.S.:

Is professor of chemistry at King's College and doctor of medicine. Has examined, in conjunction with Dr. Odling, various samples of sewage deposit taken from the Thames between Teddington and Crossness, also some from the docks and from Barking Creek, 2208–2215.

Average amount of organic matter in Barking Creek is 16·2; in 100 parts of which there is 3·1 of nitrogen. Mud of Roding above Barking contained 17·3 of organic matter, of which 3·17 per cent. was nitrogen. Mud in the creek contained 83·8 of mineral matter, 2216–2222. Thames mud from Chiswick to Westminster is practically

MILLER, Dr. W. A., F.R.S.—(*cont.*)

the same as that in the creek as far as organic matter is concerned; mud from the docks also very closely corresponds, 2223–2230. In the Barking sewage reservoir organic matter amounts to 58 per cent.; nitrogen, 4·27 in 100 parts; at Crossness, organic matter, 37·1 per cent.; nitrogen, 4·51 in 100 parts. Mud on Horse End contains less organic matter than previous samples; that near gas company's pier contains 14·4 per cent. of organic matter; nitrogen, 2·84 in 100 parts. The mud at Barking town quay is worse; it contains 25·4 per cent. of organic matter, a large proportion of which is nitrogen, 2231–2239. Mud in the creek is of the same character as that of the Thames; at Barking quay it is worse; increase of organic matter not attributable to outfall of sewage into the Thames. Some proportion of organic matter would be carried away, some deposited, the proportion varying from time to time, 2240–2252.

Cross-examination.

Mud in the creek close to Barking mill sluice contained 14·84 per cent. of organic matter, nitrogen 2·43 in 100 parts. Just at the main sewer outlet it contained 59·61 per cent. of organic matter, nitrogen 3·19 in 100 parts. Some deposit hangs on the sides of the main outfall; mud from the Horse End contains less organic matter than any other sample. States localities from which samples were taken; they were taken in dry weather, 2253–2271.

Re-examination.

Samples were selected with great care with the view of ascertaining accurately the composition of Thames mud, 2272, 2273.

ODLING, Dr. W., F.R.C.P.:

Is professor of chemistry at the Royal Institution. Has analysed, in conjunction with Dr. Miller, various samples of Thames and other mud, 2274–2278. Mud in Barking Creek and at Horse End is ordinary river mud; the surface shows that it is fully oxidized. The amount of organic matter in the mud of the creek from one end to the other is very much the same, and the variation in the samples analysed are extremely minute. The samples do not indicate any result as being due to London sewage outfall works, 2279–2289. Organic matter of sewage is of slightly higher specific gravity than water; in still water it subsides slowly, in a running stream it does not subside at all. Organic matter is not necessarily unwholesome; it is when in a putrid state that it is unwholesome. 2290–2292. Discharge of outfall sewage has not the slightest effect upon the health of the people of Barking, 2293, 2294. Produces a sample of pure sewage deposit from the reservoir, and one from the mud bank in the Thames opposite the gas company's pier, 2299–2303.

Cross-examination.

Sewage, after passing down the river for a considerable distance, loses its black colour and becomes brown, when it is no longer putrid. Mud banks below the water, when covered, do not smell as a rule, but mud banks near a sewage outfall undergo putrefaction, and smell. A small proportion of gritty matter is brought down, some of which subsides. The whole bed of the Thames contains 16 per cent. of organic matter on the average, which, if only partly oxidised, may become just as unpleasant as it was originally, 2304–2320. Horse End shoal is composed mainly of sand combined with a small proportion of organic matter. Examinations of mud taken at various depths show no very different results, 2305–2334 Mud above Barking town contains about 17 per cent. of organic matter, 2335–2337.

Re-examination.

Wherever there is mud and organic matter, the mud carries down the organic matter; sewage in the Thames, after it has flowed to a certain point, loses its colour, and hence oxidation may be inferred, 2338–2343. Result of analyses confirms the opinion that Barking town is not affected by metropolitan outfall. Experiments have been made on Thames water at Greenwich, but from variation in the volume no useful contrast can be made, 2340–2349.

Metropolitan sewage from the Barking main outfall is a far richer manuring material than any witness has met with; no other way of profitably dealing with it than applying it to land, if this cannot be, then throwing it away. Fresh sewage is not unpleasant looking stuff; when it runs out from the reservoir, though black, it is not putrid, but it abounds in worms and other things which are alive; minor sewers in the metropolis are in length largely in excess of the intercepting sewer, and the character of their sewage would be stamped upon the whole volume of what these tributaries brought in, because when once fermentation has set in, it goes through the whole volume very quickly; old sewers in London which retain deposit give a character to the sewage generally, 2357–2361.

II. Of Preventive Service Men.

DEAY, Mr. W.:

On coastguard station at Plumstead, and formerly was on the vessel when at Barking, from 1860 till she left. The sewage works caused no annoyance; there was a little smell from them, and also from Mr. Lawes's factory; the fumes from the acids affected witness's eyes. Dr. Davidson was never consulted by the men as to nuisance from the sewage. There is an alteration in the entrance to the creek; Horse End is all mud like that in the creek, 2815–2839.

Cross-examination.

Diversion of current at creek's mouth caused by diminution in backwater; does not know whether there is a mud bank formed inside the creek, except that opposite Mr. Lawes's works, 2840–2861. Sewage could be smelt when the wind was westward, but not annoyingly; never sent for the doctor on account of it. Vessels of 180 or 200 tons have gone up the creek; one went up lately, 2862–2889.

Re-examination.

His duty is to protect the revenue. Sewage was only smelt when the reservoir ventilators were open, not when going down the river. Shelf and Horse End were always just the same as now—the Horse End has got larger. The mud on the bank where boats used to land is attributable to there not being so much backwater as formerly, 2890–2908.

TOBEY, Mr. C. A.:

Was chief boatman in charge of coastguard station at Barking Creek. Supply of water for the vessel was taken from Flint's brewhouse, never from the creek. Fishing smacks used to lie outside the creek in the Thames; they formerly took their water from the river, which was given up in 1851 because the Thames water was so bad. When Mr. Lawes's factory got into operation, there was a great smell at times. The vessel was removed because the factory obstructed the view of the river, 2566–2597. In 1848 between 300 and 400 sail of smacks and cutters used to ply to Barking to refit, the fish they took direct to Billingsgate from the sea, 2598–2611. There was no difference in the Shelf between 1848 and 1866; it consisted of shingle and sand, and people could walk upon it at low-water springs. There was a sewer sluice at Barking town quay that ran into the creek, and it is there now, and dung barges discharged manure at the quay. Very little annoyance was caused by opening the London main outfall, 2612–2629.

Cross-examination.

Coastguard duty was to protect the revenue, 2630–2633. Sea-going craft of 250 to 300 tons used to go up the creek, but they had to lay outside till the tide served, and up to 1866 they could do so, 2641–2652. In 1866 there was no mud on the Shelf, nor was there any mud bank formed in front of the creek's mouth; the Shelf and the Horse End were the same as ever, 2653–2669. Smell from Lawes's factory began to annoy about 18 months after it commenced, 2670–2681. Has traced London sewage as it passed the creek, going about half stream across, 2682–2686. Never knew that Dr. Davidson made a report or gave a certificate that the matter from the London sewage was unhealthy; the Preventive vessel was removed in order to obtain a better view of the river, 2687–2708.

There always was mud on the banks of the Thames and on Horse End, similar to all other Thames mud; at times fæces might be seen floating about in different places, 2709–2725. There is a bight or bay above the London sewer, in which there is an eddy of water; never was anything floating there, except corks and things of that nature, but no more than might be seen in any other part of the Thames, 2726–2744.

Re-examination.

The coastguard vessel was removed on account of the view of the river being shut out; Mr. Lawes's factory caused unpleasant smells as well as obstructed the view; Captain Cockcraft (the inspector) might have represented this, 2751–2784. The Horse End shoal was always mud, the Shelf hard shingle. No difference in the size of vessels nor in the navigation of the creek between 1848 and 1866; the creek has made a different entrance between 1866 and now; fishing smacks went up to refit, and the colliers to take up coals, 2786–2806.

III. Lightermen, Bargeowners, &c.

BARNES, W. *(Workman at the Outfall)*:

Lives at Barking outfall. Never found any detriment to health of inhabitants living near the outfall, nor anything disagreeable arising from it, 2551–2564.

BROWN, J.:

Is a waterman and lighterman living in Barking. Shelf always had a hard bottom. Three months ago he brought a vessel of 272 tons, drawing 12 feet 8 inches, up to Davis's wharf, where she was lightened 92 tons, and then came alongside the quay; this was the "Impetuous," laden with coals, 2912–2914, 2923–2954, 2999–3008. Coffer dam of Essex Reclamation Company was the "instigation" of the mud gathering on the Horse End. This shoal has always been growing up; there was no mud on the lower side of the creek before the dam; the dam also has been the cause of mud in the creek's mouth, which has decreased since the dam was removed, 2955–2968.

Fishing boats never came up with their cargoes. The system of fishing now is different; the fish are collected from the boats fishing in the North Sea and brought to Billingsgate by steamers, 2969–2983. Paper mills at Ilford diminished the quantity of fresh water fish in the creek, 2984–2998. Since witness knew the creek it was a common thing for a vessel drawing 11 to 12 feet to come up—vessels of 250 to 272 tons, 2999–3017.

Cross-examination.

"Impetuous" was lying off the mouth of the creek for one ebb, and came up about three quarters flood, 3018–3029. Had charge of the "Look Out" since the above vessel; she had a draught of 11 feet, and her tonnage 150 tons. This vessel came up just before high water. There is now more delay for a barge than for a ship entering the reach on Horse End by about half an hour. There is less mud now between the Shelf and the mouth of the creek than there was 18 months ago, 3018–3068. Accumulation is attributable to the coffer dam; very little backwater comes down now. Drainage of Hainault Forest and a large surrounding area has not brought down such sudden flushes as formerly, 3069–3075. Witness states his general employment, cause of his dispute with Mr. Davidson; no inducement was offered to give evidence, except a sovereign to pay expenses; never offered to give evidence in support of the memorial for pay, 3076–3146.

There is an alteration at the mouth of the creek; cannot get so near to the stones by about 30 feet; the smell there is stronger at some times than at others, but not so very strong; coffer dam has caused the variation of the creek mouth, 3147–3163.

Re-examination.

There used to be sudden flushes in the Roding on account of the heavy rains, but the land having been more thoroughly drained the scouring body of water does not now come down. Mud in the creek has diminished within 18 months. With the exception that a barge cannot go in at dead low water, in consequence of mud in the creek, there is no impediment to the navigation. There is no difficulty in getting up to Barking on the flood with vessels drawing 11 feet of water, or of 200 to 250 tons burthen, 3172–3188.

Further cross-examination.

The "Abdiel" got on shore on the causeway just below where the coffer dam was; her tonnage 210; draught 10 feet; she is said to be strained—there was water running from her keel, 3189–3208.

Further re-examination.

The "Abdiel" was on the steps on the north side; her cargo was coals; her draught when laden 10 feet, 3209, 3220.

CLARK, Mr. C.:

Is a lighterman and has been acquainted with Barking Creek for 25 years. There is a little settlement of mud at the creek's mouth, from the magazine down to the steps at Lawes's factory, which can only be attributed to the drift caused by the coffer dam; with that exception the creek is the same as ever. The channel is turned a little, otherwise the navigation has been improved. Vessels never could come up till a certain time of the tide; so it is now. There is a difference of about half an hour in getting in now, due to the mud at the mouth. Confirms Brown's evidence as to the fish trade, 3222–3254.

Cross-examination.

There is mud at the Horse End and there may be a little settlement, but very trifling, outside. Barges have now to lie longer outside, which is attributable to the mud caused by the dam. The mud was always black, and smells nasty and disagreeably, as is the case with all shore mud; mud in the street, if stirred up, would smell just the same, 3255–3291.

Re-examination.

There is a disagreeable smell sometimes from the sewage, coming up the river. Barges used to go in at low water directly the tide made, now they cannot go in so early. As regards other vessels, the practice always was to let the tide make some time before bringing them in. The mud has settled a little above Lawes's factory inside the creek; mud deposit was a grand job for Mr. Lawes in preventing the tide from affecting foundations of his wall, 3292–3308.

By the Commissioner.

Has seen a little material floating in with the tide, but only a mere trifle—flowing about half a mile up the creek; never saw any London sewage floating up the creek or into the Roding, nor so far as Barking, 3309–3316.

HALL, Mr. J.:

Is a bargeowner and lighterman residing at Charlton. In the general course of navigation craft leave the Shelf altogether. Before the main sewerage works a barge could get into the creek at low water, but it would then have had to remain for nearly an hour before it would get through the second reach, on account of the rise in the bottom of the creek. Explanation as to the rise by Powell coincides wth witness's experience. There is a sediment of mud in the entrance, but there is no impediment to the navigation; would rather have the mud than not, as it prevents injury to the craft. Watched the mud gather while the coffer dam was there, 3411–3427.

Cross-examination.

Has smelt an offensive smell in going up, as from all other mud. There is an amalgamation of sewage with the mud; sewage accumulated about two years ago, at the time of the coffer dam; a little might come back on the ebbing tide, which would not deposit, but amalgamate with the mud and create a smell. Has noticed many more corks, toys, &c. floating than there used to be, 3428–3450.

Re-examination.

At certain seasons of the year if mud on banks of the Thames is stirred, it will smell, in some places more than in others, 3451, 3452.

HALLETT, Mr. S.:

Is a master lighterman, residing at Vauxhall, and has known Barking Creek for 20 years. Has taken up river craft, but never noticed any impediment to the navigation; noticed a settlement at the mouth near Lawes's factory; there always was some mud in the mouth, but it has altered; the gut of the creek is 50 feet further up from the Thames through the stones, but no impediment arises. Lightermen attribute this to the coffer dam causing a different set of the tide coming down. Since the removal of the dam the mud has gradually decreased, as the tide goes round to its old position, 3453–3472.

Cross-examination.

Mud has decreased since the dam was taken away; never noticed any particular smell from the mud. Witness proposed to get some of the mud close to the outfall and sell it to farmers, but it was not good enough; it consisted of macadam grit and sewage well washed. Between the mouth of the creek and the outfall there is a bank where plenty of mud might be got if it suited the farmers, so might plenty be got all up and down the river Thames. Could have shovelled 18 inches off the bank, 3473–3513. Barking people complain of the London sewage; they seem to think that the drift from the main outlet sewer comes up the creek; they cannot, however, smell the sewage matter in Barking town, 2½ miles away; it might be smelt a quarter of a mile from the outfall when the reservoir ventilators are open, or at the creek's mouth when the wind lay that way. The stench comes from the outfall when the sewage is in a liquid state; when deposited the tide so soon flows over it that the action of the sun cannot affect it, 3514–3533. There is a delay of half an hour in getting up the creek, caused by mud at the mouth and an alteration in the gut, 3534, 3535.

HALLETT, Mr. S.—*(cont.)*

Re-examination.

Mud prevents getting in so soon as formerly, but the craft once in can get up to Barking just as early as before. Depth of water at creek mouth at spring tides 21 feet; at Barking quay 12 feet. If a vessel draws 12 feet, 12 feet 3 of water would be quite sufficient, 3536–3543.

POWELL, F.:

Is a lighterman residing at Barking, and has known the creek for 32 or 33 years. The navigation of the creek is not impeded one iota. The mud near Mr. Lawes's factory must be caused by the Reclamation Company's coffer dam, the creek being so self-cleansing as to force outside anything deposited. In dry seasons mud will grow up in the creek, which is washed away when the freshes come down, 3317–3329.

Cross-examination.

Has heard a deal of complaint in Barking town as to the London sewage, but never found himself affected by it. Cannot see how people 2½ miles away from the outfall can detect a smell. When the tide is over the culverts there is a smell now and then like that which comes from the London gullies when the sewers are being cleansed, 3332–3341. Mud in the creek's mouth was always of a black colour, before the sewage came; there is no smell unless the mud is stirred up on purpose, 3342–3347.

A great many people complain of the London sewage—those who spend 10 hours out of 12 in London, but witness never heard it among the regular inhabitants of Barking, 3348–3365. There is no difference whatever in the navigation of the creek. The accumulation of mud in the creek's mouth emanates from the creek; since the dam has been removed the creek cleanses itself. There is now a delay of half-an-hour in entering the creek, which is caused by the rise of gravel; alteration in the creek mouth is a freak of nature; many creeks' mouths deviate in the course of years, 3366–3379. Reasons and inducements to give evidence, 3380–3393.

Re-examination.

As witness gets his living by daily work, his interest would be to see the sewage go down to where Captain Burstal suggested. Mud in the creek is no hindrance; you have to wait half an hour later, but then the craft can be got up considerably higher, 3394–3404. Can give no information as to the person who got up the Barking memorial, 3405–3410.

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BARKING:
I. The Town.
II. The Creek.

I. The Town:
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Available width at the entrance has been reduced from 40 feet to 18 feet; and the depth 1 foot; for a certain distance up the creek the accumulation is going on; higher up there was no material deposit traceable to the main sewer outfall, *Leach*, 856, 865–868. Increased difficulty in navigating the creek, *ib.* 857.
Accumulation of mud at entrance of, 6 or 7 feet deep, *Burstal*, 964.
Bed of creek 1 mile 1,080 yards from the quay has but little mud; the true bed is composed of shingle; depth of water 20 feet 6 inches; width of channel, 240 feet, *McDougall*, 1098–1105. Bed of creek 1 mile 856 yards from the quay consists of gravel, chalk, and a little soft river mud; depth of water about 19 feet, width of channel 280 feet, *ib.* 1106–1112. Description of other sections below the quay, *ib.* 1125–1171. The creek has improved since 1858, *ib.* 1113–1124. No smell in the creek; the mud accumulated may be accounted for by protection from the wind, and from no steamers passing up and down, as in the Thames; sewage deposit has no chance of remaining on the slopes, as it is washed away at low water, *ib.* 1177–1183. Mouth of creek has been deepened by the removal of coffer dam of Reclamation Company; deposit of mud was only temporary, *ib.* 1200–1202. In June 1869 water on turn of tide was brown chocolate colour; it looked worse below the tidal sluice, *ib.* 1204–1211. From the bottom of the basin to below the Reclamation Works there was no mud in 1868, *ib.* 1225–1233.
Mud at mouth of, is just such as is found at the mouths of rivers; it is a very little bar; not caused by sewage, *Bazalgette*, 1485, 1486. Creek at Barking town is in a very bad state; no sewage from the outfall gets into the creek; mud on the banks is ordinary river mud; water below the quay is purer than that above, *ib.* 1487*a*–1492. An open sewer discharges into, near the town quay; mud is black and offensive, *ib.* 1493, 1494. Mud at mouth of the Lee is of same character as that at creek's mouth, *ib.* 1628. Foreshores of, not injured by the metropolitan sewage works, *ib.* 1686.
State of water in, *Bidder*, 1817–1826. Fæcal matter on the sluices is not impossible, but highly improbable; it is mechanically impossible to come from the metropolitan sewage, *ib.* 1830–1837. Mud on the banks is ordinary river mud, *ib.* 1838–1840. Allegation as to banks of sewage 6, 8, and 10 feet is purely imaginary, *ib.* 1841.
Banks of mud within the creek are ordinary river mud; could not have been formed by metropolitan sewage outfall; bottom of creek is gravel, *Gregory*, 2058–2062, 2074–2084. Navigation not interfered with by sewage outfall, *ib.* 2063, 2064, 2085–2094.
Deposit of mud at mouth of, is attributable to natural causes, *Hawksley*, 2123. Is of a very light description, and might be easily removed by artificially contracting the mouth, *ib.* 2139. Nothing from the sewer outlet can enter the creek, *ib.* 2141.
Organic matter contained in mud of; mud very much the same from one end to the other; same practically as that of the Roding above, and the Thames, *Miller*, 2216–2222, 2285. Dung at town quay very offensive; mud at the quay contains 25·4 per cent. of organic matter, which has not been caused by metropolitan sewage; mud at Barking is in composition the same as that of the Thames generally—at Barking quay worse, *ib.* 2236-2249. Surface of mud in, is of light colour, showing that the surface is fully oxydized, *ib.* 2282.
Navigation of, not interfered with; impossible for sewage from the outfall to get up into; it is against all laws of mechanics and hydraulics, *Hemans*, 2368, 2369, 2376. Is exactly like all tidal creeks, except that it is very dirty near the town; tidal water brings up great quantities of mud to, which when it spreads out causes a partial deposit, *ib.* 2378–2382, 2389.
Mud in, is like ordinary Thames mud; it has an unpleasant smell, so has all Thames mud; there was no smell of sewage; it might be formed by vegetable matter brought down the Roding, *Haywood*, 2450–2452, 2455–2459.
Town sewage flows into; discharge of dung on the top of the quay, *Tobey*, 2623. There is no bight in which there is an eddy opposite creek mouth; there is above the sewer, *ib.* 2726–2734. The creek mouth now, instead of running out straight, has taken an angle, *ib.* 2797–2802. Up to 1866 vessels of 250 and 300 tons went from the Thames up the creek; they used to ride outside till there was water enough to put them in, *ib.* 2641–2650.
No difference to the navigation of the creek while the coastguard was stationed near it, *Deay*, 2835. Alteration in the creek mouth has been caused by a diminution of the back water from the creek; it is now impossible to land at low water; if the same quantity of backwater came down, the mud alongside the wall would be continually washed away, *ib.* 2835–2848, 2907. Vessels of 180 or 200 tons went up the creek during the time the coastguard was on the north side of the river, *ib.* 2872–2883.
About three months prior to August 1869 a vessel of 272 tons, drawing 12 feet 8 inches, was brought up the creek; she was lightened 92 tons at Davis's wharf, and then came alongside the quay; it has been a common thing for vessels of upwards of 200 tons to come up *Brown*, 2932–2954, 2999–3041. Mud in mouth of, caused by Essex Reclamation Company's coffer dams; within the last 18 months it has diminished, *ib.* 2955–2968, 3052–3073.
There is a little settlement of mud at the creek's mouth caused by the coffer dam; the channel is turned a little; no detriment to the creek so far as getting ships up goes; if anything, the navigation has been improved; there is a little difference caused by the mud, so that barges have to wait about half an hour later for the tide, *Clark*, 3233–3250, 3295–3300. Vessels other than barges always had to wait till the tide served, *ib.* 3301.
Navigation of, has not been impeded one iota, *Powell*, 3322–3324, 3404. Mud in, must have been caused by the coffer dam, as the creek is so self-cleansing that it would force out anything that was deposited, *ib.* 3326–3329, 3370. It emanates from the creek itself, *ib.* 3370. It does not injure the navigation the least in the world, *ib.* 3401, 3402. There is a difference as to the time of admission, half an hour later, but this does not affect the navigation, *ib.* 3371–3376. Channel at creek's mouth has altered; witness does not know the reason, *ib.* 3378, 3379. Rise of water at the mouth at spring tides 21 feet, *ib.* 3374.
Before the main sewerage works, a barge could get in at low water, but could not get along; it would have to remain nearly an hour before it could get through the second reach, on account of the rise in the creek, *Hall*, 3418, 3419. There is a sediment of mud in the creek, and a little rise at the entrance, but no impediment to the navigation, *ib.* 3422.
There is a settlement at the mouth near Lawes's factory, but it is no impediment to the navigation. There always was some mud at the mouth of the creek, which has altered its position; the gut is 50 feet further up the river from the Thames; this is no impediment to the navigation, *Hallett*, 3460–3466. Depth of water in the mouth at high-water springs 21 feet; at the quay 12 feet; that is the shallowest part, *ib.* 3537–3541.
See also *"Horse End;" Crowe's Chemical Works; Lawes' Patent Manure Works; Metropolis Sewage and Essex Reclamation Company; Northern Outfall Sewers; Roding, River; Sewage; Thames, River.*

"BARKING BARRACKS:"
Are eight poor houses, without cesspools, drainage or water supply, and have one common privy, *Deveson*, 560–568.

BARKING REACH:
Not an advantageous place for sewage to be sent into the river, *Leach*, 932.
Accumulation of mud on Kent side before outfall of metropolitan sewage, *McDougall*, 1190–1196.
Was selected as point of discharge of sewage after great consideration, *Bazalgette*, 1429–1433. Is in a better condition since than before the outfall of metropolitan sewage, *ib.* 1674.

BATHING:
Hundreds used to bathe, now the water is too foul and offensive, *Honey*, 616.
Water on the flood in the creek is fit for bathing, *Bidder*, 1845, 1846.

BAZALGETTE, Mr. J. W. (Engineer-in-chief to the Metropolitan Board of Works):
Evidence of, 1419–1753.

BIDDER, Mr. G. P. (Civil Engineer):
Evidence of, 1786–2025, 3560, 3561.

BIRMINGHAM:
Area sewered 7,320 acres; population 360,000; weight of materials used per annum for repair of roads in district sewered, 45,000 tons; dimensions of outfall sewers; dry weather volume of sewage daily 17,000,000 gallons; area of land used for works and deposits 12 acres; dimensions of depositing tanks; quantity per annum of grit and sludge removed from tanks 42,000 cubic yards; area of land occupied by sludge 7 acres, 4 feet deep; cost of lime 100*l.* per annum; dried refuse sold at 9*d.* a ton, *page* 30. (See also *Appendix, page* 107.)
Sewage works have entailed great difficulty upon the corporation, *Bazalgette*, 1546.
Is entirely macadamized with Rowley Rag and Kirkstall Rag, both stones more friable and more easily crushed and washed away than granite; other reasons for there being more detritus in Birmingham than in London sewage, *Haywood*, 2479. Surface and sewer gradients are much steeper than in London; street sweeping materials are shot into the sewers and then flushed away, *ib.* 2482–2484. Sediment from sewage 42,000 tons, *ib.* 2485.

BLACKFRIARS BRIDGE:
Removal of scaffolding from, will tend to improve the river, *Bidder*, 1811.

BROWN, JOHN (Waterman):
Evidence of, 2912–2914, 2923–3221.

BURSTAL, Capt. E., R.N. (Secretary to the Thames Conservancy Board):
Evidence of, 956–1002.

C.

CATCHPITS:
For road drift; cost of emptying, *Hawksley*, 2153–2155.

CATTLE:
On the marshes, near patent manure works soon fatten, *Pyner*, 183–188.

CESSPOOLS:
Notice is given by sanitary inspector of Barking when offensive; if not cleansed, the tenants are summoned before the magistrate, *Horsley*, 277, 278, 309. Contents of, are put on the land and ploughed in, *ib.* 310.

CHARTERED GAS COMPANY:
Pier belonging to, is an obstruction to navigation, and will cause mud to accumulate, *Bazalgette*, 1483, 1639–1645.
The pier will increase deposit at that part of the river; sewage will aggravate the mischief, *Hawkshaw*, 1761–1763.
Pier tends to aggravate the accretion of matter, *Bidder*, 1810.
Organic matter in mud from bank near pier of, *Miller*, 2234, 2235.
Pier of, is out of the line of the main channel of the river, *Haywood*, 2448.

CHEMICAL COMPOSITION:
Of mud in Barking Creek and several parts of the Thames, *Miller*, 2211 *et seq.*; *Odling, passim.*

CLARK, Mr. C. (Barge Owner and Lighterman):
Evidence of, 3222–3316.

COAL TRADE:
No change in mode of conducting from introduction of steam; the trade has increased, but is carried on in smaller vessels, *Quash*, 222–227.
Practice as to purchase of cargoes; if the captains refuse to come, the bargain is off; instance of refusal, *Deveson*, 460–474.

COASTGUARD:
Station removed from creek's mouth, in consequence of the stench from the sewage, *Davidson*, 122–136.
The vessel used to lie just inside the creek's mouth, now it is moved to Charlton, *Honey*, 635–640.
Vessel was moored in on the bank at the creek's mouth; supply of water was got from Flint's brewhouse, Barking town, never from the creek or the river, *Tobey*, 2568–2577. The vessel was removed because Lawes' factory shut out four miles from observation, *ib.* 2593–2596. No nuisance to the vessel caused by northern outfall sewage; when the wind blew from westward there was smell, but nothing to speak of, *ib.* 2624–2626.

COFFER DAM:
The cause of mud in Barking Creek mouth, *Gregory*, 2108; *Powell*, 3327; *Hall*, 3426, 3427.

CONFLUENT STREAMS:
Water in, can be distinguished if of a different specific gravity; if moving at a very high velocity they will become intermixed, *Bidder*, 1988–1990.

CONSERVANCY. See *Thames Conservancy Board.*

COOPER, Mr. E. (District Engineer to the Metropolitan Board):
Evidence of, 2525–2564.

CORRESPONDENCE:
Copies of letters preliminary to the inquiry, *Appendix, page* 106.

CROSSNESS:
There is accumulation of mud at, but there are no inhabitants or creek navigation to interfere with, *Leach*, 869–873.
Organic matter in mud from, *Miller*, 2231, 2232.
Shoal near Barking not attributable to outfall at, *Hemans*, 2372.
Discharge at, is larger than at northern outfall; no nuisance caused by discharge either to inhabitants or to the navigation of the river; no epidemic, nor unusual state of health caused by, *Grant*, 2508–2524.

CROWE, Mr. (Chemical Manufacturer):
Evidence of, 323*a*, 324–331.

CROWE'S CHEMICAL WORKS:
Chemicals manufactured at; number of men employed 324, 325, 328, 329; manufacture does not affect health of the men, nor is the river or creek affected, *Crowe*, 330, 331.
Nuisances caused by, *Hemans*, 2383.

D.

DAVIDSON, Dr.:
Evidence of, 115–136.

DEAY, Mr. W. (Coastguard Boatman):
Evidence of, 2815–2911.

DETRITUS. See *Road Drift.*

DEVESON, Mr. E. (Manager to a Coal Merchant, Barking):
Evidence of, 333–568.

DOCKS:
Organic matter in mud from the London, St. Katherine's, East and West India, Commercial, and Victoria Docks, identical with Thames mud; no sewers empty into the docks, *Miller*, 2226–2231.

DREDGING:
Metropolitan Board of Works have no apparatus for dredging the reservoirs, *Burstal*, 972–974 Would not get rid of mud held in suspension and the pollution of the water, *ib.* 976.
At very little cost would get rid of mud on Horse End, *Bidder* 1849.

DRIVER, Mr. R. C. (Surveyor):
Evidence of, 3544–3559.

DUNG:
Brought up in barges is left upon the quay; this is a complete nuisance, *Pyner*, 197–201.
Unloading of, at town quay operates against comfort and health of the inhabitants, *Crowe*, 323*a*.
Large quantities are brought by barges and railway, some by carts, *Deveson*, 542–550.
Nuisance from unloading of, from barges, *Harvey*, 756–758.
At the town quay, offensive odour from, *Bazalgette*, 1495–1496.

E.

ENGINEERS:
Consulted as to interception of sewage on the northern parts of the metropolis, and point of outfall, *Haywood*, 2433–2439.

ESPARTO GRASS:
Waste from manufacture of; effect of chemicals used for bleaching, when discharged into a stream, *Bidder*, 1920.

ESSEX RECLAMATION COMPANY. See *Metropolis Sewage and Essex Reclamation Company.*

F.

FÆCAL MATTER:
Its specific gravity prevents it from depositing, *Bidder*, 1940, 1941. It is not insoluble, but is immediately decomposed into an innocuous substance, *ib.* 1944–1961. For several miles none goes into the river, *ib.* 1968. Is exceedingly flocculent and quickly broken up, and being broken up is more likely to become oxydized and to disappear, *ib.* 1982–1985.

FAT:
Is collected on the shore, boiled, and then taken to London, *Honey*, 644, 647.
Many factories send grease into the river; sewage sends some, *Bazalgette*, 1596–1598.

FISH:
Business in, at Barking has diminished of late; trade in live fish has not altered; live fish could be brought up to Barking, now it can scarcely be brought to Gravesend, *Marchant*, 30–35. Live fish now are taken to Grimsby and other places; in 1859 live fish could be taken to Billingsgate better than now; fishing at Barking Creek, *ib.* 43–56, 99–102. Accommodation by railway for carriage of, *ib.* 101.
Chemicals of the paper mill affect the fish, *Davidson*, 115.
Large quantities of whitebait could be caught in the creek some years back, but there are none now, *Pyner*, 189–194.
Formerly shrimps would come up to the quay, now they do not, *Dereson*, 395.
Sewage matter not injurious to; chemicals from paper works are; Windsor sewers are the best place on the Thames for fish, *McDougall*, 1223*a*. Sewage not injurious to; not so fatal as chemical stuff, *ib.* 1368–1370, *ib.* 1374.
In Barking creek destroyed by the paper mills at Ilford; fish caught before the paper mills came were chiefly dace, very few shrimps, *Brown*, 2984–2998.

FISHING SMACKS:
Used to lie outside the creek in the river; filled their water casks from the Thames; this was given up because the water became so bad, and then a supply was had from a tank in Barking, *Tobey*, 2578–2587. Number of, in 1848, plying to Barking; they came in to refit, never to bring in fish, that was discharged outside in the Thames for conveyance to London. Very nearly all the boats have gone to other fishing grounds, *ib.* 2598–2611.
Used to come up the creek to refit—not to bring in their cargoes, *Brown*, 2972–2977.

FISHING, SYSTEM OF:
In the North Sea is different now; the fish is collected from the smacks by four steamers and taken to Billingsgate, *Brown*, 2969–2983.

FLEET SEWER:
Area of drainage, about seven square miles, nearly the whole of which is densely inhabited; flood flow of sewage from, in wet and dry weather, *Haywood*, 2500–2504.

FLOAT EXPERIMENTS:
Result of second series of, *Burstal*, 956–963.
Theory founded upon; if the experiments are to be trusted, it is impossible for London sewage to return to Barking, *Hemans*, 2393–2401, 2420.

FORCES, COMPOSITION AND ACCELERATION OF:
Effect of, on the sewage in the Thames; illustration of, *Hawksley*, 2168–2197.

G.

GRANT, Mr. J. (Assistant Engineer to the Metropolitan Board of Works):
Evidence of, 2505–2524.

GRAVESEND:
Points of outfall below Gravesend would have been better than Barking, as there would have been a freer scour to seaward, *Leach*, 876–882.

GREASE. See *Fat*.

GREENWICH:
Experiments at; variation in volume of water from season to season is great; no useful comparison can be made as regards Barking, *Odling*, 2346.

GREGORY, Mr. C. H. (Member of the Institute of Civil Engineers):
Evidence of, 2048–2116.

H.

HADDOCK:
Now come from Grimsby because the water is so bad in the Thames, *Marchant*, 33.

HAINAULT FOREST:
When this existed land floods came down heavily, and cleared the channel of the creek, *Dereson*, 507, 508.
Has been drained of late years; no sudden flushes come down the river now the land has been thoroughly drained, *Brown*, 3074, 3075.

HALE, Mr. W. (Smack Owner):
Evidence of, 682–711.

HALL, Mr. J. (Barge Owner and Lighterman):
Evidence of, 3411–3452.

HALLETT, Mr. S. (Master Lighterman):
Evidence of, 3453–3543.

HARVEY, Mr. E. (Smack Owner):
Evidence of, 712–765.

HAWKSHAW, Mr. J. (Civil Engineer):
Evidence of, 1754–1785.

HAWKSLEY, Mr. T. (Civil Engineer):
Evidence of, 2117–2207.

HAYWOOD, Mr. W. (Surveyor to the City Commissioners of Sewers):
Evidence of, 2429–2504.

HEALTH OF BARKING:
Sewage discharge must affect, *Crowe*, 323*a*.
Not affected by metropolitan outfall sewage, *Odling*, 2293, 2294, 2344.

HEMANS, Mr. G. W. (Civil Engineer):
Evidence of, 2363–2428.

HONEY, Mr. J. (Shipbuilder):
Evidence of, 603–681.

HOPE, Mr. W.:
Evidence of, 1003–1066.

"HORSE END:"
Has increased, especially during the last five or six years, *Marchant*, 23.
Accumulation of filth on, and at the mouth of the creek, *Pyner*, 172–178.
Formation of mud bank on, since discharge of sewage; it may be seen at low water; there was deep water here at one time, and ships used to anchor in it, now they have to go higher up the Thames; barges cannot reach the ships till some time after flood, *Dereson*, 343–351. Mud bank 8 or 10 feet deep is within a few hundred yards of the houses at the creek's mouth, *ib.* 401–417.
Barges sink into the mud on the shore end of, *Watts*, 575–602.
Bank of mud on is from 3 feet to 3 feet 6 inches deep, *Honey*, 676.
A scull can be put down into the deposit of mud on, more than two feet, *Templeman*, 779.
The shoal has much extended since opening of the main sewer; there must be seven feet of mud; nature of the deposit, *Leach*, 856–864.
Bed is lightish mud, 3 or 3½ feet deep; width of channel, 250 feet, *McDougall*, 1082–1097. Deposit of mud on; no difference now from what there was years ago; there is a decrease; soundings, and mode of taking, *ib.* 1294–1367, 1407–1411. If there be fæcal matter on, it cannot be from metropolitan sewage, *ib.* 1973–1977.
There is a tendency to accrete matter here; very little expense in dredging would relieve it, *Bidder*, 1849.
Metropolitan sewage nothing to do with increase of; caused by action of wind, tide, and flood, *Gregory*, 2064–2066.
Extension of, not altogether attributable to effect of the Roding, *Hawksley*, 2198, 2199. Small deposit of mud on, *ib.* 2138, 2139.
Organic matter in mud from, *Miller*, 2233. Mud contains less organic matter than any other sample, *ib.* 2263.
Mud at, and in Barking Creek, is ordinary river mud; it does not contain sewage deposit; *Odling*, 2279–2281. Bed of, is composed of sand, combined with a very small proportion of organic matter, *ib.* 2321–2323 *et passim*.
No tendency to accumulation on, when witness was there in 1866, *Tobey*, 2651–2669. Always was mud on, which is of same character as other Thames mud—black and offensive, *ib.* 2718–2722.
Is all mud of the same kind as that up the creek, *Deay*, 2837–2839. Has extended a little further out; it has got larger, *ib.* 2899, 2900.
Has been growing up ever since witness can remember; accumulation of mud on, caused by coffer dams of Essex Reclamation Company, *Brown*, 2955–2965.
Shoal at the point of Horse End has existed ever since witness knew the creek (25 years), *Clark*, 3231, 3232. There is a little mud on it, *ib.* 3267–3271.

HORSLEY, Mr. W. (Sanitary Inspector, Barking):
Evidence of, 267–322, 801–812.

I.

ILFORD:
No injury from paper mill at, *Marchant*, 28, 29, 36–42.

INSURANCE OFFICES:
Object to vessels entering the creek in consequence of the obstructions, *Deveson*, 371.

INJUNCTIONS:
To restrain pollution of rivers, *Hawkshaw*, 1775–1778.

IRRIGATION:
If sewage were used for irrigation, the pollution and silting of the river would be prevented, *Burstal*, 981–984.—Is not impossible; whoever can utilize the sewage of London will be a national benefactor, *Bidder*, 1872–1879.
See also *Birmingham*.

ITALIAN RYE GRASS:
Dressing used for, on Lodge Farm, *Hope*, 1033, 1034.

K.

KING BRIDGE:
Mud bank formed near, since the London sewage started, *Deveson*, 521.

KIRKSTALL RAG:
Birmingham macadamized with, *Haywood*, 2479.

L.

LAND FLOODS:
Do not come down so heavily as formerly, through Hainault Forest being divided into farms; they clear the channel, *Deveson*, 505–508.

LAWES' ARTIFICIAL MANURE WORKS:
No bad smells from; cattle on the marshes near the works soon fatten, *Pyner*, 183–188.
Number employed, *Crowe*, 326.
Stench from, *Bidder*, 1803–1805.
Shoal off, has been there time out of mind, *Hawksley*, 2139, 2140.
They are very offensive, *Hemans*, 2383–2388.
A great smell from, at times, especially with a south-east wind; coast-guard vessel was removed because the building obstructed the view of the river, *Tobey*, 2589–2593, 2597, 2674–2681, 2695–2708, 2778–2784.
Smell from, when the wind blew from southward and westward; fumes of acids affected the eyes of the coast-guard men, *Deay*, 2823–2828.

LEACH, Mr. S. W. (Engineer to Thames Conservancy Board):
Evidence of, 813–955.

LEE RIVER:
Tidal portion of, is dirtier than the Roding, *Bazalgette*, 1501–1505. Mud at mouth of, is of much the same character as at the mouth of Barking Creek, *ib.* 1628, 1629.

LETHEBY, DR.:
Report by, on Thames water and mud, *Appendix, page* 108.

LLOYD'S PAPER MILLS:
No sediment from them; they contaminate the water, *Honey*, 664, 667.

LOCAL BOARD OF HEALTH:
One much wanted in Barking, *Crowe*, 323*a*.

LODGE FARM. See *Metropolis Sewage and Essex Reclamation Company*; also evidence of *Hope* and *Pollard*.

LONDON, CITY OF:
Sewers in, have very fair gradients, taking the average; as good as in any parts of the metropolis, and better than most; road drift lies in the sewers notwithstanding; minimum sewage flow in sewers of, in dry weather, and minimum scour; any material from the roads would lie in the sewers, with certain exceptions, *Haywood*, 2485–2488.

M.

MCDOUGALL, Mr. J. (Surveyor and Assistant to the Metropolitan Board of Works):
Evidence of, 1067–1418.

MAIN DRAINAGE:
Plans for, of Messrs. Simpson, Galton, and Blackwell, *Bidder*, 1790. If sewers for, were carried further down they must be tidal, unless the expense of pumping were incurred; the cost would be enormous, without any advantage, and the sewage would have been carried past land where it might be utilized, *ib.* 2005–2015.—About 4,000,000*l.* has been spent upon the works, *Haywood*, 2441, 2442.

MANURE. See *Dung*.

MAPLIN SANDS:
Scheme for utilizing sewage on, *Hope*, 1016. Money would be forthcoming in 24 hours, if Metropolitan Board gave a guarantee, *ib.* 1020–1023, 1049, 1050. Capital of company 2,100,000*l.*, *ib.* 1052. Works and cost of construction; operations are now stopped, *ib.* 1053–1059. If works were carried on there would be no financial loss, 1060.
Scheme will not answer commercially, *Bidder*, 1999–2004.
See also *Metropolis Sewage and Essex Reclamation Company*.

MARCHANT, Mr. (Resident in Barking and Smack Owner):
Evidence of, 1–114, 322*a*–323.

MEDWAY:
Receives some sewage, but in small proportion to the volume of water in the river, *Odling*, 2340.

MEMORIAL FROM BARKING:
Of vicar and other inhabitants of Barking, *page* 1.
Handwriting of; was taken round for signature, *Deveson*, 430–440.
Allegation as to loss of 11 feet of water in the channel of the Thames is true as regards the depth of mud, but not as to its position, *Burstal*, 964, 965.
Allegation that the dangerous condition of the Thames is owing to discharge of sewage is imaginary and contrary to fact, *Bazalgette*, 1427–1428.
Statement in, as to danger of health from sewage outfall has no foundation; no part of the memorial is correct, *Cooper*, 2548–2550.
Evidence taken in support of allegations in, see Evidence of *Marchant*, 1–114, 322*a*–323; *Davidson*, 115–136; *Pyner*, 137–201; *Quash*, 202–266; *Horsley*, 267–322, 801–812; *Crowe*, 323*a*–331; *Deveson*, 333–568; *Watts*, 569–602; *Honey*, 603–681; *Hale*, 682–711; *Harvey*, 712–765; *Templeman*, 766–800; *Leach*, 813–955; *Burstal*, 956–1002.
Evidence taken in refutation of allegations in, see *McDougall*, 1067–1418; *Bazalgette*, 1419–1753; *Hawkshaw*, 1754–1785; *Bidder*, 1786–2025; *Gregory*, 2048–2116; *Hawksley*, 2117–2207; *Miller*, 2208–2273; *Odling*, 2274–2362; *Hemans*, 2363–2428; *Haywood*, 2429–2504; *Grant*, 2505–2524; *Cooper*, 2525–2550; *Barnes*, 2564; *Tobey*, 2566–2814; *Deay*, 2815–2911; *Brown*, 2912–2914, 2923–3221; *Clark*, 3222–3316; *Powell*, 3317–3410; *Hall*, 3411–3452; *Hallett*, 3453–3543.
Notice of public inquiry into allegations of, *Appendix, page* 106.

MERSEY, RIVER:
Velocity in mid-channel at half tide; rise of tide is higher than in the Thames, *Bidder*, 2024, 2025.

METROPOLITAN BOARD OF WORKS:
Have no apparatus for dredging sediment from the reservoirs, *Burstal*, 972–974.
Contemplated utilization of the sewage from the commencement; encouragement given to the Essex Reclamation Company, *Bazalgette*, 1654–1663. Operations of, have not injured the navigation of the Thames or affected the foreshore of Barking Creek; they have rather improved the navigation, *ib.* 1686. Never put any difficulties in the way of the Sewage Company; on the contrary, has given every encouragement, *ib.* 1707–1724.

METROPOLITAN OUTFALL SEWERS. See *Barking; Mud; Navigation; Northern Outfall Sewers; Sewage; Southern Outfall Sewer; Thames, River*.

METROPOLITAN SEWAGE:
Should be utilized and kept out of the Thames if it can be done successfully, *Hemans*, 2403, 2404.
As to assumption that 700,000 tons from main outlet sewers—assumes that not an atom has been decomposed; 700,000 tons is entirely supposititious as applied to London, *Haywood*, 2488 *et seq*.

METROPOLIS] SEWAGE AND ESSEX RECLAMATION COMPANY:
Lodge Farm.—Is an experimental farm of 220 acres, *Hope*, 1012; *Bazalgette*, 1724.—Results as to produce satisfactory, *Hope*, 1017, 1018. Per-centage payable to Metropolitan Board, *ib.* 1019. Crops irrigated, *ib.* 1027. Dressing for Italian rye grass 4,000 tons per acre per annum, *ib.* 1033, 1034. Complaint as to stagnant sewage on; this has been remedied; it was no very great affair, *ib.* 1006, 1007. Sewage is applied for agricultural purposes; nothing offensive in its application, *ib.* 1008–1010.—Sewage from, has run into a fishpond and killed the fish; it is smelt in hot weather, especiall yduring east and south-east winds, *Horsley*, 294–299, 315–321.—Cannot detect any smell from sewage deposited on land of, *Powell*, 3335.

METROPOLITAN SEWAGE, &c. COMPANY—*cont.*
Description of coffer dam; the dam caused an obstruction to flow and ebb of tide; deposit of mud has been washed away; there will be nothing injurious hereafter from this; since the removal of the dam the mouth of the creek has deepened, *McDougall*, 1197, 1203.
Arrangement between the Metropolitan Board and the company still holds good; if company carry out their contract river will be free from sewage, *Bazalgette*, 1529–1533. Hrs always had sewage for nothing, *ib.* 1724.
Engineering part of the scheme is chimerical, *Bidder*, 1880. Maplin Sands scheme will not answer commercially, *ib.* 1899–2004.
Metropolitan Board of Works has not thrown any discouragement in the way of the scheme; they have assisted the company in every possible way, *Pollard*, 2027*a*, 2028. Explanation as to passage from report of 1867–8, *ib.* 2030–2047.
Explanation as to Mr. Hope's evidence relating to cause of failure of, commercially; has received every assistance from the Metropolitan Board of Works, *Hemans*, 2377, 2405–2418.
Coffer dam used in carrying out the works was the cause of mud gathering on the Horse End and at the lower part of the creek, *Brown*, 2955–2965.

MILLER, Dr. W. A. (Professor of Chemistry, King's College):
Evidence of, 2208–2273.

MOLE:
No mud in; all sand and gravel; organic matter is almost nil, *Odling*, 2338, 2339.

MORTALITY:
High rate of, in Barking, *Crowe*, 323*a*.

MUD:
Constituents of sewer mud are pretty nearly the same in the river from Kew to Woolwich, *Leach*, 900–907.
Organic matter in various samples; difference in composition of, on the two sides of the river, *Miller*, 2216 *et seq.*
Surface of, in Barking Creek is light in colour, which shows that it is fully oxydized, *Odling*, 2282. Almost impossible for sewage mud to become oxydized while in a state of mud; it is different when suspended in a large quantity of water, *ib.* 2284. Variations in samples of, are extremely minute; they do not indicate result as being due to metropolitan outfall sewage, *ib.* 2286–2289. Containing organic matter has become partially oxydized, *ib.* 2319. Witness coincides in Dr. Miller's analyses of; samples of sewage from the reservoir and of mud from the Thames near Chartered Gas Company's pier, *ib.* 2295–2304. In a condition in which it cannot absorb more oxygen will putrefy, *ib.* 2314. As a rule mud banks below the surface of the water do not smell, but where there is a mud bank near sewage discharge the material undergoes putrefaction and does smell, *ib.* 2315–2317. From Barking Quay is very different from mud of the creek, *ib.* 3326. Mud carries down organic matter, *ib.* 2340.
Of the Thames must at present have a certain quantity of sewage in it, the upper northern system not yet being completed, *Hemans*, 2372.
At the mouth of the creek smells a little, but not offensively, *Brown*, 3150–3156.
In Barking Creek smells like all other mud; has been caused by the coffer dam, *Clark*, 3280–3291. There is a little disagreeable smell sometimes from the sewage, *ib.* 3293, 3294. The mud serves to keep up the wall above Mr. Lawes's factory, *ib.* 3307, 3308.
Near Mr. Lawes's factory has always been of a very extreme depth before the sewer came; it always was black, and when disturbed smelt; there is no difference between it and ordinary mud, *Powell*, 3342–3347.
In creek's mouth caused by the coffer dam; there was more 18 months ago than there is now, *Hall*, 3426, 3427. Smells offensively, like all other mud on the banks of the Thames, but it never had the smell of sewage; no doubt there is amalgamation of sewage with the mud, but it would not deposit itself there, *ib.* 3432–3444, 3451, 3452.
In the creek's mouth attributable to the coffer dam causing a different set of the tide; now the dam is removed the mud gradually goes away, the tide going round to its old position, *Hallett*, 3467–3472. Never noticed any particular smell from the mud of the river; tried to induce farmers to take some for manure, but it was not good enough; if it was, plenty could be got; on the shore from the outfall there is a bank of about 18 inches deep, *ib.* 3479–3513.
See also *Barking; Navigation; Organic Matter; Sewage; Thames, River.*

N.

NAVIGATION:
I. Of the Thames.
II. Of Barking Creek.

I. Of the Thames:
Injured by accumulation of sewage mud on the Horse End, *Dereson*, 343–354.
Deposits of sewage mud will seriously interfere with, *Honey*, 641–644.
Loss of 8 or 9 feet of water in the channel between the Shelf and the Ridge, *Harvey*, 736–755.
No complaints are made to the Conservancy Board as to being impeded by mud banks, *Burstal*, 975.
Has not been injured, nor the foreshores of Barking Creek been affected by the sewage works, *Bazalgette*, 1686.
Present mode of discharge of sewage not dangerous to navigation; it is beneficial to the river, *Bidder*, 1792–1797.
Allegations in memorial as to, not founded in fact, *Hemans*, 2368.
In the general course the Shelf would be left altogether, *Hall*, 3417.

II. Of Barking Creek:
Difficulty with vessels of 9 or 10 feet draught; no money spent to keep the channel open, *Marchant*, 23. Impeded by outfall of sewage, *ib.* 24, 25; *Pyner*, 158, 159.
Difficulty of, at entrance to the creek; there is a bar, *Quash*, 213, 215.
Has been injured by the accumulation of sewage deposit, *Dereson*, 356–400.
Deposit of mud at creek mouth the only impediment to, *Hale*, 711.
Northern outfall has not injured the navigation, *Bidder*, 1855.
No difference in the navigation of the creek while the coastguard was stationed there, *Deay*, 2835.
No more difficulty now in bringing up vessels than heretofore, except that there is a little delay for barges in the reach by the Horse End, and the mouth of the creek has altered, *Brown*, 3042–3051, 3083, 3147, 3148, 3183.
Has been improved, *Clark*, 3240.
Has not been injured one iota; it is not injured by the mud in the mouth, *Powell*, 3322–3324, 3401–3404.
No impediment to navigation in the creek whatever; the mud is rather an advantage to barges, as it protects the craft from injury, *Hall*, 3422–3425.
No impediment to, caused in Barking Creek, except a little delay at the creek's mouth, about half an hour to an hour, caused by the mud and the alteration of the gut, but barges can get up to Barking just as soon as before, *Hallett*, 3460–3466, 3534–3536.

NITROGEN:
Per-centage of, in organic matter contained in various samples of mud, *Miller*, 2217 *et seq.*
See also *Mud; Organic Matter.*

NORTH SEA FISHERY:
Fish caught, *Marchant*, 31–34. Barking depended upon, formerly; not interfered with, as far as concerns Barking, only the fish is taken to Yarmouth, *ib.* 99.

NORTHERN OUTFALL SEWERS:
Water has become very impure since opening of, *Quash*, 216–220.
Commenced to deliver sewage into the Thames in 1864, *Dereson*, 509. Sewage is liberated from some time on the ebb, and flows downward till it meets the coming tide, leaving between high and low water mark an unpleasant deposit, *ib.* 510–520.
Plans of, were submitted to the Thames Conservancy Board, and approved on the understanding that only the sewage water should be pumped into the river, *Leach*, 887–899, 928–932.
Design was adopted after great deliberation, *Bazalgette*, 1429–1433. Plans were submitted to Conservators and to the Admiralty; no undertaking or statement made as to clarified water only passing into the river, *ib.* 1436–1438, 1442–1446. Were opened in August 1864, *ib.* 1434. Works have no effect on the shore, *ib.* 1483. Engine power at; surplus power, *ib.* 1518–1523. Average daily quantity of sewage poured into the Thames, 32,743,000 cubic feet, *ib.* 1548, 1549. There is no set of current or backwater at the outfall, so that sewage cannot flow back; it all goes off to sea, *ib.* 1560–1595. Barking Reach is in a better condition now than before the outfall of London sewage, *ib.* 1674.

Place selected the best, taking cost into consideration, *Hawkshaw*, 1764–1766.
Present position the best that could be selected, *Bidder*, 1789.
Have not injured the Thames, nor prejudicially affected Barking itself, *Hawksley*, 2123, 2144. Best point for northern outfall is the present one; mode of outfall is the best, *ib.* 2146, 2147. Cleansing of reservoirs, *ib.* 2157–2163.
Shoal near Barking not attributable to; quantity of sewage sediment discharged daily, 70 tons, *Hemans*, 2372, 2373.
Point for discharge was selected, after large amount of investigation, by engineers of great eminence, as the most eligible; *Haywood*, 2433, 2443. It fulfils the requirements of the metropolitan population as well as of those who live below the point of outfall, *ib.* 2444, 2453, 2454.
Ventilators over the reservoirs and works; smell from, depends upon the wind; at 100 yards not perceivable; main outlet, except for four hours out of 24, is covered with water; no discharge from, after water has left the soffit of the arch; discharge from, depends on the tide and height of water in the river; ordinary daily flow of sewage into the Thames, 32,000,000 gallons or 4,500,000 cubic feet, *Cooper*, 2530–2542. Population near, are very healthy, especially the children, *ib.* 2544–2547.
Nothing affecting health arises from the outfall or the reservoirs, *Barnes*, 2551–2564.
No nuisance from, experienced on the coastguard vessel when stationed on the north side of the river; there was a little smell when the wind was westward, and the ventilators open, *Deay*, 2822, 2863–2869.
A little of the material from the outfall, such as straws and corks, float about two reaches up the creek, but none of the London sewage, *Clark*, 3309–3316.
The smells that surround the outfall rather kill the smell that comes from the sewer; the smell is similar to that from London gullies when the sewers are being cleansed, and is only perceived occasionally when the tide is over the culverts; never smelt it in Barking, *Powell*, 3334, 3335–3341. Has been the subject of conversation in Barking; those who think it injurious are the railway travellers; as far as domestic circles are to be spoken of, witness never heard either man, woman, or child speak of the ill effects of the London sewage, *ib.* 3348–3365.
Sewage may be smelt a quarter of a mile from the outfall when the reservoir ventilators are open; at the creek's mouth the stench is smelt when in a liquid state; when deposited on the bank the tide soon flows over it; there is no particular smell from the outfall; there may be for a short time when the sluice is open, *Hallett*, 3522–3532.
On 3rd August 1869 sewage was pouring out into the Thames, in considerable volume, from six or seven or more sluices, the tide at the time being on flood; rainfall could hardly have produced this effect, *Driver*, 3550–3559. (See also *Rainfall.*)
Area sewered, 50 square miles; population sewered, 2,300,000; ordinary daily flow into Thames at Barking, 33,000,000 gallons, *page* 30 (see also *Appendix, page* 107.)
As to effect of, generally on the navigation of Barking Creek and of the Thames, see *Barking; Navigation; Roding, River; Thames, River.*

Nuisance:
From dung left on the quay, *Pyner*, 197–201.
None caused by outfall, *Haywood*, 2465, 2466, 2474.

Nuisance Works:
Foul smells from, *Deveson*, 554–559.

O.

Odling, Dr. W. (Professor of Chemistry at the Royal Institution):
Evidence of, 2274–2362.

Organic Matter:
Per-centage of, in mud of Barking Creek; of the Roding above the mill; between Chiswick and Westminster; from the docks; from Barking Reservoir and from Crossness; from Horse End; from bank near pier of Chartered Gasworks Company at Barking Quay, *Miller*, 2216 *et seq.* A proportion of, in sewage would be carried away, and some deposited, *ib.* 2250–2254.
In mud of Barking Creek very much the same from one end to the other, *Odling*, 2285. Specific gravity of, in sewage very slightly above water; subsides but slowly when not putrefying; when putrefying, putrefaction lifts it up; in a running stream it would not subside, *ib.* 2290, 2291. Is not necessarily unwholesome; in a putrid state it is unwholesome, *ib.* 2292. On bed of Horse End shoal, *ib.* 2321–2323. In the Mole is almost nil, *ib.* 2338, 2339. Mud carries down organic matter, *ib.* 2340. Greater amount of, in salt sea water than in fresh river water, *ib.* 2349.
Considerable quantity of, brought down by agricultural land drained by the Thames, *Haywood*, 2499.

Outfalls:
For sewage into the Thames; proposed by Messrs. Simpson, Galton, and Blackwell; expense of, *Bazalgette*, 1506–1511.

Oxygen. See *Mud; Sewage.*

P.

Paper Mills:
At Ilford, no injury to Barking Creek from, *Marchant*, 28, 29.
Effect of chemicals from, on the fish, *Davidson*, 115. Materials used, *ib.* 116–120.
Destroyed the fish in the creek, *Brown*, 2984–2998.

Paris:
Macadam of, is formed with a limestone, which is easily convertible into impalpable powder; mode adopted in Birmingham is used in Paris, *Haywood*, 2484.

Penalty:
For throwing road drift into sewers, *Bazalgette*, 1741, 1742.

Pollard, Mr. J. (Clerk to the Metropolitan Board of Works):
Evidence of, 2026–2047.

Powell, F. (Lighterman):
Evidence of, 3317–3410.

Preventive Service. See *Coastguard.*

Putrefaction. See *Mud.*

Pyner, Edward:
Evidence of, 137–201.

Pyroligneous Acid:
Fumes from manufacture of, affected the coastguard men, *Tobey*, 2680; *Deay*, 2824–2828.

Q.

Quash, Mr. J. (Resident in Barking, Smack Owner):
Evidence of, 202–266.

R.

Rainfall:
For 12 hours previous to overflow of sewage on 3rd Aug. 1869 thirty-five hundredths of an inch; twenty-nine hundredths fell in 4½ hours, or at the rate of 1½ inch per day; about a third of the rainfall of the metropolis flows off in 24 hours, *Bidder*, 3560, 3561.

River Surveying:
Requires special practice and special knowledge, *McDougall*, 1417, 1418.

Road Drift:
Detritus from the sewers enters to a very small extent into formation of banks above the outfall, *Hawkshaw*, 1755.
Quantity discharged is infinitesimal, *Bidder*, 1911, 1912.
Formerly all went into the Thames, now a very large proportion is removed before sewage matter proper goes into the river, *Hawksley*, 2123, 2124.
In sewers is diminishing, and will diminish year by year; as an economical matter, there is a tendency to make the gullies intercepting; from the slight inclination of the intercepting sewers, and the insufficiency of the current in the outfall line, very little can pass into the main sewers, *Haywood*, 2477–2481. Comparison between London sewers and Birmingham; differences between the two systems, *ib.* 2485. Would pass out of the Fleet sewer, London Bridge, and other arterial lines in the city, *ib.* 2488.
See also *Birmingham; London, City of.*

Roding, River:
Comes from the upper part of Essex; has some sharp turns in it, *Quash*, 231–233.
Organic matter contained in mud in, *Miller*, 2219.
Mud from above Barking contains 17 per cent. of organic matter; could not have come upwards, *Odling*, 2335–2337.
Tendency of the stream would be to deflect the sewage across the Thames; large population grown up on, above Barking, which sends down large quantities of sewage, *Hawksley*, 2143, 2144. Extension of Horse End not altogether attributable to, *ib.* 2198, 2199.

RODING, RIVER—*cont.*
There is a deposit at mouth of; 250*l.* would probably remove it; deposit is not attributable to the outfall sewer, the conditions of discharge prevent that, *Haywood*, 2447.
Quantity of water passing down, varies with the season, *Powell*, 3329.

ROWLEY RAG:
Birmingham macadamized with, *Haywood*, 2479.

S.

SANITARY ACT OF 1866:
Information given by the Commissioner as to operation of, and mode of applying, *page* 11.

SANITARY INSPECTOR:
Duties of; salary, *Horsley*, 269–278, 309, 322.

SCARLET FEVER:
Many cases of, in 1868, *Horsley*, 810.

SEDIMENT:
250 tons a day passes into the sewers, *Bidder*, 2019, 2020.

SEWAGE:
Stench from, is intolerable, *Davidson*, 122, 123.
Water in the creek contaminated by, *Pyner*, 139–152. Accumulation of, on the Horse End, *ib.* 172–178.
Stench from floating materials is very great, *Quash*, 258, 259.
Of Barking partly goes into the creek, *Deveson*, 485–490.
Deposits of, prevent vessels coming into the creek, *Honey*, 609–615. Depth of sewage mud in the creek, *ib.* 627–632.
Is sent up the creek by the flood of the rising tide, *Templeman*, 775, 783. Where there is a backwater the sewage lies, *ib.* 785, 786.
There should be several outfalls, some 10 or 15 miles to seaward, *Burstal*, 978–980, 985, 986. Effect of pouring sewage on to land is to deodorize it and purify it, *ib.* 983, 984.
At Lodge Farm is applied for agricultural purposes; quantity taken, *Hope*, 1008, 1012, 1013; sewage of London might be utilized at a profit, *ib.* 1015; area necessary to utilize London sewage, *ib.* 1031.
Not so injurious to fish as chemical stuff, *McDougall*, 1368–1370, 1374.
Is discharged from the outfall one hour after high water; discharge lasts for about two hours; velocity; ebbing stream of the Roding helps to drive the sewage further into the Thames; character of the sewage is the same now as formerly, but the mode of discharge is vastly better, *Bazalgette*, 1446–1461. Road detritus is prevented from getting into the sewers as far as possible; a great deal of it is intercepted by catch-pits, at the street gullies, *ib.* 1462–1464, 1525, 1543, 1544. Three-quarters of a mile below the outfall sewage cannot be traced, *ib.* 1484.
Will aggravate the mischief caused by Chartered Gas Company's pier, *Hawkshaw*, 1763; cost of carrying, 15 or 20 miles beyond Barking, 12,000,000*l.*, compared with 3,000,000*l.* or 4,000,000*l.*, *ib.* 1767. If possible should be diverted from the river, *ib.* 1770–1774.
Present mode of discharge of, not dangerous to navigation; it is beneficial to the river; old mode of delivery, *Bidder*, 1792–1800. The volume of river water as compared with the sewage is so enormous that all trace of the sewage is lost three-quarters of a mile below the outlet, *ib.* 1801–1803. Little if any sewage silt comes back, *ib.* 1812, 1813. Sewage matter delivered into the Thames is of less specific gravity than the water, so cannot be deposited; it is kept flowing backwards and forwards, and is eventually delivered into the sea, *ib.* 1905–1910. Effect of velocity in delivery, *ib.* 1908–1914. Is mixed with Thames water in the proportion of 1 to 20,000 parts it becomes entirely changed in its nature, *ib.* 1935, 1937, 1938. Quantity poured into the Thames is smaller now than before the intercepting sewers were executed, *ib.* 1972. Finds its way into the midst of the tidal current, which has a velocity plus that of the delivering sewer; the tendency is to mix with the water on both sides and to dissipate it; the fluid and whatever it contains is there, except the fæculent matter, which rises to the surface and becomes rapidly oxydized, *ib.* 1992–1998. Quantity held in suspension before passing into the Thames; volume of water with which mixed, *ib.* 2016–2018.
Is carried down the river, *Gregory*, 2067, 2068.
Much less solid matter passes into the river now; proportion of undissolved solid matter in sewage; all trace of sewage is lost three-quarters of a mile down the stream, *Hawksley*, 2125–2137, 2164–2167.
A proportion of organic matter in, would be carried away and some deposited, *Miller*, 2250–2254. Samples of, for analysis, whence taken, *ib.*, 2257–2273.
No accumulation of sewage filth or refuse in the river near dwellings of the memorialists; metropolitan outfall sewage has not the slightest effect on health of Barking, *Odling*, 2293, 2294. Oxidation of, by action of the external air and water, and by the dissolution of air in water, *ib.* 2341–2343. Metropolitan sewage from the Barking main sewers outfall is very rich sewage; it is a far richer manuring material than any witness has met with at places where sewage irrigation is practised; should be applied to land; no other way of dealing with it, either that, or throwing it away; fresh sewage is not unpleasant looking stuff; when it runs out from the reservoir, though it is black it is not putrid, but it abounds in worms and other things which are alive, *ib.* 2353–2356. The sewage which is sent into the reservoir is always black; minor sewers in the metropolis are in length largely in excess of the intercepting sewers, and the character of their sewage would be stamped upon the whole volume of sewage by what the tributaries brought in, because when once fermentation has set in it goes on through the whole very quickly; there are many miles of old sewers in London which retain deposit; these give a character to the sewage generally; if put on land it would make a rich manure, *ib.* 2357–2361.
Impossible for sewage from the outfall to be injurious; the amount is so small as compared with body of water it is mixed with, *Hemans*, 2369, 2397. Is subject to disintegration; during the whole of the ebb it is flowing down, and reaches seven or eight miles before it commences to return, *ib.* 2421–2428.
Annual quantity of solid matter from all the sewers from the population of the metropolis, taking it at 3,500,000, is about 92,000 tons (which allows 3 oz. of solid matter per head per day, exclusive of urine) omitting road detritus; thus it would take seven or eight years before 700,000 cubic yards could be deposited from the metropolitan sewers, *Haywood*, 2454, 2488–2490. It is possible that it may return to Barking, under very exceptional circumstances, just as salt water has reached Westminster Bridge, but the occurrence is very rare, *ib.* 2467–2473.
Discharge of, at Crossness has had no injurious effect on the navigation of the river, or the health of people residing near, *Grant*, 2509–2520.
Fæces, a few corks, and things of that sort seen floating on the surface in different places, *Tobey*, 2723–2725, 2733–2743.
No doubt there is an amalgamation of sewage with the mud in the creek; signs of sewage matter, such as corks and toys, float up and on the surface, which could not all come from Barking, *Hall*, 3445–3450.
See also *Barking; Mud; Navigation; Northern Outfall Sewers*, &c.

SEWAGE RESERVOIRS:
Proper to cover them over, *Bazalgette*, 1515, 1516.

SEWER MUD:
Constituents of, pretty nearly the same in all parts of the river from Kew to Woolwich, *Leach*, 900–907.
See also *Mud; Navigation; Organic Matter; Sewage.*

SEWERS. See *London, City of; Northern Outfall Sewers; Southern Outfall Sewer.*

"SHELF," THE:
In the Thames, opposite the Horse End, *Deveson*, 498–500.
Accumulations of mud on; the Shelf is a bank of shingle, *Honey*, 678–681.
Is a mixture of clay and gravel; on the top clean gravel; has not been dredged; is increasing, *McDougall*, 1212–1216.
No difference in its condition between 1848 and 1866; it was dry at low-water springs, and consisted of shingle and sand, *Tobey*, 2612–2618, 2653–2669.
Has a hard bottom; is still used for berthing and cleaning boats upon at low water; has always been of this character since witness knew it, *Brown*, 2925–2931.
Has always been in the river, *Clark*, 3230.

SHIPS AND VESSELS:
With live fish-wells cannot now be brought up to the quay, *Marchant*, 31–35.
No shipping office at Barking, *Quash*, 265, 266.
Tonnage of, prior to 1862; greatest present draught; insurance offices object to vessels entering the creek, *Deveson*, 357–371. Of different tonnage may have same draught, according to their build, *ib.* 441, 442.

Vessels drawing not more than 10½ feet can come up the creek; before the sewage, vessels drawing 14 feet used to come, *ib.* 455–458.
Cannot get into the creek so early as they used to do; ships in consequence are very different to what they used to be; this is caused by the London sewage, *Honey*, 609–615. Same class come now as formerly, but not so many; number of smacks has diminished because they have gone nearer the fishing grounds, *ib.* 656–661. Are not now supplied with river water because it is impossible, *ib.* 673, 674.

SHRIMPS:
There were very many shrimps before the paper mills came at Ilford, *Brown*, 2990, 2991.

"SOLIDS:"
Definition of, as evacuated by the human body, *Haywood*, 2491–2498.
See also *Sewage*.

SOUTHERN OUTFALL SEWER:
Was opened in April 1865, *Bazalgette*, 1435. No surplus engine power at, *ib.* 1521.
Lies south-east of Barking; smell from, is so bad the vicar has to close his windows, *Marchant*, 322*b*, 322*c*.
Does not affect Barking much, *Deveson*, 534.
Engineers consulted would have recommended a higher point but for the general feeling against it, *Bidder*, 1789.
Discharge from, is larger than at northern outfall; no nuisance caused by, *Grant*, 2508–2524.

STEAMERS:
Four belonging to the fish company come to Barking to be cleaned after discharging their cargoes, *Deveson*, 475–484.

SULPHURIC ACID:
Fumes from manufacture of, affected the eyes of the coastguard men, *Tobey*, 2676–2680; *Deay*, 2824–2828.

T.

"TALBOT:"
Mud has grown up 9 or 10 feet about the former station of; the vessel was removed in consequence, *Burstal*, 964.
Accumulation of 7 feet 6 inches only of mud at the late berth of; mud must naturally accumulate there, it does not arise from northern outfall sewage, *Bazalgette*, 1482, 1483, 1555–1557.

TEMPLEMAN, J. (Fisherman):
Evidence of, 766–800.

THAMES CONSERVANCY BOARD:
Does not dredge within the creek, *Quash*, 249–253.
Surveys made by, *Leach*, 849–854. Plans of northern outfall were approved by, on the understanding that there were to be settling reservoirs, and that only the sewage water would pass into the Thames, *ib.* 887–899, 928–932. Prosecutions by, to prevent solids being thrown into the river, *ib.* 920–927.
The only question the board had to deal with was how far the main drainage works would affect the navigation; the understanding was that the sewage should subside and the clarified water alone run off into the Thames, *Burstal*, 969, 970. Receives but few complaints as to impediments to navigation from the mud; complaints are more general as to deposition on the river shores, *ib.* 975.

THAMES EMBANKMENT:
Beneficial effect of, in preventing deposits in river, *Bazalgette*, 1537–1540.

THAMES, RIVER:
Not affected by Mr. Crowe's chemical works, *Crowe*, 330, 331.
Formation of mud bank on the Horse End in the low-water tideway caused by metropolitan sewage, *Deveson*, 343–351. Shoaling up of the shore on the London side of the creek mouth, *ib.* 522–523.
The different banks are growing up and filling with silt; nothing of the kind existed before the outfall; there is a black mark across the river from the London sewage outfall; there is a continuous mass of floating filth, *Harvey*, 715–723.
Channels between Horse End and the Ridge, and between the Ridge and the Shelf, have been much changed; and a loss of about 8 or 9 feet of water has been occasioned by the sewage mud, *ib.* 736–755.
Boats cannot get from the river to the creek mouth as they could formerly, from the slush and mud that has grown up; the smell is terrible, *Templeman*, 772–774. The main channel in the true tideway remains the same as before, *ib.* 781, 798.
At the berth of the "Talbot" powder vessel, when first moored, there was 12 or 13 feet of water, now there is a loss of nearly 7 feet, *Leach*, 815–830. From 1864 to 1867 there was a deposit of about 700,000 cubic yards in the river generally; analysis of mud; if things remain as they are the shoalings will increase, *ib.* 835–840. This should be stopped, *ib.* 843. No apprehension of the main navigable channel being choked up, *ib.* 841, 842. Cost of removing the deposit 1*s.* 9*d.* per cube yard, or about 20,000*l.* a year, *ib.* 844–848, 953–955, 944–945. True channel has been much deepened by dredging; no dredging has taken place on the "Shelf" and "Ridge;" these shoals are natural to the river, *ib.* 809–913. Deepening of water on south side has not influenced the shore on the north side, *ib.* 914–919. Tidal water has always been more or less muddy, *ib.* 939–943. The only practicable mode to prevent sediment passing into the Thames is to take the outlets further to sea, *ib.* 946, 947.
Large accumulations of mud in the Thames are taking place inshore about Barking Creek, and three-quarters of a mile above it, *Burstal*, 964. Surveys of, in 1832, in 1861, in 1867; considerable difference in depth between the two latter years, *ib.* 967, 975. Dredging would not get rid of mud held in suspension, and the pollution of the water, *ib.* 976. Pollution and silting of the river would be prevented by using the sewage for irrigation purposes, *ib.* 981–984. The accumulation of mud does not go on at the same rate it did between 1864 and 1867; the deposits from 1867 to 1869 are not of a nature to cause serious alarm as to the general navigation of the river being injured, but where there are eddies the deposit will increase, *ib.* 993–997.
Prior to northern outfall, mud had accumulated of a similar kind to that now found at Barking Creek; no difference in the mud banks since northern outfall, *McDougall*, 1184–1196. Mud thrown into, by Trinity dredgers, *ib.* 1218–1223.
Allegation as to dangerous condition of, contrary to fact, *Bazalgette*, 1427, 1428. Net increase of mud, between 1864 and 1867, taking the whole reach, is 60,000 cubic yards, *ib.* 1467–1479. Remarkable change in the river between 1867 and 1868; diminution of mud deposit; causes of, *ib.* 1480–1482. Shifting of silt with the tides has always taken place, *ib.* 1535–1536. At Barking reach is in a better condition since than before the outfall of London sewage, *ib.* 1674. Waterway has been deepened on both sides, *ib.* 1675–1678. Navigation of, not injured by works of Metropolitan Board, *ib.* 1686.
Soundings over the whole of a given reach must be considered in arriving at a conclusion as to accumulations of mud, *Hawkshaw*, 1758. Bank the subject of inquiry is not likely to diminish, *ib.* 1760.
Navigation is improved by present mode of discharge, *Bidder*, 1795, 1811. Silt discharged into, is about 90,000 tons per annum; the statement that 700,000 cubic yards has accumulated near the Barking outfall is not tenable for a moment, *ib.* 1806–1810. Causes affecting conditions of, *ib.* 1811. Is purer at Kew than through the whole extent of its course; no sewage is allowed to pass into the river from Kew to Barking, *ib.* 1968–1971. Velocity of, differs with rise and fall of tide; in mid-channel at half tide is from 3 to 3½ knots an hour, *ib.* 2021–2025.
Shoals near the outfall; mud black and foul smelling, but very little of it, *Gregory*, 2052–2055. Navigation of, not interfered with by metropolitan outfall sewage, *ib.* 2069–2073.
Has not been injured by outfall works; the river has been improved by removal of road drift and detritus, *Hawksley*, 2123, 2124.
Mud between Chiswick and Westminster is chemically the same as that in Barking Creek; organic matter in the mud; general similarity in properties of Thames mud, *Miller*, 2223–2225, 2255. Banks of, are coated with mud a very considerable depth down, *ib.* 2264, 2265.
The whole bed, on the average, contains 16 per cent. of organic matter, a proportion of which is derived from sewage; a certain amount of insoluble gritty matter is brought down, and some subsides, *Odling*, 2318. While there is very little inland water running down, tidal or sea water comes up very much higher, and then there is a very much larger amount of sea water at high water at Greenwich and upwards than at other times, *ib.* 2348.

THAMES, RIVER—*cont.*
Navigation of, not impeded by sewage outfalls; shoal has formed near the outfall; causes of—mud caused by abrasion of the river banks, London sewage which comes down the Thames, and Barking sewage, *Hemans*, 2368–2372, 2389–2401. Area of, as compared with area of sewage; Mr. Bidder meant by a discharge of 250 tons a day the total amount of all London sewers in their original condition; quantity discharged from northern outfall is only 70 tons a day, *ib.* 2373–2375.
Accumulation in, has reached its maximum, and is falling off; navigation has not been impeded, as the accumulations have taken place out of the line of navigation, *Haywood*, 2445. Drainage area of 6,000 or 6,500 square miles; a large portion of this is agricultural land, highly manured, bringing down after heavy rains a considerable quantity of organic matter, *ib.* 2499.
In going up and down the river there is no need to go near the Shelf, except to go into the creek; in the general course of navigation the Shelf would be left altogether, *Hall*, 3416, 3417.
See also *Docks; Mud; Navigation; Organic Matter.*

THAMES WATER AND MUD:
Report on, by Dr. Letheby, *Appendix, page* 108.

TIDAL RIVERS:
Difficult to define where shore deposit comes from; effects of abrasion on the bottom and from the banks, *Hawkshaw*, 1780–1785.

TIDES:
Neaps do not bear so much silt as springs, nor carry it up so far; springs run with greater strength, *Leach*, 937, 938.

TOBEY, Mr. C. A. (Chief Boatman, Coastguard):
Evidence of, 2566–2814.

TONNAGE:
Of vessels coming to the creek, *Deveson*, 357–367, 421, 422, 441–446.

"TRIPCOCK." See *Barking Reach.*

U.

UTILIZATION OF SEWAGE:
Of London, might be carried on at a fabulous profit, *Hope*, 1015. Is a commercial and agricultural success, *ib.* 1017. Will become necessary as a sanitary precaution, whether at a profit or not, *ib.* 1025. There have been difficulties in some places in finding a market for produce, but this would not occur with London; area necessary to utilize London sewage 40,000 or 50,000 acres, which would absorb 2,500 or 3,000 tons per acre per annum; dressing for Italian rye grass on Lodge Farm, *ib.* 1028–1034. Utilization of Edinburgh sewage, *ib.* 1037–1046. There are cases where towns would lose by utilizing, *ib.* 1047.
Questions of utilizing sewage and abstracting sediment did not enter into consideration of board when deciding as to place of outfall, *Bazalgette*, 1512–1514.
The only means of preventing pollutions of rivers by sewage, *Hawkshaw*, 1777.

V.

VELOCITY:
Diminished velocity a cause of deposit on Horse End, *Hawksley*, 2198–2205.

W.

WANDLE, RIVER:
Is a very pure stream, *Bazalgette*, 1627.

WANSTEAD:
Is becoming very populous; distance from Barking; sewage from, falls into the Roding, *Hawksley*, 2148–2152.

WATER:
Supply of, none at Barking, except from wells, which is sold to the inhabitants at so much per pailful, *Crowe*, 323*a*; for coastguard vessel, whence obtained, *Tobey*, 2576, 2577.
In the creek cannot now be used for drinking purposes, *Pyner*, 145, 146, 168–170.
Is much more impure since the northern outfall sewer was opened, *Quash*, 216–220.
Not surprising that water is very impure, considering that two great sewers empty into the river; is discoloured by the stuff discharged from metropolitan sewers, *Crowe*, 323*a*.
Vessels used to take water from the creek for a 10 weeks' voyage; they cannot do so now, *Honey*, 625, 626.
At the mouth of the creek is purer than at Barking Quay, *Bazalgette*, 1697.
Quantity of passing down the Roding varies with the season, *Powell*, 3329. Rise of, at Barking Creek's mouth at spring tides 21 feet, *ib.* 3374.

WATTS, Mr. H. (Lighterman):
Evidence of, 569–602.

WHITEBAIT:
Large quantities of, could be caught a good many years back, but none now, *Pyner*, 189–194.

WINDSOR:
Sewers at, the best place on the Thames for fish, *McDougall*, 1223*a*.

WISE, Mr. A. (Surgeon and Physician):
Evidence of, 2915–2922.

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REPORT

UPON

INQUIRY AS TO THE TRUTH OR OTHERWISE OF CERTAIN ALLEGATIONS

CONTAINED IN A

MEMORIAL FROM THE VICAR AND OTHER INHABITANTS OF BARKING, IN THE COUNTY OF ESSEX,

CALLING ATTENTION TO THE

POLLUTION OF THE RIVER THAMES

BY THE

Discharge of Sewage through the Northern Main Outfall Sewer of the Metropolitan Board of Works.

BY

ROBERT RAWLINSON, ESQ., C.B.

TOGETHER WITH

MINUTES OF PROCEEDINGS, ABSTRACT, AND INDEX.

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

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