Review of the report by the General Board of Health on the supply of water to the Metropolis : contained in a report to the directors of the London (Watford) Spring Water Company / by Samuel Collet Homersham.

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Hampstead Water Company.

STATEMENT of the Charges which would be made by the Hampstead Waterworks Company for Water Supply, on High and Low Service, in the undermentioned cases, according to the existing Scale of the Company.

Low Service—

Houses not exceeding 15 feet in frontage,	4*s.* 0*d.*	per room per ann.
„ above 15 ft. and not exceeding 18 ft.	4*s.* 6*d.*	„
„ „ 18 „ 21 „	5*s.* 0*d.*	„
„ „ 21 „ 24 „	5*s.* 6*d.*	„
„ „ 24 ft.	6*s.* 0*d.*	„

High Service—

	More than 7 ft. and not exceeding 14 ft. above the pavement, per cent. extra.	Exceeding 14 ft., per cent. extra.
Houses, the low service rate of which does not exceed 1*l.* 4*s.* per annum	25	30
Houses above 1*l.* 4*s.* and not exceeding 1*l.* 10*s.* per annum	30	40
Houses above 1*l.* 10*s.*	40	50

No extra charge for water-closets.
Coach-houses, 10*s.* per annum for each carriage-standing.
Stables, 5*s.* per annum for each stall.

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For Her Majesty's Stationery Office.

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REVIEW

OF

THE REPORT

BY

THE GENERAL BOARD OF HEALTH

ON THE

Supply of Water to the Metropolis;

CONTAINED IN A REPORT TO THE DIRECTORS OF

THE LONDON (WATFORD) SPRING WATER COMPANY.

BY

SAMUEL COLLETT HOMERSHAM, C.E.

ROYAL COLLEGE OF PHYSICIANS OF LONDON

LONDON:

JOHN WEALE, 59, HIGH HOLBORN.

1850.

LONDON:
GEORGE WOODFALL AND SON,
ANGEL COURT, SKINNER STREET.

PREFACE.

So great is the interest of the inhabitants of the metropolis in obtaining a cheap and plentiful supply of wholesome water, that no apology is necessary for presenting to the public the following Review of a Report by the General Board of Health on that subject.

It is both a novel and a foreign proceeding for a government Board in England to interfere in such a question. The diligent study of the present Report has not reconciled me either to the novelty or to the foreignness. Well was this Board's conduct, as manifested in this Report, prefigured in an able constitutional work, published sixteen months before the appearance of the Report. "What evidence they please is taken, and no more. "All evidence is taken in secret, and so much published *as*, and "*when*, they like, and with such an accompanying GLOSS as they "please to give it. No liberty of cross examination—that is, "of extracting dissimilitudes—is admitted. Judgment is pro-"nounced in the absence of every party affected, or whose "property or interests are brought in question."* Nor can this Board be justly regarded as disinterested. Some of the members of it, being formerly on the Metropolitan Sanitary Commission, had influence to suggest a Report of that Commission highly condemnatory of all existing Metropolitan Commissions of Sewers, who were forthwith superseded, and those, their Judges, appointed with a few others in their place†. Having, from their incompetence, seen themselves in their turn superseded, and practical men appointed in their stead, we find the same persons depreciating the new Board, their successors, under the pretence of reporting on the supply of water to the metropolis,

* "Government by Commissions Illegal and Pernicious. By J. Toulmin Smith, Esq., Barrister-at-Law," page 168. London, Sweet, 1849.

† Idem, pages 115, 116.

apparently in the hope of recovering their lost control over the sewers. Even the humble business of an undertaker has not been too lowly for the ambition of our accomplished Commissioners, who, after the labours of Mr. Walker and others, could not recommend so well-established a sanitary improvement as extramural interments, without abusing this class of tradesmen, with the avowed object of superseding even them in their business. Though unsuccessful to this extent, the consequence of their labours is that a new occupation and a new Commissioner, with 1200*l.* a year (possibly one of the Judges), with a string of new officials, will be added to the General Board of Health. With regard to water-works, whether established or projected, whether originating with private speculators or sanctioned by parishes, we find in the present Report that the knowledge, the motives, and the conduct of every person connected with them are vilified in order to prepare the way for the same disinterested Judges, whose period of appointment on the present Board terminates, according to the Act, in 1853. Till then, it is not unnatural that they should seek to prolong their official existence, by making interest to find for the Board permanent occupations.

I have waited, till I could wait no longer, for the evidence that should have accompanied the Report. This evidence must have been all in type before the Report was printed. While yet unproduced, the House of Commons, on the 25th of July, within three days of two months after the date of the Report, voted 20,700*l.* to the Board for the year; a fact that shows too well what a farce is the boasted responsibility of such a Board to Parliament.

London, 19, Buckingham Street, Adelphi,
August 10, 1850.

REPORT.

To the Directors of the London (Watford) Spring-Water Company.

GENTLEMEN,

IN my Report to you, dated the 8th of January last, I fully explained the nature, position, and cost of the projected works for collecting at Bushy Meadows, near Watford, the pure, cool, pellucid, spring water abounding in the chalk formation at a great elevation above London, and for distributing it for the domestic supply of the north of the metropolis and the adjoining suburbs.

Since then a bill for carrying out this project, supported by petitions signed by 39,000 inhabitants of the places proposed to be supplied, was presented to the House of Commons*; but, by the influence of the Government, exerted at the instigation of the General Board of Health, the second reading of this bill was postponed three successive times, and, after being delayed upwards of three months, the bill was finally rejected, along with another similar private bill, in order, as was professed, to give time for the Legislature to receive and consider a long-promised Report by the General Board of Health on the supply of water to the metropolis.

In this manner has been prevented, at least for the present, such a searching investigation into the merits of this project, as similar bills invariably undergo before the Committees of both Houses of Parliament. Before these tribunals competent authorities would have been publicly heard, both for and against the bill, and their evidence would have been sifted with all the ability that is so conspicuous in counsel practising before parliamentary Committees.

* See Appendices A, p. 47, and B, p. 49.

The long-expected Report of the General Board of Health at last appeared, dated the 28th of May, 1850; but, strange to say, it was not accompanied, and has not yet been followed, by the documentary or other evidence upon which it professes to be founded. How defective in respect to impartial investigation this Report is, and how deficient in fair statement, I will not permit myself to say, but leave you to judge for yourselves after considering the observations that it is now my duty to lay before you.

In proceeding to perform this duty, it is necessary to inform you that the Report before me (which, although professing to be "on the supply of water to the metropolis," is far from being confined to this subject) is so devoid of clearness and order—so copious in information on points nothing to the purpose—so inexplicit and confused on points that are of vital importance—so besprinkled with what must at once strike every water-works engineer as erroneous conclusions, many of which are the more difficult to deal with, because they are indicated rather than stated—that I feel perplexed how to arrange my observations upon it so as to avoid touching upon much irrelevant matter. I shall try to get out of this perplexity by confining my remarks as closely as possible to the supply of water to the metropolis, and by endeavouring to bring before you the *public* aspect of this question. Of course, it must be at least in part as a remunerating commercial speculation that you and others have become subscribers to the London (Watford) Spring-Water Company; but it is only as a scheme conducive to the public good, that the public and parliament can be expected to patronize this project. A counter project (if only vague, unintelligent, and unintelligible statements can be called a project), for erecting new water-works for the supply of the whole of the metropolis, and for buying up the old ones—all at the expense of the ratepayers—has been suggested in the Report by the General Board of Health. Comparing their scheme with yours, I now propose to inquire—

I. Which will secure to the metropolis water of the best quality?

II. Which scheme proposes to supply and distribute water in the most suitable quantity and in the most convenient manner

for the use of the inhabitants of the north of the metropolis and its suburbs?

III. Which scheme can supply water cheapest to the consumers?

First.

AS TO THE QUALITY OF THE PROPOSED WATERS.

Perhaps it will enable some of your number to make up your minds on this point with more confidence and satisfaction, if I endeavour to lay before you the chief causes of the different qualities of water, so far as those causes have been ascertained by men of science.

Water *perfectly pure* may be procured in any part of the world by *repeated* distillation. Pure distilled water is always of one and the same quality; but water in this state never occurs in nature in a form available as a source of supply, and indeed it then has peculiar properties, such as render it inconvenient, and as give us reason to doubt whether it would be so useful to mankind as the waters now procured from the ordinary sources. For example, distilled water in contact with air, or containing it, acts upon cisterns and pipes of lead, and of some other metals, so as to destroy them in a short time; whereas the generality of ordinary waters have no such corroding effect.

Of ordinary waters, one differs from another on account of the different kind, and the different quantity, of foreign matter that each contains. This foreign matter may exist in the water either in a *state of mixture* or in a *state of solution*. The matter contained in a state of mixture, consists of floating or finely-diffused solid matter, such as may in general be effectually separated, either by subsidence or filtration, or by both processes. But spring water, such as that we propose to bring from Watford, contains no solid matter in a state of mixture. Filtration or subsidence applied to such water would be alike superfluous processes. Its peculiar qualities depend entirely on the foreign matter it holds *in solution*.

If you put a little fine sand into a glass of water, and stir up the sand, you will see it diffused through the water in a *state of mixture*. If you put into another glass of water fine powdered salt or sugar, and stir up the solid substances as before, you

may observe them disappear: what was before a liquid and a solid is now all a liquid: the sugar or the salt contained in the water is in a *state of solution.* In a water, then, such as the Watford springs afford (where there is to the eye or even to the microscope, no perceptible trace of diffused solid matter), all the foreign matter it contains is exclusively in a *state of solution.*

Now solid matter in a state of solution in any water is either *mineral* or *organical.* The most common kinds of mineral matter present are salts of lime or of magnesia, and salts of potash and soda. *It is chiefly the presence in water of salts of lime or of magnesia that gives rise to the quality called hardness.* The presence of salts of soda or potash has no such effect. The amount of hardness depends upon the quantity of lime or magnesia that may be present in the water, and not at all on what particular salt of lime or magnesia is present. To express the amount of hardness, Professor Clark has suggested that if 16 grains of chalk, or the quantity of lime contained in it, be dissolved in a gallon of pure distilled water, the hardness of such a water should be called 16 degrees. The chalk may be dissolved in the water without decomposition by means of carbonic acid, or the lime contained in the chalk may be dissolved in the water by means of sulphuric, nitric, or many other acids, as these acids decompose the chalk and combine with lime, the basis of chalk: the degree of hardness will be 16 degrees in each case; but there is this important difference, that chalk dissolved without decomposition by means of carbonic acid, and forming what is called bicarbonate of lime, will for the most part be deposited again, on the water being boiled; whereas if the lime contained in the chalk have been dissolved by any other acid than the carbonic, it cannot be deposited by boiling, and the water will remain of the same degree of hardness after boiling as before. Water containing chalk is softened in a similar manner, but in a smaller proportion, by mere exposure to the atmosphere in reservoirs.

Among the salts that produce hardness, which, as before stated, are the salts of lime and salts of magnesia, it is of great consequence to distinguish the carbonates from the other salts, for *carbonate of lime and carbonate of magnesia are nearly all deposited, on the water containing them being merely boiled.* Among the salts of potash or soda, which never of themselves destroy soap, it is also of consequence to distinguish so much even

of them as consists of bicarbonates, for, upon waters containing bicarbonates of potash and soda being boiled, new compounds are formed should any of the neutral salts of lime or magnesia be also present, and the lime or magnesia is deposited in the form of carbonates.

Thus it appears that while the salts of lime or magnesia dissolved in water produce hardness, boiling alone softens water when its hardening matter consists of salts that are carbonates, and that the same thing occurs when hard water contains in solution bicarbonate of potash or soda, although the hardening salts contained in them be formed with sulphuric, nitric, or any other acid.

Among the mineral matter that may be present in a water, I had almost forgotten to mention salts of iron; for, indeed, such salts are notoriously so inconvenient in a water intended for domestic use, that one containing them is but rarely thought of for such a purpose. As, however, a portion of the water selected by the Board of Health is contaminated with iron, this occasional mineral component of a water ought not be passed over here without notice. Iron in water is one of the substances that produce hardness, but it is much more objectionable, on account of its imparting to linen washed with it a yellowish tint.

In now proceeding to consider the qualities of the water that would be supplied from the Watford springs, and of the new water proposed by the Board of Health to be introduced into the metropolis, I cannot but advert at the outset to the quality of HARDNESS*; for this quality predominates in the mind of the Board over all other qualities of water, insomuch, indeed, that they represent the Thames, above the sewage no less than below, filtered as well as unfiltered, and in like manner, all its tributaries, as the river Lea, the Colne and the Wandle, and even the New River no less than the Thames, nay, the unpolluted springs that feed these rivers, as unfit for use, on the single consideration of their hardness alone. Hence *the Board gravely recommend that all the sources of water at present in use, or heretofore proposed to be used for the supply of the metropolis, are to be at once abandoned or rejected, and that the present works be bought up at the expense of the ratepayers, and new works erected instead. The market value of the existing works is about six millions and a half sterling.* We ought, there-

* See Appendix E, p. 53.

fore, to find in a Report making so important a proposal, the result of the most circumspect inquiry, and a cautious but a full and fair statement of the *whole* truth, so far as it is known, or can be ascertained by the Board.

The Board represent the hardness of the Thames as of 16 degrees, that is to say, of the same hardness as would be produced by dissolving 16 grains of chalk in a gallon of pure distilled water; and they justly represent the New River, and the other sources of supply that they recommend to be abandoned or rejected, as not materially different in hardness from the Thames.

I wish I was able to accept this statement of the Board, which is the main foundation of their recommendation to abandon the present sources of supply, and to buy up the existing works, as an unvarnished and incontrovertible statement; but it is my unpleasant duty to show you that this statement is exaggerated, and that, even when stript of its exaggeration, it presents but *a part* of the whole truth.

In the first place the Thames is very seldom so hard as 16 degrees. Instead of stating the average hardness of the river, the Board have been pleased to give almost the highest degree of hardness that ever occurs. The Board should have stated that it is not unusual to find that the water in the supply-pipes of the Companies is one-third less hard than what the Board have represented as the hardness of the Thames. Now it would not be fair to represent this lower degree of hardness as the customary hardness of the water supplied to the consumers, because this would be representing the water not at the average hardness, but near its lowest hardness; but neither, on the other hand, is it fair dealing in the Board to represent the highest degree of hardness as the average hardness; where this very quality of hardness has been made by them the basis of a proposal to abandon all the existing waterworks of the greatest metropolis in Europe, and to make a purchase, at the expense of confiding ratepayers, of property now at the artificial value of six millions and a half sterling.

All the hardness of the Thames and the kindred waters in question, except about one or two degrees, is due to the presence of chalk (held in solution in the form of bicarbonate of lime). Now, as already explained, chalk thus held in solution is mostly deposited by boiling. This is a most important peculiarity of a chalk water. Lime held in solution in any other manner could not be

deposited in water by mere boiling. Accordingly, *the Thames and similar waters fall to only three or four degrees of hardness after being boiled.* This important fact was given in evidence by Professor Clark, in 1843, before the Commission on the Health of Towns*. This gentleman's evidence, so far from being unknown to the Board, has been carefully culled by them to furnish reasons for giving predominant consideration to the quality of hardness; but the fact thus made known to the Board has not been thought worthy of notice by them. Holding out only that the waters they desire to be abandoned are of 16 degrees of hardness, and making much ado about the saving that is to be effected in making tea and otherwise, by the adoption of softer sources of supply, they never state that these waters of the Thames and New River are only 4 or 3 degrees of hardness after being boiled. These waters, in thus losing 12 or 13 degrees of hardness out of 16, deposit 12 or 13 grains of chalk per gallon.

A process has been proposed for producing, by very cheap and simple means independent of boiling, a like deposition and like softening in the whole water supplied to the metropolis. I allude to the softening process proposed by Professor Clark, of Aberdeen. The effect of this process on the Thames water is to reduce it from about 16 to 4 degrees of hardness; and this effect is produced simply by causing 12 grains of chalk to deposit, as in the case of boiling. The process does nothing more, so far as the mineral contents of the water are concerned, than merely remove 12 grains of chalk per gallon. It leaves no new mineral matter in the water that was not in it before; so that, if the mineral contents of the water were obtained by evaporation, there would be found 12 grains per gallon less by weight of mineral matter from the softened than from the unsoftened water. A collateral effect of this process is to take down a considerable portion of any organic matter that may be present in water subjected to it, so that the deposited chalk from a contaminated river water, instead of being of a pure white, may be observed to be coloured, as we see the deposit in our kettles coloured. The softened water is, in consequence, freed of much of its organic matter, and left not only softer, but in a greater degree of purity. This process, applied to the Watford spring water, which derives almost the whole of its hardness from chalk held in solution by carbonic acid, gives, however, while reducing it to only

* See Appendix O, p. 71.

3 degrees of hardness, a perfectly white deposit, because that water contains no organical impurity*. I do not know how I could more simply explain the operation of this important process than in the words of the inventor, which I will here quote:—

"To understand the nature of the process, it will be necessary to "advert, in a general way, to a few long-known chemical properties "of the familiar substance chalk; for chalk at once forms the bulk "of the chemical impurity that the process will separate from water, "and is the material whence the ingredient for effecting the separa- "tion will be obtained.

"In water chalk is almost or altogether insoluble; but it may "be rendered soluble by either of two processes of a very opposite "kind. When burned, as in a kiln, chalk loses weight. If dry "and pure, only nine ounces will remain out of a pound of sixteen "ounces. These nine ounces will be soluble in water, but they "will require not less than forty gallons of water for entire solution. "Burnt chalk is called quicklime, and water holding quicklime in "solution is called lime-water. The solution thus named is per- "fectly clear and colourless.

"The seven ounces lost by a pound of chalk on being burned, "consists of carbonic acid gas—that gas which, being dissolved "under compression by water, forms what is called soda-water.

"The other mode of rendering chalk soluble in water is nearly "the reverse. In the former mode, a pound of pure chalk comes "to be soluble in water in consequence of losing seven ounces of "carbonic acid. To dissolve in the second mode, not only must "the pound of chalk not lose the seven ounces of carbonic acid "that it contains, but it must combine with seven additional ounces "of that acid. In such a state of combination chalk exists in the "waters of London—dissolved, invisible, and colourless, like salt "in water. A pound of chalk, dissolved in 560 gallons of water "by seven ounces of carbonic acid, would form a solution not "sensibly different in ordinary use from the filtered water of the "Thames in the average state of that river. Chalk, which che- "mists call carbonate of lime, becomes what they call bicarbonate "of lime when it is dissolved in water by carbonic acid.

"Any lime-water may be mixed with another, and any solution "of bicarbonate of lime may be mixed with another, without any "change being produced: the clearness of the mixed solutions

* See Appendix C, p. 49.

"would be undisturbed. Not so, however, if lime-water be mixed "with a solution of bicarbonate of lime: very soon a haziness "appears; this deepens into a whiteness, and the mixture soon "acquires the appearance of a well-mixed whitewash. When the "white matter ceases to be produced it subsides, and in process of "time leaves the water above perfectly clear. The subsided mat-"ter is nothing but chalk.

"What occurs in this operation will be understood if we suppose "that one pound of chalk, after being burned to nine ounces of "quicklime, is dissolved so as to form forty gallons of lime-water; "that another pound is dissolved by seven ounces of extra-car-"bonic acid, so as to form 560 gallons of a solution of bicarbonate "of lime; and that the two solutions are mixed, making up to-"gether 600 gallons. The nine ounces of quicklime from the "pound of burnt chalk unites with the seven extra ounces of "carbonic acid that hold the dissolved pound of chalk in solution. "These nine ounces of caustic lime and seven ounces of carbonic "acid form sixteen ounces—that is, one pound of chalk—which, "being insoluble in water, becomes visible immediately on its "being formed, at the same time that the other pound of chalk, "being deprived of the extra seven ounces of carbonic acid that "kept it in solution, re-appears. Both pounds of chalk will be "found at the bottom after subsidence. The 600 gallons of water "will remain above, clear and colourless, without holding in so-"lution any sensible quantity either of quicklime or of bicarbonate "of lime*.

The Board, while recommending that the present water sources be abandoned, and that the existing works, now at the market value of six millions and a half sterling, be bought up, and while endeavouring to reconcile the ratepayers to this purchase, by dilating on the hardness of the waters now supplied to them, take no notice of this process for the removal of three-fourths of that hardness, such as to make its nature or the effect of it known to the reader. The

* "A New Process for Purifying the Waters supplied to the Metropolis by the Existing Water Companies: rendering each Water much softer, preventing a Fur on boiling, separating vegetating and colouring Matter, destroying numerous Water Insects, and withdrawing from Solution large Quantities of solid Matter not separable by mere Filtration." By Thomas Clark, Professor of Chemistry in the University of Aberdeen. Fourth Edition. London: Richard and John E. Taylor, Red Lion Court, Fleet Street, 1849. See also "Chambers's Journal," January 19 1850, No. 316.

process is indeed incidentally alluded to twice in the following words:—"Professor Clark's process appears to be well deserving "of attention for the hard-water districts." (Page 77.) "In chalk or "hard-water districts, where no soft water was available within any "distance now deemed practicable, the Engineering Inspectors "have in several instances recommended the adoption of Professor "Clark's process on a large scale, as a means of amelioration. "The importance of a natural purity of quality appears, however, "to be so great as to justify *much additional expense* to procure "it for any town, but this importance increases with the magnitude "of the population to be supplied." (Page 82.)

"Professor Clark's process!" this is all that is said about it. What the object of the process is, as to how it works and with what success—on these and all such points the Board are silent; silent most of all on the fact that it can remove three-fourths of the hardness complained of. Nevertheless it is true of this unexplained process, as indeed the Board have hinted, that four out of their seven inspecting engineers have recommended the adoption of it in such towns as Dover, Cambridge, Croydon, Portsmouth, and Hull, which towns are supplied with waters similar to the Thames. During the present session of Parliament, the Maple-Durham scheme for bringing in water in sufficient quantity to supply all the existing water companies, proposed, and indeed made it a prominent part of their project, to soften the Thames water by this process, which would reduce it to nearly 4 degrees of hardness. The Watford spring water, as I explained in my Report to you, dated January last, may be reduced by Clark's process to $3\frac{1}{4}$ degrees of hardness, and, without having pledged you to carry out this process, provision was made in the plans deposited in November, 1849, to procure an advantageous site for erecting works necessary for that purpose; and ever since last autumn I have been in communication with Professor Clark as to the best means of effecting this object, and I have prepared detailed plans and estimated the cost of doing so. This process has been for some time and is now in successful operation at the works of Messrs. Thomas Hoyle and Sons, the eminent calico-printers, Manchester (whose letter in answer to my inquiries will be found in the Appendix*), and would probably not be more troublesome or expensive to

* See Appendix D, p. 52.

carry out on the spring water procured at Bushey Meadows, than the filtration of river or surface drainage water; an operation unnecessary for the Watford spring water, although an indispensable adjunct to the project of the Board of Health.

I submit to you that it is not a right thing, and that it reflects but little credit upon the country, for men entrusted by their Sovereign to act on the public behalf, while making such an important recommendation as that all the present water-works supplying the metropolis shall be abandoned on account of the hardness of the water, to dare to give colour to their recommendation by exaggerating this hardness as if it were usually of 16 degrees, and by concealing the facts, that upon mere boiling it softens to 3 or 4 degrees*, and that it may be all reduced by a simple and inexpensive process to a like low degree of hardness.

The reasons why the Board so strongly insist upon the disadvantage of the quality of hardness in water are the waste of soap that the using of such water occasions in the washing of clothes, the waste of tea in making infusions, and the loss occasioned in other culinary operations, besides its unwholesomeness for drinking.

First, as to the waste in soap, the Board give out (page 284), that "*by the use of soft instead of hard water, the expense of soap "will be reduced one-half.*" But the Board, in their own loose way, have omitted to give any precise estimate of the whole annual cost of soap in the metropolis. We are left to guess what their estimate is. In page 77 of the Report we find them cite the estimate of Professor Clark as 12,000 tons of soap per year, and another estimate, by Mr. William Hawes, at 20 per cent. less, or 9,600 tons per year; which lesser estimate the Board seem to think should be increased, because, as they say, "It must, at the "same time, be observed, that a proportion (probably a large one) "of the clothes worn in the metropolis are washed at places some "distance from it." Taking the larger estimate at 45*l.* per ton, the annual cost of soap will be 540,000*l.*, taking the lower estimate at the same price, it would be 432,000*l.* As the Board have indicated their impression that the lower estimate is too small, and made no stricture on the higher estimate, we may assume, in round numbers, that 500,000*l.* must have been understood by

* See Appendix C, p. 49.

them to be near the present annual expense of soap for the metropolis. *It follows that* 250,000*l*. *worth of soap is the Board's estimate of the annual saving that would arise from the use of soft water instead of the present waters.*

Allow me your patience while I endeavour to test the accuracy of this estimate of the saving to be effected in soap. The Board give no particulars to enable us to judge with what confidence we may adopt their statement of the saving being equal to one-half of the whole consumption. I will endeavour to assist you in examining its trustworthiness.

The saving in soap from the use of a given softer water will depend on the quantity of water made use of along with soap. Professor Clark gives as the whole average quantity of water likely to be made use of for the washing of clothes where the supply of water is copious, as about 400 gallons per head per year, including, of course, men, women, and children*. Now it is well known that, where soft water is made use of, rather less than the half of the water is consumed along with the soap, and rather more than the half in rinsing the clothes. I may assume, then, that 160 gallons of water per head per year is made use of along with soap, so as to require more or less soap according as the water is more or less hard, and the remaining 240 gallons out of the whole 400 gallons in merely rinsing. I may further assume an estimate that seems to be adopted by the Board (page 72), that while 100 gallons of the hard water will consume 30 ounces of soap before producing a lather, 100 gallons of the soft water will take only 10 ounces. The saving in soap by soft water will thus be 20 ounces per 100 gallons of water made use of along with soap. But as 160 gallons have already been assumed as the quantity of water that is consumed along with soap per head per year, it will follow that 32 ounces, that is 2 lbs. of soap, is the quantity likely to be saved per head per year, by the substitution of soft water for the hard in the washing of clothes. Perhaps the additional saving in washing the person may be taken at ½ lb. Altogether, 2½ lbs., or about one shilling's worth of soap per head per year, which, taking the population as about two millions, would come to 100,000*l*. a year as the saving in soap for the whole metropolis. But this estimate must be very uncertain. On the one hand, it should be increased on account of the average amount of

* Taken from a proof copy of Professor Clark's evidence, with which I was favoured by him a few months ago.

washing being considerably more in London than in the kingdom at large, and, on the other hand, it should be diminished, first, on account of the hardness of the water being reduced by boiling; and second, on account of part of the water being softened by means of soda. Little or no money-value should be attributed to this second deduction, because, with no more knowledge than is possessed in laundries, soda may be employed so indiscreetly as to cost more by injury to clothes, than it will save in soap. Professor Clark gives a hypothetical estimate of the value of the soap that would be saved in the metropolis by the use of soft water at 63,000*l.* If we take his estimate to be an unexaggerated and a safe one, what shall we say of the estimate of the Board, which comes to four times as much?

But *the Board in claiming for their own project any saving whatever of soap to the consumers,* on account of the softer water to be introduced to the metropolis, *compare their proposed water with the water supplied by the existing companies, and keep altogether out of view the softness of the water that would be introduced by other companies that have been stopped from going on by the influence of the Board itself.* The Maple-Durham scheme would have introduced water of only about 4 degrees of hardness, and the London (Watford) Spring-Water Company, water of only about 3 degrees of hardness. Have the Board proposed to bring in softer water than this? I find by referring to page 265 of their Report, that the total daily supply they propose to introduce is 40 million gallons per day. I find by the next page, that they propose to draw this supply from various sources, yielding in all 178 million gallons a day, of an average of *about* 6 *degrees of hardness,* and that *the softest* 40 *million gallons per day of this water that could be selected would be* $3\frac{3}{4}$ *degrees of hardness. Taking the Board's own account, then, their water would not be a whit softer than the water they have prevented the inhabitants of the metropolis from obtaining from new companies.* INSTEAD OF A SAVING OF 250,000*l.* WORTH OF SOAP RESULTING FROM THEIR INTERFERENCE, THERE WOULD NOT BE A SAVING OF ONE PENNY.

I now proceed to consider the other savings alleged by the Board as likely to arise from the introduction of soft water; and these are far from being inconsiderable.

In page 116 I find the Board stating a certain portion of the expense of bringing in water according to their scheme to the metropolis, "at little more than *one million* sterling," and a little further on in the same page, "We fully believe, that *two* "*years' saving* from the use of the purer water would fully repay "this portion of the outlay." Therefore, at least half a million, or 500,000*l.* a year, is the total saving that is to arise to the metropolis from the introduction of a softer water. "By the use of "soft instead of hard water," say the Board (page 284), "the "expense of soap will be reduced one-half; the economy in tea "will be as five to three, and the saving in other culinary opera-"tions will be in like proportion." Deducting then from this 500,000*l.* the already considered saving of 250,000*l.* worth of soap, there will, according to the Board, remain a saving of another 250,000*l.* in tea and cooking.

Now here, as in other parts of this Report, you can never bear too strongly in mind that the question in hand cannot be fully and fairly considered, unless there be brought before you facts that the Board have in their wisdom been pleased to conceal. Compared with the waters of the present companies, the water of the Board, lying between $3\frac{3}{4}$ and 6 degrees of hardness, cannot be softer for infusing tea or for cooking than water of the Thames, the Lea, or the New River, which, *after being boiled,* lie between 3 and 4 degrees of hardness; and I need hardly state to you, although it will perhaps not be superfluous information to the General Board of Health, that tea can only be made with boiling water. Nor, compared with the projected supplies of the new companies, can it be softer than the water that would be introduced by the Maple Durham or the Watford spring-water schemes, which would bring in water to the consumers at 4 and 3 degrees of hardness, and producing no deposit or fur on boiling. *Supposing, then, the Board had stated the facts of the case honestly and fairly, where would have been the foundation of their estimate of this second annual saving to the community of* 250,000*l.*?

Observe what confidence is to be placed in an estimate of this Board, in order to guide you in the confidence that you should afterwards give to some other loosely-formed estimates of theirs, to be brought under your consideration. There are 500,000*l.* a year *promised* as a saving from softer water to the community, where there is little chance of a saving of even 100,000*l.* as against the

waters of the present companies, and a certainty of no saving at all as against the waters of new companies*.

Having thus, as I hope, disposed of the question of economy in reference to the hardness of water, I proceed to consider the question of WHOLESOMENESS. The Board give out that the Thames and kindred waters are unwholesome, not only on account of organic matters which some of them contain, but on account of their hardness. Be it so: this objection can apply only to the waters of the existing companies. It cannot apply to the soft waters that the Board have hindered new companies from bringing in.

But, without caring to maintain a proposition on this point contrary to the one of the Board of Health, I cannot help adverting to the evidence adduced by them in support of it, in order to show you what scraping and what stretching of evidence the Board will condescend to make, when wishing to establish any point of their own.

In this case, their proposition is, that "Lime in water probably "impedes the process of digestion and assimilation" (page 50), and, more specifically, that it does so at the degree of hardness of the Thames. Now, if this proposition were true, it would be a very important one, not only to the health, but to the happiness of every individual in London (for it is impossible to impede the digestion of man, woman, or child, without diminishing their happiness); and indeed the community would have reason to be grateful to the Board of Health for taking up so appropriate a subject; but in that case the Board would have no difficulty in establishing their proposition. Within reach of physicians and surgeons, looked up to, not only in the United Kingdom, but throughout the world, the Board would be able to produce irrefragable evidence to justify their own considerateness. Are you curious then to know which of our eminent living medical or surgical practitioners the Board selected to examine before venturing to publish so momentous an opinion? So far as can be gathered from their Report, the Board have had the want of discretion (or, as they were bent on making out a point, I should perhaps rather say they have had the discretion) not to examine

* See Appendix I, p. 65.

one such witness. In the absence of any London authority, the Board have had recourse to Dr. Sutherland, an intelligent medical gentleman now in their employment. "Having lived," says he (page 51), "for a number of years in Liverpool, a town which has a "supply of very 'hard' water for domestic use, my attention has "for a length of time been called to the fact, that the continued "use of this water has a somewhat peculiar effect on the digestive "functions in certain susceptible constitutions. *There are so many "local causes of disease in the town, which may be left behind "by going to other more favourable localities, that it is not very "easy to state positively how much injury may be done by the "quality of the water alone,* but after some experience and "observation, both in myself and others, I arrived at conclusions "which I frequently expressed several years ago, and which "nothing has since occurred to alter, and these are that in the "class of constitutions referred to, the 'hard' water tends to pro-"duce visceral obstructions; that it diminishes the natural secre-"tions, produces constipated or irregular state of the bowels, and "consequently deranges the health. I have repeatedly known "these complaints to vanish on leaving the town and to re-appear "immediately on returning to it; and it was such repeated occur-"rences, which fixed my attention *on the hard selenitic water of "the new red sandstone* as the probable cause, as I believe it to "be, of these affections." When a physician advises a patient with disordered digestive functions to leave a large town for the country for recovery, there are so many circumstances, as change of climate, exercise in the open air instead of confinement to close places of business, recreation instead of labour, that anybody may be aware, as well as Dr. Sutherland, of the difficulty of attributing a recovery made under such circumstances to a change in the water drank by the patient, or to any one other single cause. If Dr. Sutherland, without sending his patients out of Liverpool, had put them on a beverage of distilled or other soft water, and found them to recover, his conclusion would have risen from the rank of a vague valueless conjecture to that of an ascertained fact, relating, however, to the waters of Liverpool, not to the waters of London.

Any reader unacquainted with the difference in the chemical qualities of various kinds of "hard" water would suppose that water from the red sandstone at Liverpool was the same in quality as the water of the New River or Thames, especially

when Dr. Sutherland's evidence is prefaced in the Report by a statement that the "water to which he refers is *water of about "the same degree of 'hardness' as the Thames water;*" but the fact is, that while the principal mineral contents of the Thames or New River water is chalk in the form of bicarbonate of lime, the principal mineral contents of the new red sandstone water at Liverpool are sulphate of lime and carbonate of magnesia; for instance, according to a recent analysis by Mr. Richard Phillips, in a report by Mr. Robert Stephenson, on the supply of water to the town of Liverpool, the water from Bevington Bush well contains 12 grains of sulphate of lime, and 10 grains of carbonate of magnesia per gallon; the water from Copperas Hill 7½ grains of sulphate of lime, and 7½ grains of carbonate of magnesia. Some of the private wells at Liverpool are still more remarkable for containing these salts. One at the Soho River Mills contains 12¾ grains of sulphate of lime, and 16 grains of carbonate of magnesia per gallon; another, belonging to Mr. Jack, a boiler maker, contains 144 grains of sulphate of lime, and 209 grains of chloride of magnesium; and a third, at Mr. Howard's brewery, contains 19 grains of sulphate of lime, and 39½ grains of carbonate of magnesia. I may here mention that a suspicion of the unwholesomeness of magnesia has resulted from some researches in France, on the contents of waters from districts where *goître*, and where the particular form of idiocy called *crétenisme* are common diseases among the inhabitants*. The Thames and kindred waters contain only about a grain or half a grain per gallon of carbonate of magnesia, and only about 1½ or 2 grains of sulphate of lime, the principal component, as before stated, being chalk in the form of bicarbonate of lime.

The mineral contents of the Liverpool water being so essentially different from those of the waters of the London companies, the effects upon the human constitution can no more be assumed as similar than can their respective fitness for making tea. Although I have resided for many years in a town entirely supplied with spring water from the chalk containing chiefly bicarbonate of lime in solution, I could never discover upon inquiry that the presence of this salt was unwholesome; but at any rate the Board have given no evidence whatever to show that such is the fact.

* M. Grange, Annales de Chimie et de Physique, tomes xxiv. and xxvi., 1848, 1849.

Without undervaluing the advantages really resulting from the supply of a pure "soft" water to a town population, distributed upon the most improved principle, it may be safely asserted that the *mineral* contents of the water supplied to London are by no means unwholesome, that such water is excellently adapted for making tea, and by no means ill adapted for washing purposes, although it may undoubtedly be improved in this last respect. The crying evil in the present London supplies is the presence of excremental or decomposing *organic* matter, which, especially in summer, serves to pollute much of the pipe water*. Accordingly, a large portion of the population of London habitually resort to well waters for drinking purposes, because the most of such waters are free from *organic* matter, although Dr. Clark has shown that in respect of hardness they vary from 32 to 80 degrees, and Professor Brande has shown that in respect of mineral contents, they hold in solution from 75 to 105 grains per gallon.

Having thus compared the several waters in respect to the *mineral matter in solution*, I now proceed to compare them in respect to *organic matter in solution*.

The Watford spring water is free from organic matter†. This explains its pellucid appearance. "The water," says Mr. Robert Stephenson, in speaking of the experimental well at Bushey Meadows, "was so beautifully transparent as to admit of the bottom "of the well being seen when the water was upwards of thirty feet "deep." This being the case, the superiority of this water to the water either of the Companies or of the Board, may be considered to be well established by the evidence of the Board themselves, since that evidence proves that the waters both of the Companies and of the Board is contaminated with organic matter. At page 20, "Mr. John Thomas Cooper, the eminent practical chemist, who "resides in the Blackfriars' Road," is stated, in answer to the following question, to say—

"*Board.* What is your observation of the company's water "which you receive at your own residence?—Mr. *John Thomas* "*Cooper.* It frequently comes in tainted with the smell of decaying "animal or vegetable matter; it having, in fact, a slight putrescent "smell and taste.

* See Appendix N. p. 70.

† See Appendix C, p. 49.

"*B.* Is it delivered filtered, or free from organic matter in suspen-
"sion?—*C.* It comes in much clearer than it used to do, and de-
"posits very little matter in the bottoms of the vessels in which it
"is detained. I think it more likely that it is cleared by subsi-
"dence than by filtration.

"*B.* Do you filter the water you use?—*C.* Yes; we filter all the
"water we use for culinary purposes.

"*B.* Are we to understand, then, that the smell you speak of is
"perceptible even after filtration?—*C.* Yes.

"*B.* It is, perhaps, superfluous to ask you, as a chemist, whe-
"ther you consider that this is a water which ought to be supplied
"to a population?—*C.* I certainly think not.

"*B.* What description of filter do you use?—*C.* One made
"of finely-powdered glass and animal charcoal; one stratum of
"about half an inch thickness of finely-powdered glass, upon
"which is a layer of about an inch and a half of well-burnt animal
"charcoal, and over this about three quarters of an inch to an
"inch of more coarsely-pounded glass, and over that the usual
"sponge for filters. This, I conceive, is a mechanical as well as
"chemical filter.

"*B.* How does it act?—*C.* Very well.

"*B.* But does it not yet detain the matter in solution to which
"you attribute the disagreeable smell?—*C.* No; but I believe it
"diminishes it."

At page 84 the Board say, "Mr. Bowie states, that in the
"water of the river Lea, which he received into his own house
"during the potato disease, he distinctly perceived the peculiar
"smell of that disease, and that it was much noticed by other
"persons. This result was no doubt produced by the flow of the
"surface waters from tracts of land laid out in potatoes, and
"presents an example of that effusion of vegetable matter and
"manure, which, from the absence of any peculiarity by which
"it may be detected, is generally unnoticed."

But it must be unnecessary to dwell on this subject. Every inhabitant of the metropolis knows that the water supplied to London contains insects, accompanied by vegetation, and much of it contains also decaying animal and vegetable matter, and is, especially in summer time, unfit for drinking. Organical impurities, so far as they are held in solution, no filtration can remove. Water thus

contaminated acts directly, however slowly and insidiously, on the health of persons using it as a beverage; and indirectly upon others, by driving them to drink perhaps a less unwholesome, but still an unwholesome well-water, or by causing them to avoid water altogether as a beverage.

Any one then unacquainted with the composition or the habits of the Board of Health would naturally have expected that this Board, in seeking a new source from which to supply the metropolis with water, would in an especial manner have avoided any water containing organical impurities of whatever kind. Yet the proposal of the Board of Health, as their Report on this subject informs us, is to collect in large "covered" reservoirs the rain water falling upon and flowing through or off the surface of 150 square miles of a sandy country with a peat-covered surface, situated near Bagshot, and the waters of some unnamed tributaries to the Wye. It is impossible to explain to you the exact nature of the project proposed by the Board of Health for supplying the whole of the metropolis with water; for they not only have omitted to furnish any map or plan showing the structure and situation of their projected works, but have not even given us a substitute for such customary and necessary aids, in an intelligible description. All, therefore, at present known is that the waters of some unnamed streams are somehow to be joined to the rain water flowing off or through the surface of an extensive tract of wild, peaty, and sandy country, and collected in large "covered" reservoirs, so that the rain falling in wet seasons may be stored for use in dry seasons. This plan of collecting surface water is borrowed, with strange variations, from Lancashire and other parts of the United Kingdom, where rain water falling upon and flowing off steep ground of the primitive geological formations, has long been impounded in large *un*covered reservoirs, for the use of canals, water-mills, manufactories, and town populations. The top surface of a reservoir of this description frequently extends over from 60 to 120 acres of ground, and the combined top water area of the whole of the reservoirs now constructing for the supply of the town of Manchester covers 408 acres. In the localities where such reservoirs have been hitherto formed for the supply of towns, it usually has been impossible to get a supply by any other means, as the rivers and streams yield very little water in dry seasons, and are

preoccupied with mills, while the water they contain has been so contaminated with the refuse of dye, print, and other works, as to be quite unfit for domestic use. The physical character and geological formation of the ground in these localities is such that but a small portion of the rain water is absorbed by the ground, and the greatest portion flows off the land almost as rapidly as it falls, and would be conveyed by the river courses to the sea in floods; but by intercepting such floods in reservoirs, our northern neighbours collect and store water for use. The Board of Health have had just so much judgment as to copy their practice for the supply of London, where no similar necessity exists, and to select a gathering district where there is nothing to correspond in the physical character or geological formation of the ground.

All information such as would enable an engineer, much more any other person, to appreciate their scheme, having been withheld by the Board, I can only in the mean time observe generally, in reference to their vague description of it, that rain water flowing from the surface of land when collected in large reservoirs, and especially drainage water from cultivated land or from land covered with peat, is contaminated with organic matter, and is very far from being a choice water for drinking. Such water, it is true, is frequently very "soft," and contains in solution but little mineral matter, and is well adapted for saving soap; but it should be known, that water when coloured by peat discolours linen, and is particularly objectionable on this account even for washing purposes. When it is remembered that rain collected from the surface of land necessarily comes in contact with much decaying vegetable and animal matter, the origin of this organic matter will be easily understood. Water so collected is often unpleasant to the taste as well as unwholesome for drinking, more especially in summer and autumn, when surface drainage or river water always contains organic matter partly in solution and partly in a state of mixture, which is then liable to undergo decomposition. The inhabitants of the towns of Bury, Ashton, and Preston, which are supplied with such water, usually pass it through a filter before using it as a beverage. And any person that has ever seen rain water collected for household use, may tell how much it is contaminated with organic matter, and how apt it is in consequence to become offensive especially as a drink. Surface water,

even when collected from the almost bare primitive geological formations, such as slate and millstone grit, is not entirely free from organical impurity, especially in summer.

Accordingly, even the one-sided evidence* of the Board of Health proves that organic matter abounds in the surface or field drainage water proposed by them to be collected at Bagshot and Farnham for the supply of the metropolis. At page 96 we are informed that the surface of the common from which it is proposed to collect water "is generally heath and peat, and at some "periods, during heavy floods, the water is apt to acquire colour "from the infusion of peat." Again, at page 104, Dr. Angus Smith lets out, in reference to the Farnham water, which is a sort of model water of the Board, that "*it is less coloured with peat than the "water of Bala Lake.*" Again, further, at page 205, the question is put to Dr. Smith by the Board, "*You do not then think that "the infusion of peat*, even if the water were taken as it is, *would "be highly objectionable?*" "No, *it is not thought so;* peat "itself is *highly antiseptic;* it is not considered favourable to the "production of animalcules; it is not directly convertible into animal "life, like the organic matter in the Thames, and most river water. "*The only objections I know to it are the taste and the colour*, "which are disagreeable when the infusion is considerable." A good map, an unbiassed witness, will tell you what sort of water is to be expected from the district recommended by the Board, for, on referring to one, you will find a river draining a considerable portion of the district under the characteristic name of THE BLACK WATER.

Let the inhabitants of the metropolis only think of the treat that is awaiting them—*an infusion of peat!*—which has no objection but the taste and the colour, and which passes with the Board of Health as perfectly wholesome, because *peat is highly antiseptic.* If I substitute the word *antiputrescent* instead of *antiseptic*, perhaps the expression will be more generally intelligible. Peat, indeed, has a remarkable power in this way. About thirty years ago, the body of a man was found in a wild moor in Scotland, buried in peat. The body, when taken out, was in good preservation, and so were the clothes, insomuch that it was easy to recognise that he was dressed in the livery of Lord Elibank. The old domestics

* See Appendix H, p. 61.

of the family could remember, that some thirty or forty years previously, a footman was mysteriously missing. He had been murdered, and his body buried in peat at the spot where it was found. This antiputrescent property, peat shares with *arsenic* and *corrosive sublimate;* substances that are extensively employed by naturalists and anatomists to prevent putrescence, but which it is difficult to conceive that even a Board anxious to enter into the undertaking line should not pronounce as highly objectionable contents of a water to be drunk. The Board, indeed, seem to have some very peculiar notions as to what is, and what is not, highly objectionable in a water to be drunk, as will appear when we discover what sort of matter is found in the water of a small water-works that the Board have applauded and adopted as a sort of model. At page 115 it is boldly stated, that the "well through which the water "supply for Farnham is delivered, is a permeable brick wall in "the midst of a garden. Some traces of the *manure* of the garden "were after a heavy rain detected in the well."

It is in summer or autumn that specimens of field-drainage or river water should be examined, because it is at those seasons that organic matter abounds in them in the largest quantities. Many streams, specimens of which collected in cold winter or spring weather, might be pronounced excellent water for domestic purposes, are wholly unfitted in summer and autumn for such uses; which arises not only from the large amount of organic matter contained in them at those seasons, but from the tendency that such matter then has to decompose. As to mineral matter, they frequently contain only from two to three grains per gallon.

The Board, notwithstanding, do not mention either the season of the year or the temperature of the specimens of water collected for examination by them, and treat the presence of organic matter in water as of secondary importance; so much so, that *they have never once mentioned whether the river water they mean to use has much or has little organical impurity.* On the face of the Report, indeed, it appears that neither have they caused the waters they recommend to be examined in summer or autumn, nor does it seem to have occurred to them that such examination is essential to a safe and prudent choice of river or surface-water.

Spring water is everywhere instinctively sought after as a beverage, and preferred to river or surface-drainage water, because it is generally free from organic matter. Accordingly, Dr. Lyon Playfair, having been requested to examine the Watford spring water,

with an especial reference to the amount of organic matter contained in it, reports that "not the minutest trace of organic matter could be "detected in it by the most severe tests."* This result is substantially confirmed by Professor Clark, of Aberdeen. Any allusion to this point of superiority of the Watford spring water the Report of the Board of Health altogether omits, just as it omitted to state that this water softens by mere boiling, or can be supplied to London so low as $3\frac{1}{4}$ degrees of hardness.

Passing in our comparison from the foreign matter contained in the waters to their physical properties, I next advert to the quality of COOLNESS. The Watford spring water, in common with all springs of a similar depth, is uniformly at a temperature near to the average of the climate for the whole year, keeping about 52 degrees Fahrenheit, and scarce exceeding or falling below this temperature either in summer or winter. River and surface-drainage water on the contrary, ranges from 70 degrees Fahrenheit in summer to 35 degrees in winter, and consequently is warm in summer, which promotes decomposition in the organic matter, and is excessively cold for drinking in winter, and easily frozen in the distributing pipes. During the months of June, July, and August, the temperature of the waters of the present companies is generally above 65, and sometimes above 70 degrees. The temperature of the water proposed to be brought in by the Board of Health, being a surface-water, would be no lower. I have already said that in summer or winter the Watford spring water would vary little from 52 degrees.

The Board, although they expressly treat on coolness as a desirable quality in water distributed in summer for domestic consumption, seem to believe that when water pipes are laid deep in the ground, any water passing through them will "be cooled" in summer—such is however by no means the fact. So large in mass is the water passing through pipes compared with the pipes themselves, which lie buried in a slow conductor of heat, that it is rather the water that imparts its temperature to the pipes, than the pipes that impart their temperature to the water. I have had the temperature of pipe water, as delivered for use on the continuous system, examined in many different towns, and the water is invariably delivered in the summer time, even through pipes the top surface of which is three feet below the ground, at one or two degrees

* Appendix C, p. 49.

warmer than the reservoir, or the river or the spring it comes from. But mistaken as the Board are, in imagining that their water was to be cooled by being stored in covered reservoirs, conducted in closed channels, and by passing through distributing pipes, well did they know that several of the new schemes embraced the two latter means of cooling adopted by the Board—supposing them to be the means of cooling, while no other project but the Board's required the monster "covered" reservoirs, which the Board pride themselves upon copying, as they pretend, from the ancient Romans. I wish you then to observe, in the following quotation, how the Board have chosen to conceal that thus far they only propose what other companies have before them proposed (see page 36 of Report). "*The disregard of ar-* "*rangements for securing coolness in the water delivered,* the "neglect of the powerful effects upon its quality of exposure to "polluted atmospheres, and the apparent unconsciousness of the "operation of such influences upon the quality of the water sup- "plied *by the leading companies,* may be adduced as facts de- "cisive of the character of their management, and not less so of "*the new leading schemes of water supply, in which these qua-* "*lities,* as influencing the public health, *are equally unnoticed* "*or disregarded.*" You will perceive that the Board ingeniously but not ingenuously labour to produce the impression that they have proposed what *none* of the new companies *have proposed,* by saying that *some* of those companies *have not* so proposed, and by being silent on the fact which they knew right well, that *others* of them *had* so proposed. As to how to secure the regular temperature they aimed at, it is plain that this bragging Board was not aware that yours is the only scheme yet brought forward that could accomplish it.

Collecting, then, the results of the comparison as to QUALITY, we find:—

I. The Watford spring water is free from solid matter *in a state of mixture,* such as would be contained in the water of the Board of Health, and as confessedly would render filtration necessary for their water.

II. The Watford spring water contains in solution no mineral matter that unfits it for domestic, drinking, or culinary

uses, while, by a process as simple as filtration, it can be delivered to the consumers "softer" than the water proposed by the Board.

III. *The Watford spring water is pellucid, being free from organic matter*, not only in a state of mixture, but in a state of solution, while the waters proposed to be collected by the Board are, even when filtered, contaminated with dissolved organic matter, and are discoloured or made ill-tasted by peat.

IV. The Watford spring water *at all seasons of the year is of a uniform temperature* of 52 degrees Fahrenheit, which is agreeable for drinking, and cooler in the height of summer, and warmer in the depth of winter, by 18 degrees Fahrenheit, than the water proposed to be collected by the Board.

Secondly.

WHICH SCHEME PROPOSES TO SUPPLY AND DISTRIBUTE WATER IN THE MOST SUITABLE QUANTITY AND IN THE MOST CONVENIENT MANNER FOR THE USE OF THE INHABITANTS OF THE NORTH OF THE METROPOLIS AND ITS SUBURBS.

The Board of Health remark, that they have taken considerable pains to ascertain the amount of water daily supplied to the metropolis by the existing water companies, and also to ascertain the portion of this amount that is actually made use of in the houses, and the portion that runs to waste. At pages 126 and 127 of their Report they give the result of this examination in the following words:—"It has been stated that the quantity of water "now delivered into the metropolis is nearly forty-five millions of "gallons per diem. From the gaugings of the run of water in the "sewers, from the examination of the works of the water com-"panies, and from the evidence respecting them collected by Mr. "Cresy, our inspecting engineer, *we believe these returns to be, on "the whole, correct.* Believing this to be so, it follows, from the "various examinations of the quantity of water actually consumed, "*that nearly thirty millions of gallons are daily pumped into the "metropolis in waste.*" That is to say, the Board gravely state

that two-thirds of the water raised by the existing companies is "wasted." Before putting forward such a statement in a public document, reflecting as it does, not merely upon the management of one water company, but upon the varied and independent managements of nine water companies, which supply above two millions of persons, it would have been natural to suppose that the accuracy of this conclusion had been verified in every possible manner, more especially when the Board found on this conclusion a proposal to stint the domestic supply of the metropolis to one-half of its present amount.

If, as according to the Board, 45 million gallons of water per day be delivered into the metropolis, and 30 million gallons are daily wasted, it would follow that 15 million gallons is the actual daily consumption. Deducting from this 15 millions the 5 millions conjointly used for the supply of the wholesale consumers, for the watering of roads, for the flushing of sewers, and for the extinguishing of fires, there will remain 10 millions for the domestic supply of the 270,581 houses, shown to be supplied by the metropolitan companies (see page 7 of Report), or 37 gallons per house per day, which, at $7\frac{1}{2}$ persons per house, comes to 5 gallons per head. From these 37 gallons per day, let there be deducted 15 gallons as the ordinary supply of a water-closet to such a household, and only 22 gallons per house per day remain for private baths, horses, stables, washing carriages of all kinds, and frequently the watering of gardens, independent of washing, drinking, and culinary uses; for, under the title of house or domestic consumption, the water supplied by the companies for all those purposes is included. Twenty-two gallons per house corresponds to 3 gallons per individual per day, which is manifestly insufficient for all the purposes above enumerated.

The manner in which the Board have arrived at the startling conclusion that two-thirds of the water supplied to the metropolis is wasted, appears to have been by selecting blocks of houses, and gauging the discharge of water from them into the sewers, so as to ascertain how much water passed into the sewers on days when the water from the companies was on, and how much on days when the water was not on. The latter and lesser quantity seems to have been assumed by the Board to represent the water actually consumed for household use, and the difference between the latter and the former, as water gone to waste during the time of delivery.

The water, supposed to be consumed, was, it is asserted, checked in the case of a block of 1200 houses, by ascertaining "the con-"sumption of water by gauging the butts and cisterns during the "intervals of the delivery of the supplies by the Company;" an assertion so remarkable, in reference to 1200 inhabited houses, as to make me very desirous of seeing the yet unpublished details of the observations. But the little value of the results of the observations peeps out in page 121 of Report, where it is stated, "*there was no doubt*, however, *that from the defects of the present* "*system of permeable brick drains and sewers, and from the loss* "*in cesspools, the quantity really delivered was greater than the* "*gaugings represented.*" Thus, then, it appears that water would be lost by the permeability of the drains and sewers, before arriving at the place where it was gauged, and that "cesspools" received the waste water from at least some of the "runs" of some of the houses; but whether these cesspools had any communication with the sewers that were gauged, does not appear, and it is ten chances to one that no such communication did exist.

It is now necessary that I should inform you, what seems to be altogether unknown to the Board, although every water-works engineer is well acquainted with the fact, that the water distributed by the water companies, being contaminated with organic matter, is necessarily drawn off periodically from what are technically termed the dead ends of the distributing pipes, as in such parts the water becomes discoloured, especially in the summer time, as then the organic matter putrifies and renders the water offensive and unfit for domestic purposes. This takes place not only in the metropolis, where the intermittent system of distribution is yet practised, but also in towns supplied with water, where the continuous system of delivery has always been in use. For instance, at Ashton, in Lancashire, the water company, which supply about 5000 houses, draw about 100 end plugs per week, which plugs vary from $2\frac{1}{2}$ to 3 inches diameter, and are left out till the water is clear, which is usually from 5 to 10 minutes. At Bury, in Lancashire, the water company, supplying also about 5000 houses, draw from 75 to 80 end plugs per week, from $2\frac{1}{8}$ to $2\frac{1}{4}$ inches diameter, which plugs are also left out till the water is clear, which takes place in from 5 to 20 minutes, according to the state and temperature of the weather. These two towns are supplied with surface waters collected in large

reservoirs. The exact amount of water consumed in this manner it would be difficult to ascertain; but as the consumption that thus takes place was unknown to the Board, no estimate of it was attempted by them; but, whatever it was, it cannot be justly accounted as "waste;" and under any system of distributing river or surface water, it must be calculated in the quantity to be supplied.

The end plugs of the distributing pipes are always drawn on the days when the water of the companies is on, indeed immediately before letting it on, and, as not only the days, but the very hour, when the water is to be put on by the companies is well known, a larger quantity of water is then consumed for extraordinary household purposes, especially where the cistern room is small. The washing out of a back court, the watering of a garden, the filling-up of baths, the washing of clothes, the scouring of a house, and the cleansing out of stables, are instances of operations reserved for water days. No wonder then if we find, at page 123, Mr. Gotto, a surveyor, stated to say, that, on Friday, a water day, the discharge per house was 85 gallons, and on Saturday, also a water day, 104 gallons, while on Monday, *not* a water day, it was only 40 gallons. Allowing these observations to have been accurately made, they would by no means show that only 40 gallons are the ordinary daily supply, nor that the 45 gallons additional on Friday, and the 64 gallons likewise additional on Saturday, all went for loss. The water consumed by a household varies considerably in different days and is notoriously largest on Saturday. At Ashton, in Lancashire, a town supplied from a reservoir, on the constant supply system, Mr. Hibbert, the company's superintendent, tried (in May, 1847) some experiments at my request, to ascertain the amount of water used per head of the population on different days in the week; and the result was, that the amount of water consumed on a Saturday was to that consumed on a Monday as about 8 to 5. This case will serve to show, that supposing the observations instituted by the Board to have been carefully made, yet that more experience in the art of investigating physical facts, and more knowledge of the details of water-works practice than the Board possessed, were necessary in order to conduct the observations on correct principles, and to arrive at a safe conclusion.

But although the conclusion arrived at by the Board is that 37 gallons per house, or 5 gallons per individual, is the *average* daily

domestic consumption *for the whole of the metropolis*, I wish you to observe that *not a single observation quoted by the Board warrants so low a statement.* According to Mr. Gotto's evidence on "*the lower neighbourhoods*" of the north-eastern districts, the daily consumption was 59 gallons per house, or 6 gallons per individual. (See page 123.) "But in such places," says Mr. Gotto, "the houses have not all cisterns; most of them procure their "water from the stand-pipe in stone jars; many others have pails "and kettles; but few have cisterns or water-butts." Mr. Lovick found, page 121 of Report, "the average consumption as ascer-"tained from the gauging of the butts and cisterns of 1200 houses "was 51½ gallons per house per day;" and at page 122 it is stated, "that Mr. Roe, the chief surveyor, gauged the run of waste "water from houses of the highest class, all of which would have "water-closets, many of them also *baths and stables;* and the run "of water from them did not average more than 76 gallons per "diem, *on the ordinary days when the water was not on.* In third-"rate streets, the run of water was about 45 gallons per house per "diem," that is, on days when the water of the companies was not on. This is the lowest amount of "runs" recorded by the Board; and yet a positive statement is made by them that two-thirds of the water distributed by the companies is wasted, or only 37 gallons per house is used for domestic consumption.

The average daily amount of water supplied in the several districts of the existing companies for domestic consumption is shown, at page 7 of Report, to vary from 89 gallons to 222 gallons, according to the sizes of the houses. To understand how apparently so large a supply becomes necessary, it must be remembered that this average amount per house includes the supply given not only to private houses, but to club-houses, hospitals, butchers, bakers, fish-mongers, inn-keepers, public-houses, and shop-keepers, and, as before stated, all the water used for baths, water-closets, horses, washing carriages, cabs, and omnibuses, and frequently the watering of gardens, besides drinking and culinary uses, and besides so much water as is necessarily consumed in letting off the corrupted water that accumulates in the dead ends of the distributing pipes. We find the Board, at page 163, making the following, a much lower estimate:—"From all the information we have received, in respect "to the present habits of the population, and the probable exten-"sion of the use of water by the introduction of supplies of su-

" perior quality and improved distribution, we believe that it will " be *an ample estimate, comprehending, indeed, many new and* " *unforeseen uses,* if we provide for the daily supply to the whole " population of an average equal to the *actually ascertained con-* " *sumption* (?) in houses of the higher class, namely, of about 75 " gallons per diem per house." And again at page 265 of Report, we find the Board, in their own self-complacent way, calling 75 gallons per house per day " an *improved* domestic supply," notwithstanding that the existing companies, as before stated, distribute for domestic consumption during the year an average daily supply, in the poorer districts, of 89 gallons per house, and in the richer districts, 222 gallons per house.

Although among houses of a lower class it may be freely granted that a portion of the water raised by the existing companies is wasted, under an intermitting supply, on account of leakage, or of the ball-cocks being out of order or displaced, yet I am certain that no considerable amount is lost in the better and first-class houses. Good houses are usually supplied with ample cistern-room, and furnished with ball-cocks and appendages of the best quality.

Large houses frequently contain ten to twelve inhabitants. In the registrar general's return the average population per house of St. James's, Westminster, is given 10·3. A large house may be estimated to require the following quantities of water on an average, but more in dry summer weather:—

	Gallons.
For water-closets	22
Coach-house, stables, horses, &c.....	30
For baths	120
Culinary, washing and cleaning, and other purposes	80
Gallons.....	252

One of the greatest drawbacks to the introduction of baths to small houses is the intermittent system of distribution, for such houses have rarely cisterns or butts, large enough to afford a supply for baths. When the continuous system of distribution at a high pressure is introduced into the metropolis, and a small pipe can be taken even into the top rooms of the highest houses, so that water can be drawn in every room of the house without the labour of carrying, there can be no doubt that

private baths will rapidly increase in number and be very generally adopted. Supposing a family of 7 or 8 persons to use but one bath per week to each person, this would consume about 55 gallons per day, and as the water-closet requires 15 gallons per day, these two uses alone would consume 70 out of the 75 gallons per day allowed by the Board.

It is stated in the Report of the Board, on the authority of the returns by the water companies, that an average daily supply of 146 gallons per house is afforded to the tenants. Granting that some "waste" takes place, especially in the water supplied to the lower-class houses under the intermitting system of distribution, yet, considering the increased consumption of water that may be calculated upon for baths and water-closets, I believe that more instead of less water per house will be needed for the domestic supply of the metropolis under an improved system of distribution.

Taking into consideration the superior class of houses existing in the north-western portion of London, which you propose to supply, and the rapid manner in which this class of houses is increasing in this locality, I have allowed for an average consumption per house, including the water required for horses, carriages, baths, &c., &c., at 170 gallons per day, or about the amount now distributed by the Chelsea Water Company, whilst the Board of Health propose to limit the supply to the metropolis at large to but 75 gallons per day, including all the above uses.

After these remarks, you can judge for yourselves of the reliance to be placed on the observations instituted by the Board, as a basis for diminishing by one-half the present domestic supply.

As explained in my previous Report to you, dated January 8, 1850, the water to be distributed by you is intended to be supplied from large reservoirs, situated in the country, entirely lined with hard burned bricks, the bottoms of the highest and lowest of which are respectively at an elevation of 488 and 302 feet above Trinity high-water mark. The higher reservoir commands houses situated on the very top of Hampstead Heath, Harrow, Edgeware, Hendon, Finchley, Stanmore, Bushey, and other elevated districts, which are at present *entirely* unsupplied with wholesome water, while the lower reservoir commands Child's Hill, and a high district of the metropolis at present very inefficiently supplied with this necessary of life.

As the Board have not condescended to state either the site or elevation from which they propose to supply their water, no in-

formation exists on this subject, and therefore it only remains for me to observe, in respect to DISTRIBUTION—

I. That the Watford Spring Water Company propose to distribute an average daily supply of 170 gallons per house, including the water consumed for horses, carriages, baths, washing, culinary, and other domestic purposes, while the Board propose to limit the supply for all the above purposes to 75 gallons per day, or one-half the present delivery.

II. That the Watford Spring Water Company propose to supply water on the continuous and the most approved system, even to the tops of houses situated at Hampstead, Stanmore, Harrow-on-the-Hill, and other upland districts elevated at 450 feet above Trinity high-water mark, as well as to the tops of the houses in the most elevated part of the metropolis, by known, practised, and fully-explained means. The Board, it is true, propose also to make use of the continuous supply, but how, they have not explained.

Thirdly.

WHICH SCHEME CAN SUPPLY WATER CHEAPEST TO THE CONSUMERS?

The Board state in their Report, page 116, "That an entirely "new supply of *the softest water* may be brought to the metro- "polis, pure, filtered, and well aërated, and may be delivered into "every house in the metropolis, on a constant supply, *unlimited* "*in quantity*, for drinking, for culinary and other domestic pur- "poses, *for baths*, (?) and for washing, at an average original rent- "charge, *inclusive of the expense of the tenant's supply-pipes, and* "*tap, of* 2*d. per week per tenement.*"

Reflecting on the above paragraph in connection with other portions of the Report, it has occurred to me that in many respects the GENERAL BOARD OF HEALTH, IN GWYDYR HOUSE, ESTABLISHED IN 1848, resemble the more venerable BRITISH COLLEGE OF HEALTH, IN THE NEW ROAD, ESTABLISHED IN 1828. The College dealing in Morisonian pills and powders,

the Board in Chadwickian projects and promises, both equally disinterestedly require the public to swallow their nostrums largely. Alike unqualified for what they undertake, by professional education or scientific knowledge, they agree in their detestation of the "regular" practitioner*. Both, depending for success upon their own exaggerations and the simplicity of the public, widely disseminate selections of one-sided evidence, which they agree in taking privately; and little wonder either, for how could these respectable bodies produce evidence that would answer their purposes, in fair open hearing, according to the customary laws of inquiry and justice? The main difference between the College and the Board is that the College is the more tolerable, as it only proffers its nostrums to a discerning public, while the Board, by duping an undiscerning Government and Parliament, succeed in forcing the adoption of their nostrums on a discerning public. The College, too, is the cheaper institution, for, acting under a Government stamp, it adds to the revenue of the country, while the Board, acting under a Government seal, diminish it. Indeed, the College, it must be acknowledged, helps to pay the Board; while the poor country is overborne by the unscrupulous energies alike of the voluntary College and of the coercive Board.

The College, I have said, is the more venerable institution; but the Board, though a young Board, is a *very* promising one; they *promise* the inhabitants of the metropolis a new continuous supply of *the softest* water, *unlimited in quantity*, for domestic uses, "baths," and for washing, at 2*d.* per week, or 8*s.* 8*d.* per tenement per annum!

Let us examine these *promises*. The water the Board allude to as "the softest water," we have already learned, from pages 265 and 266 of Report, to be at least $3\frac{3}{4}$ degrees of hardness. The town of Aberdeen is and has been for several years supplied with water about one degree of hardness—so much for the Board supplying *the softest* water.

At pages 163 and 265 we learn that the Board mean by "an "*unlimited* supply of water" for domestic use, for *baths*, and for *washing*, what they are pleased to term "an *improved* domestic "supply of 75 gallons per day," which is *equal to only one-half the quantity supplied by the present companies*, or little more

* See Appendix G, p. 60.

than is requisite to supply water for the water-closet of a family of seven persons, and a bath to one of them daily; so that *softest* and *unlimited* are mere poetical licences, such as perhaps might be looked for in the composition of such imaginative persons as the members of the College or the Board.

Let us now attend to the price of 8*s.* 8*d.* per house per year held out by the Board. There is in town a well-known system of decoy prices. Some might call it a discreditable system, but it has been adopted by the Board. *A most attractively low price* appears in conspicuous characters in a shop-window. These "he "that runs may read." But there is an *addition* so inserted that not only he that runs but he that stops to stare may *not* read. Let us try if we cannot make out the Board's *invisible addition,* by a close examination.

At page 322 we find the following recommendation by the Board:—"In respect to the existing companies * * * * * "WE RECOMMEND THAT THEIR PLANTS SHOULD BE PURCHASED, "*but we are not prepared to recommend any preappointed terms* "*of purchase.*" At page 272 we are further told, "Whatsoever "might have been the origin or the conduct of the companies, "*there would*, probably, in case of such a change of system as we "would recommend, *be no other disposition on the part of the* "*public but to pay the companies fairly and liberally the actual* "*value of this stock. The determination of that value would,* "*however, be the subject of a separate inquiry.*"

Here we have indicated that it is an indispensable adjunct to the carrying out of their scheme for favouring the public with one-half the present domestic supply of water, that the whole of the nine existing water-works should be first purchased at the expense of the ratepayers, from whom the price is in the mean time concealed with considerate delicacy. Hence the *invisible addition* to the price of the Board; but as I have undertaken to make it visible to you, if possible, I will try to assist you to estimate what would be the probable cost of making this purchase.

In the "Statement of the plan for supplying London with "water, proposed in the Metropolitan Water-works Bill" (Henley-on-Thames and London Aqueduct), page 20, the net revenue of the existing companies is estimated at 300,000*l.* Another approximate estimate of their net income may be gathered from the returns of the water companies given in the Report of the

Board, which show that 270,581 houses are supplied with water by the existing companies, and from the parliamentary returns in 1843, which show that the average annual charge by all the companies was 1*l.* 10*s.* per house. This would give a gross income of 405,871*l.* Deducting from this amount one-third for working expenses, or the sum of 135,290*l.* (which would probably be very near the exact amount), 270,581*l.* would be the net income. This property it would not be practicable to buy at less than 25 years' purchase of the net income, the smallest estimate of which would give 6,764,525*l.* as the money to be paid to the existing companies. Supposing this amount to be raised in the usual way, *on the security of a compulsory water-rate, levied by act of parliament on house property,* at 4 per cent., this would occasion an annual charge (on the 288,037 houses stated by the Board as the number now comprising the metropolis) of 18*s.* 8*d.* per house, to which must be added the expense of collection, which would raise this sum to at least 19*s.* *The conspicuous* DECOY PRICE *of the Board for* 75 *gallons of water per day per house is* 8*s.* 8*d. per year; their* INVISIBLE ADDITION *is a permanent rent-charge of* 19*s. per house per year for the purchase of the works of the existing companies; the* REAL PRICE, *if the Board succeed in duping the Government and Parliament, and do not bring upon the ratepayers more expense than they promise, will be* 1*l.* 7*s.* 8*d. per house per year for* 75 *gallons per day; probably not far from what they now pay to the companies for twice the supply.*

The cost at which you proposed to supply the north of the metropolis with Watford spring water was 1*l.* per house per year, for 170 gallons per day, or 9*s.* per year for 75 gallons per day, which is the Board's allowance for a house. *Thus, then, it turns out that the metropolis can secure by the aid of a private "trading" company, without seeking any other favour from the Board than that they should be gone out of the way, a supply of* 75 *gallons of water per day for* 9*s. per year per house, while the cost of the Board's supply would be* 1*l.* 7*s.* 8*d., or thrice as much.* I have been anxious to explain to you, knowing how largely some of you are interested as proprietors of houses in the metropolis, what would be the real situation of the ratepayers under the scheme of the Board of Health, as it would not be easy for you to judge what is awaiting them by merely reading the Report of the Board.

It is not unadvisedly that the Board have made this proposition of thus mulcting the ratepayers. In March, this year, you will remember, I had the honour of being present with some of you at an interview with the Board of Health, who, I believe, had short-hand writers present to record what passed. I then took the pains to point out fully to the Board that any system for supplying the metropolis with water that was based on the purchase of the existing water companies at their present artificial value, could only tend *to burden for ever* the house property of the metropolis with the present heavy water-rates, and might further burden it with the cost of any wild crotchet or experiment that a board of amateurs, spending the money of the public without responsibility or check, might choose to fancy. I pointed out that, in fact, the inhabitants of Manchester, Liverpool, and other places had thus entailed upon themselves heavy water-rates, and I warned the Board, vainly enough as now appears, not to lead the Metropolis into a like error.

Recapitulating, then, the QUALITY, DISTRIBUTION, and COST of the waters that can be supplied to the metropolis from the springs at Bushey Meadows, near Watford, and by the project of the General Board of Health, it appears, AS TO QUALITY :—

I. That spring water can be supplied to the metropolis from Watford, perfectly free from organic matter, while the water proposed by the Board would at all times be impregnated with peat and other organical impurity.

II. That spring water from Watford can be delivered in London at a temperature never exceeding or falling below 52 degrees Fahrenheit by more than 3 or 4 degrees, while the water proposed by the Board varies in temperature with the atmosphere, and ranges from 68 degrees in summer to 36 degrees in winter.

III. That the Watford spring water is at all times colourless and pellucid, while the water proposed by the Board is coloured with peat, especially in summer.

IV. That the Watford spring water can be delivered in London of $3\frac{1}{4}$ degrees of hardness, while the water proposed by the Board would be $3\frac{3}{4}$ degrees of hardness.

As to Distribution:—That intelligible and practicable plans, surveys, and levels have been made and completed to distribute the spring water to the north of the metropolis and its upland suburbs at high pressure on the continuous system, while no plans, surveys, or levels are accessible to show how and where the water proposed to be supplied by the Board can be collected and distributed.

As to Cost:—That 75 gallons per day of Watford spring water can be delivered per tenement to the metropolis for 9*s.* per annum, while the delivery of 75 gallons per day of the water proposed by the scheme of the Board will cost 1*l.* 7*s.* 8*d.* per annum.

In making the foregoing comparison between your project and the Board's, I have assumed that the quantity, quality, and cost of the water proposed to be collected by the Board will be as they have themselves stated; but I should be sorry for you to believe that my assumption proceeds from any confidence in their statements on these subjects.

The absence of such obvious and customary requisites as maps, plans, sections, and levels, or even of a written description of their projected works, renders it impossible for any one to understand, and consequently for me to point out to you, the exact nature of the Board's project. Judging from the internal evidence of the Report itself, and marking the habit of exaggerating and misstating* indulged in by the Board, I should say that the estimate given at page 281 of their Report, in the following words,—

"Storage reservoirs and intercepting culverts on gathering "ground; covered aqueduct thence to service reservoirs; "covered service reservoirs and filter-beds; principal mains "from reservoirs, street and branch mains, and services, "&c., &c., over the whole district; including land for works "and compensation £1,432,000,"

is a mere snare. For this approximate estimate to be worth anything, surveys and levels of the country on which the works are proposed to be constructed must have been procured or made, and the proposed works must, in point of fact, have been laid down on such plans. Private companies, before they are entitled even to apply for parliamentary powers to construct works, are, by the Standing

* See Appendices G, I, K, L, and M, pp. 60, 65, 66, 67, 68.

Orders of Parliament, properly obliged to deposit surveys, plans, and sections, showing the exact situation and nature of the intended works, as well as an estimate of the cost of constructing the same, so as to enable every competent person to appreciate the scheme. I have known of such plans being made for private companies, and completed, with all the details required by the Standing Orders of Parliament, in two or three months. Surely, then, it is a disgrace to a public Board, professing to have a staff of engineers, and proposing to purchase property worth 6½ millions of money, and to expend 1½ million more upon new works, that even a general plan, showing the situation and main level of their proposed works, has not yet been published, if, indeed, such plans do exist, or at least did exist at the date of the Report, which I, for one, will believe, not when the Board say it, but when they prove it.

The Board propose to collect field drainage or surface water in large "covered" reservoirs, so as to store the rain falling on a large tract of country in wet seasons for use in dry seasons; and at page 113 of Report it is stated, "The nature of the source "requires a preservation of the rain during periods of its maximum "fall, for a regulation of the supply during periods of a minimum "fall. The storage room must therefore be very extensive. The "primary engineering disadvantages of this district are, that it "presents no deep natural hollows, such as are available to many "of the northern towns, for the storage of water without extensive "excavations. Here the excavations for storage reservoirs must "be very large and expensive. Against the modern engineering "practice of exposed and open reservoirs, we would rather revert "to the custom of the Roman engineers, and recommend cover-"ing the service reservoirs and aqueducts to the utmost extent "practicable." Again, at page 115 of Report it is stated, "As a "foundation for proximate estimates, *plans have been got out by "our engineering inspectors for extensive covered reservoirs, and "for the conveyance of the water in deep conduits, also covered.*"

The Board, in their customary loose way, have nowhere explained what *area* their "covered" reservoirs would extend over. I will enable you to judge by relating what has been done elsewhere. In the hilly districts of Lancashire, Cheshire, and Derbyshire, where the average fall of rain in a dry year is as much as 36 inches in depth, and in a wet year 48 inches,

reservoirs to store in wet seasons the rain flowing off the sides of steep retentive hills, for use in dry seasons, are made large enough to contain from 5 to 6 months' supply. Now the average depth of rain falling per annum for the district about Bagshot and Farnham is only about half this quantity. In a dry year it may be estimated at 20 inches, and in a wet year at 28 inches, while the ground is neither retentive nor steep; so that, if a daily supply of 40 million of gallons to the metropolis be required by the Board, if we could suppose them to be guided by experience, their reservoirs must be laid out to contain at least from 5 to 6 months' supply; but calculating upon only nine days more than *four* months' supply, *such a reservoir, of an average depth of* 30 *feet would cover a square mile.* Until the details of the monstrous expense of excavating, lining, and "covering" such a reservoir be given to the public, I will allow the Board as much credit as to believe that they never had before them even the rudest estimate of these items; for *the covering alone of this reservoir constructed upon the cheapest plan that experience has yet sanctioned, would cost more than the Board's whole estimate for their new works.*

I shall not trouble you with any lengthened observations upon the many irrelevant matters contained in the report of the Board on the water-supply to the metropolis. A great portion of this document is taken up with suggesting what they are pleased to term improvements in drainage, and with giving opinions as to the form of sewers and house drains; matters that would have been much better left alone, as these have already been withdrawn from the control of any of the amateurs that make up the General Board of Health, and are at present in the hands of the practical engineering and scientific Members of the Metropolitan Sewage Commission.

Another large portion of this Report is taken up with assertions intended to convey the impression "that the separation "of the works of pipe-water supply from those for the removal of "waste water, occasions delay in the execution of works of pri-"mary importance for sanitary improvements, as well as increased "expense."—(Page 319 of Report.)

All persons practically conversant in such operations, and having no interest in bringing the management of such various works into their own hands, will admit, and even the public can understand,

that the works requisite to supply pure water to a town, and those requisite for the construction of sewers and drains, to carry off the water of heavy rains from the roofs of the houses, from the streets or from roads, and to get rid of the excremental and refuse matter of the population, are by no means necessarily connected. Excellence in carrying out detailed works required in each of these departments is much better ensured by a division of labour; and the remarks of the Board on this head are another proof, if not of their ambition, of their want of practical knowledge.

The remarks of the Board in reference to the jets of water that may be procured from distributing pipes or mains when the continuous system of supply is introduced, are one mass of fallacies. In one portion of the Report it is contended that under that system small and cheap distributing-pipes can be made use of; in another that under the same system jets of water might be made to rise at pleasure from the streets to the tops of the highest houses. There is no difficulty in making provision for jets of water rising with much force to considerable altitudes, should such be desirable; but to represent that this can be accomplished through small and economically-arranged distributing-pipes, although of amply sufficient capacity for house supplies, is a palpable absurdity. The same may be said of their remark (page 261), that the introduction of the system of constant supply "would afford the means of "speedily extinguishing *two thirds of the ordinary fires, and that* "*it would reduce the insurance risks in still greater proportion.*"

The continuous system of supply, though occasionally spoken of by the Board as if it were an invention of their own, was brought into use upwards of 30 years ago, and no other system has been in use in Edinburgh, Glasgow, Aberdeen, Preston, Oldham, Bury, Dukinfield, &c., but the rate of insurance in the above-named places is no lower than in London. It is true, that the intermittent system of distribution is in many respects much less convenient, especially for small houses, than the continuous system; but jets of water to extinguish fires, to cleanse pavements, and for other purposes, can be as easily supplied under the one system as the other; for although, under the intermittent system, the service-pipes conveying water from the mains to the houses are periodically shut off, yet those mains are themselves kept full of water, and may at all times be made available for the supply of jets for any purpose.

Another large portion of the Report is taken up with insisting

upon the advantages that would accrue to the inhabitants of the metropolis from purchasing the works of the whole of the existing water companies, and handing them over to a public body (I presume the General Board of Health), subjected to that kind of irresponsibility that is preposterously called responsibility to Parliament, upon the plea that, in this manner, a great saving would be made in the annual expenses. A very little consideration will show that this arrangement, if carried out, could not effect a saving even in the annual working expenses; the principal items of which, independent of the interest of capital, consist—in the cost of coal to generate the steam required for pumping engines; in the repairs of the engines, boilers, and pumps; in taxes, public and local, upon pipes and works; in wages for the working of the steam-engines, pumps, and distributing apparatus; in the extending of pipeage; in the collection of water-rates (which is usually paid for by a percentage on the amount collected); and in remuneration of qualified officers to direct and superintend these various operations. A steam-engine can raise no more than a given quantity of water to a given height with a certain expenditure of fuel, under any management; the cost of repairs will not be more under the management of a private company than under the management of governmental paid officials; the taxes must after all remain the same in amount, or, if not, must at least be paid for by the ratepayers in another form; and in no other way can there be a practical saving in the working expenses. Indeed it is very doubtful whether the metropolis, north and south of the Thames, containing two millions of persons, could in any way be so well or so economically supplied as by dividing it into districts under independent management. By this means minute attention is given to details by different minds, rivalry is maintained, and improvement introduced.

Certain at least it is that the public, who at present complain—as, indeed, the Board of Health themselves complain—of the exorbitant charges of several of the present water companies, could in no way be benefited by the purchase of the existing works at their present monoply or artificial value. Such a purchase would simply burden *for ever* house property in the metropolis with a rate equal to the interest of the money so improvidently laid out. The present water-rates, instead of being lowered, would be perpetuated. The question instead of being, as now, When are the water-rates to be lowered? would be then only, When are they to be raised?

It is worthy of remark, that no one instance is given by the Board where the system of superseding private companies in the supply of water to a town has answered, while, on the contrary, I may specify the towns of Manchester, Liverpool, and Bolton, as places where the inhabitants are severely suffering from so impolitic and unwise a proceeding.

I will only allude to the "insolence of office" manifested in this Report indited by a paid public servant, where it dares in this commercial country to throw discredit, and pass sneers upon any companies for being traders. It is owing to the beneficial operation of trading enterprise, that all the large towns in Great Britain, not excluding the metropolis, are better and more efficiently supplied with water than any towns in Europe; and it must be remembered, that no towns are so efficiently and cheaply served with water as those that are supplied by private "trading" companies.

The effect of leaving it to competition by private and joint enterprise to remedy the acknowledged evils in regard to water, by admitting the formation of the London (Watford) Spring Water Company, and others of a similar character, would be to secure at once to the metropolis a supply of undoubtedly wholesome spring water, distributed upon the principle of constant supply, and at from one-half to one-third the price of some of the existing companies.

The introduction by a new company, of a pure, soft, and cheap water, distributed on the system of constant supply, would immediately *force* the established companies also to soften and purify their waters, or to resort to better sources—to lower their charges, and to adopt the continuous supply, with an expedition and completeness that would startle the officials of a consolidated Board. *Clauses in the bill under which your Company was to be constituted would effectually have restricted the charges to be made, as well as the percentage of dividend on the capital embarked.* When such a company obtains an Act of Parliament, and not before, will the inhabitants of the metropolis be able to obtain an abundant and an unobjectionable supply of water *secured to them at a cheap rate, by effective clauses in an Act of Parliament.*

Thus, directly and indirectly, will the carrying out of your scheme effect such improvements as are required in the water-supply of the metropolis at large, besides distributing pure water

to a populous and important upland district, at present without a wholesome or adequate supply, and all this without any violent interference with established and vested interests, and with the best security that these improvements, once introduced, will be lasting.

Seeing, then, that the admission of a new Company, under legislative restrictions, would effectually remedy the evils of the present water supply to the metropolis, and that the "recommendations" of the General Board of Health, if carried out, could not remedy those evils, and that the rude touch of governmental interference has only tended, up to the present time, to perpetuate and strengthen those evils, it is to be hoped that the inhabitants of the metropolis will insist upon the Government letting them alone, as they can only hinder, and cannot help them. The truth is, the Government have a great deal of business of their own to do, and, in general, they do not perform this business so particularly well, as to induce any sensible man to wish *them* to help *him* at *his* business. To secure to the metropolis an immediate supply of pure and cheap water, all that is required of the Government is, to let the inhabitants mind their own business. IT IS THE GOVERNMENT AND THE BOARD *that are the real obstructives to an improved supply, and the* EFFECTIVE PROTECTIONISTS OF DEAR AND POLLUTED WATER*.

Any person of common sense could only have anticipated that a Report by the General Board of Health, on the supply of water to the metropolis, would exhibit such want of practical information and of scientific knowledge as it has been my duty to point out to you. It was impossible that the persons whose names are attached to this Report, and who have taken upon themselves so eagerly and voluntarily to obtrude before the public their views, evidently regarded by themselves as most valuable, *could practically* know anything of the matter they undertook to discuss; and it is improbable that their minds should have been trained to comprehend, much less to apply, that varied scientific and technical knowledge which only years of exclusive study and devoted application will admit of any one attaining, and which was, nevertheless, essential to qualify them for such a task. Yet this amateur Board, in innocent ignorance of how much they were compromising the scientific and engineering reputation of the country,

* See Appendix F, p. 57.

amusingly felicitate themselves (page 3) on having afforded instruction not only to English but to foreign engineers by their wonderful Report, which, according to themselves, as "an exemplification of sound, efficient, and economical principles," they "encourage the hope, may have an important influence even beyond the British dominions." No hesitation have they to recommend to the Legislature such a radical change or revolution AS THE ABANDONMENT FOR ALL PURPOSES of the whole of the sources from which water is at present, or has been for two and a half centuries supplied to the metropolis. Not only placing their crude notions in opposition to the most eminent and practical professional authorities of the present and past days, but showing their contempt for the common sense of the inhabitants of the metropolis, they state (pages 266 and 267 of Report), that the water of the Thames, as low down the river as Battersea and Kew, when filtered, is superior in quality to the water which, when cleared by subsidence in large reservoirs, is distributed by the New River Company. Accordingly, the Board recommend that the works of the Grand Junction and of the Vauxhall Water Companies, both of which derive their supply from the Thames within the influence of the tide, and, consequently, where the river is contaminated by the excremental and refuse matter poured out from the drains of the metropolis*, should be maintained and be made use of, in case of the failure of their own project (which they have had sense enough to anticipate), in preference to the works of the New River Company, whose water, derived in a large measure from springs, and the rest exposed in incomparably smaller proportion to contamination from a scanty population, and wholly out of the influence of the sewage of the metropolis, is conducted into London at a natural altitude of 84 feet above Trinity high-water mark, and is in volume equal to 14 million gallons daily, while the volume supplied by the Vauxhall and the Grand Junction Companies combined, only amounts to 9½ millions. The Board, at the same time, omit any mention, *not* of the objectionable old works, but of the new works of the Lambeth Company now in rapid progress of construction, for bringing a supply of water to the South of London from the Thames opposite Hampton Court, a site considerably above Teddington Lock, and, consequently above all

* See Appendix N, p. 70.

influence of the sewage of the metropolis. This omission, like the recommendation of the Board, unduly exalts the two companies that have somehow obtained their patronage.

I believe I have now adverted to all the matters contained in the Report before me, so far as you are interested. I sincerely wish that I could congratulate myself that the labour of examining any further compositions of the Board was closed; but if ever the particulars of their proposed works (heretofore withheld) are given to the public as well as the evidence upon which their Report is professed to be founded, it may be again my duty to address you.

I have the honour to be, Gentlemen,

Your most obedient Servant,

SAMUEL COLLETT HOMERSHAM.

19, Buckingham Street, Adelphi,
August 8, 1850.

APPENDIX.

(A.)

In September, 1849, it was determined by a body of gentlemen (some of whom were large house-owners, and deeply interested in procuring a supply of pure and cheap water for the north of the metropolis), to take the necessary steps for applying to Parliament for powers to bring to the north of the metropolis, and its adjoining suburbs, a supply of the pure spring water abounding in the neighbourhood of Watford. Accordingly gazette notices were given, and the necessary surveys and levels were taken, and plans deposited at a heavy expense by the 30th of November, 1849, in accordance with the standing orders of Parliament. All other requisite forms having been complied with, on February 6, 1850, the London (Watford) Spring Water Bill was presented to the House of Commons, and read a first time.

On February 11, 1850, in answer to a letter from Col. Knox, Sir George Grey stated "That the subject of the supply of water to the metropolis "was under the consideration of the Board of Health, and that a Report "from that body might be expected at an early period; in the interval it "would be desirable that no bills for the formation of companies for sup-"plying the metropolis with water should be allowed to proceed." About this time the following minutes of the Board of Health were presented to both Houses of Parliament by order of Her Majesty.

"The Board having had under consideration the applications pro-"posed to be made to Parliament for private Acts to authorize new "trading companies to raise capital for supplying water to the me-"tropolis:

"*Resolved*,—That it has been established by the Commissioners "for Inquiring into the Means of Improving the Health of Towns, "as a general principle of legislation, which has been confirmed by "subsequent inquiries made under the Metropolitan Sanitary Com-"mission, and adopted by the Legislature as a fundamental provision "of the Public Health Act, and which, so far as this Board has pro-"ceeded with its own investigation, appears to be equally applicable "to the metropolis—*that the works for supplying the public with "water should be under the same jurisdiction or management with "works of drainage, paving, and surface cleansing* (!!) That, apart from

"the merits of any particular scheme of new water-works, and pend-
"ing further investigations as to the practical means of applying the
"foregoing principle to the metropolis, it is inexpedient to sanction
"the investment of fresh capital in the same field of supply, as it is
"probable that the new works will have to be repurchased, and there
"can be no security that these will be applicable to the arrangements
"that may be hereafter recommended.

"*Resolved*,—That a copy of these Resolutions be transmitted to
"Her Majesty's Principal Secretary of State for the Home Depart-
"ment.

"[Extracted from the Minutes of the General Board of Health,
"and attested by

"ALEXANDER BAIN,
"ASSISTANT SECRETARY."]

On February 12, 1850, it was ordered, on the motion of Sir George Grey, "That no Bill for the supply of water to the metropolis, or any "part thereof, be read a second time before Easter" (that is to say, on the 21st of April).

Accordingly, on April 25, 1850, the London (Watford) Spring Water Bill was presented for second reading, when, after a discussion, it was arranged to postpone the second reading until May 13, to give time for the Members of the House to receive the report of the Board of Health, which Lord Ashley said he hoped would be ready for distribution within a fortnight of this time (that is to say, on the 9th of May).

On May 14, the report of the Board had not been printed, neither did it appear until about three weeks afterwards. Upon that day, on the second reading of the London (Watford) Spring-Water Company being moved for, Lord Ashley, in reference to the second reading of the London (Watford) Spring-Water Bill, and the Metropolitan Waterworks (Henley-on-Thames and London Aqueduct) Bill, expressed himself as follows:—"I "feel called upon to take a very decided part against both these projects. I "think the Watford scheme, whilst it would be very injurious to the neigh-"bourhood, would produce no beneficial effect whatever*. I am therefore "very desirous that the Watford Bill should be thrown out altogether; and "I may add that I think a plan will be suggested by the Board of Health "by which the mode of administration may be *five times cheaper than by* "*either of these bills.*" †

After such a statement by a member of the General Board of Health,

* Upon what evidence, my Lord Ashley? The report your lordship signed contains none.

† Why, my Lord, have you not explained your plan, by which this valuable saving is to be effected? The plan you have put your name to would cost the consumers thrice as much as the Watford plan.

and principally owing to the exertions of the Government, the London (Watford) Spring-Water Company's Bill was thrown out; the number voting for the second reading being 90, and the number against, 196.

(B.)

The inhabitants of the following places which were to be supplied with water by the London (Watford) Spring-Water Company, petitioned the House of Commons, after the first reading, in favour of the bill for establishing that Company.

	Number of Signatures.
The inhabitants of Kilburn, Maida Hill, and Vale, and the Vicinity	673
The inhabitants of Notting Hill and Kensington	724
The inhabitants of the Borough of Finsbury	2,024
The inhabitants of St. Matthew, Bethnal Green	9,034
The inhabitants of St. Pancras	4,426
The inhabitants of Paddington	1,229
The inhabitants of St. Marylebone	5,663
The inhabitants of the City of Westminster	10,749
The inhabitants of St. Luke's, Chelsea	1,357
The inhabitants of Hampstead	510
The inhabitants of Watford	692
The inhabitants of Pinner	264
The inhabitants of Bushey	347
The inhabitants of Rickmansworth	344
The inhabitants of Great Stanmore	188
The inhabitants of Edgeware and Little Stanmore	122
The inhabitants of Elstree	125
The inhabitants of Harrow on the Hill	516
Total number of signatures	38,987

(C.)

On February 27, 1850, I forwarded to Dr. Lyon Playfair eight gallons of Watford spring water, requesting him to make a quantitative analysis of the same, and especially to determine whether this water contained any, and if so what, amount of organic matter per gallon. I also desired Dr. Lyon Playfair to ascertain to what extent the Watford spring water

softened by boiling in a given time, and requested him for this purpose to boil a large quantity and try the hardness of specimens drawn off one quarter of an hour after the boiling commenced, one half hour ditto, three quarters of an hour ditto, one hour ditto, one hour and a half ditto, two hours ditto, three hours ditto, and four hours ditto. I also forwarded to Dr. Lyon Playfair for analysis (March 14, 1850), two gallons more of the same water, collected at a different time, and received from him the following report, in which the specimen of water first sent is called "Spring Water," and that last sent, "Spring Water B."

"Museum of Practical Geology,
"28, Jermyn Street, May 16th, 1850.

"I herewith send you the results of my experiments undertaken on behalf of the London (Watford) Spring Water Company. Two different specimens of water were forwarded to me for examination, one of which I shall designate 'Spring Water,' and the other, 'Spring Water B.'

"'Spring Water.'—The preliminary examination of this water showed that the chief constituent was carbonate of lime, containing traces of sulphate and phosphate of lime, and a small quantity of carbonate of magnesia. It contains, besides, a small quantity of chloride of sodium. The water appeared entirely free from organic matter, for not a trace could be detected by the most delicate reagents, and this supposition appeared more probable from the presence of a small quantity of nitrates, which tended to show that the organic matter had been completely oxidized. The hardness of the water was $18\frac{3}{10}$ths, the alkalinity $17\frac{9}{10}$ths, the hardness after boiling being $2\frac{7}{10}$ths. The unboiled water would therefore require, in this case, 40 oz. of soap per 100 gallons, and the boiled water $7\frac{3}{4}$ oz. per 100 gallons in order to form a lather.

"The quantitative analysis of the water gave the following results, calculated on an imperial gallon:—

	Grains.
Silica	0·80
Carbonate of lime	18·20
Carbonate of magnesia	0·45
Chloride of sodium	1·25
Chloride of potassium	0·64
Total per gallon	21·34

"I next proceeded to try the effect of boiling the 'spring water,' with a view to ascertain *the time* required in order to effect a material softening. In these experiments I employed a vessel similar to a common tea-kettle, which had already been employed for a like purpose, and containing a considerable amount of deposit, or fur. The water was boiled for two hours, and specimens collected for examination every quarter of an hour after the

boiling commenced. I found that the sample collected a quarter of an hour after the boiling commenced was reduced to 4½ degrees of hardness, and the specimen collected half an hour after boiling was 4 degrees, and the succeeding specimens differed from each other only by a small fraction of a degree. Consequently the consumption of soap by 100 gallons of the 'Spring Water,' is reduced from 40 oz. to 11¼ oz. by a quarter of an hour's boiling.

"'Spring Water B.'—This sample was very similar to the former one, and may be considered almost identical with it. The hardness was 18·4, the alkalinity 17 degrees, and the hardness after boiling, 3 degrees.

"The consumption of soap is therefore, for 100 gallons,

	oz.
Unboiled	40
Boiled	8¼

"The results of the quantitative analysis, calculated as before, are—

	Grains.
Silica	1·14
Carbonate of lime	17·00
Carbonate of magnesia	0·43
Sulphate of lime	1·20
Chloride of sodium	1·82
Chloride of potassium Phosphate of lime } . . .	traces.
Total per gallon . .	21·59

"The specimen, like the former one, appeared quite free from organic matter, but contained traces of phosphates and nitrates.

"From the preceding examination you will perceive that the Watford spring water, containing as it does only earthy carbonates, and no sulphates, is admirably fitted for the application of Dr. Clark's process for softening waters.

"Sir, I have the honour to be,

"Your obedient Servant,

(Signed) "LYON PLAYFAIR, F.R.S."

"To S. C. Homersham, Esq."

Soon after receiving the above report from Dr. Lyon Playfair, I requested him to try the amount of softening which took place by boiling the Watford spring water, four, eight, twelve, and sixteen minutes, and received from Dr. Lyon Playfair, the following report.

"London, 4th June, 1850.

"Sir,

"The following experiments show the softening of the Watford water

every four minutes to sixteen minutes, the water being kept in ebullition during the whole time.

	Degrees.
Original hardness	$18\frac{3}{10}$
After boiling 4 minutes, hardness	9
„ „ 8 „ „	$7\frac{1}{2}$
„ „ 12 „ „	$6\frac{6}{10}$
„ „ 16 „ „	$5\frac{1}{2}$

The experiments were made in a clean glass vessel quite free from deposit. The former experiment sent to you, in which the hardness was reduced to 4·5 after 15 minutes boiling, was made in an iron vessel already containing a slight deposit in order to have the same influences as in an ordinary kettle.

Under the latter circumstances the softening would be more rapid.

"Sir, I have the honour to be,

"Your obedient Servant,

(Signed) "LYON PLAYFAIR."

"S. C. Homersham, Esq."

I may state that the Watford spring water has also been analyzed for the (London) Watford Spring Water Company, by Dr. Ronalds and Professor Clark, of Aberdeen, as well as Dr. Lyon Playfair, and that the analyses by all these eminent chemists agree in every essential particular.

(D.)

PROFESSOR CLARK'S SOFTENING PROCESS.

Extract from a report of analysis of waters, with experiments to ascertain the nature of some of their phenomena. Addressed to the Commissioners of the Metropolitan Sanitary Commission, by Robert Angus Smith, June 18, 1848.

"*Action of Lime on Water.*—Dr. Clark proposes to precipitate the lime from water by converting the bicarbonate into the carbonate; this is done simply by adding caustic lime.

"I tried the process at Lambeth on ten gallons, and have little more to say, than that it agreed with the description given of it by the inventor. The lime was mixed with the water in the afternoon. In the morning the water was clean, perfectly so. This water was kept three months, and did not show any animalcules."

I have been favoured with the following letter from Messrs. Thomas Hoyle and Sons, of Manchester, in answer to some inquiries I directed to them.

"MAYFIELD PRINTWORKS, MANCHESTER,
"July 27, 1850.

"SIR,

"In reply to your enquiry received this morning, we have to state that we have made trial of Professor Clark's softening and purifying process for the last seven weeks, and are continuing the use of it. We understand that the Professor did not consider our water as a particularly favourable one for his process. Our principal object was to avail ourselves of an incidental property of the process—its power to free the water of organic matter, which troubled us in our operations, especially in summer weather. In this respect it has been decidedly satisfactory. We have also experienced the advantages of the process in softening the water. The process, as in our circumstances we have been obliged to try it, has been without any of the advantages that it would have in a water-works constructed for the purpose of carrying it on. We formerly pumped the water into a setling lodge, from whence it was transferred to a filtering-bed; and in applying the process we have made no alteration in those old arrangements.

We have stated that we have found the process quite satisfactory for the purpose we tried it. We operate upon several hundreds of thousands of gallons daily, and we have observed nothing in our operations to lead us to doubt that the process would work well on the largest scale.

"We are, Sir,

"Yours very respectfully,

(Signed) "THOMAS HOYLE AND SONS."

"S. C. HOMERSHAM, ESQ."

(E.)

NOTE ON THE TERMS *HARD* AND *SOFT* WATER.

The popular expressions *hard* and *soft* water really give little information concerning the wholesomeness or character of a particular water, and its adaptation for drinking or culinary or even washing purposes. Water may be "soft," free from organic impurity, but, owing to the presence of a large quantity of mineral matter, be quite unfitted for drinking, cooking, or even for washing. To give a practical illustration: the water supplying the Trafalgar Square fountains, and which is lifted from a well sunk into the chalk formation beneath the London clay, the bottom of which is about 350 feet below the level of the sea, is a "soft" water about $5\frac{1}{2}°$ of hardness; but this water contains, according to the analysis of Mr. Brande

and the Royal College of Chemistry, from 66 to 79 grains of mineral matter per gallon, from 60 to 72 grains of which are common salt and soda. Water of this description is unfitted for drinking or making tea, and some other culinary operations, because the soda contained in it, when habitually used, acts medicinally on the kidneys; and it is unfitted for washing, because the effect of soda, if used for washing clothes, tends to discolour white cotton, flannel, or linen, and to spoil the colours of certain prints; it is also unfitted for warm baths, because the soda is apt to form a soap with the oily matter which exudes from the pores of the skin, and therefore causes it to become rough and chap.

On the other hand, water may be "soft" from the almost entire absence of mineral matter in solution; water of this description, from only 1 to 2 degrees of hardness, may be found in streams fed from the rain falling upon the primitive geological formations. I have had water analyzed that was collected from streams fed by the rain falling upon the millstone grit formation containing only $2\frac{1}{2}$ grains of mineral matter per gallon, and only $1\frac{1}{10}$th degree of hardness, and yet the use of this water for most purposes is avoided by the inhabitants living near these streams, because a large portion of the ground draining into them is covered with peat, which, being taken into solution, and especially in summer weather, so completely contaminates the water with organic matter, that it is unfitted for drinking; for, when so used, it produces sickness and diarrhœa. These streams, especially after heavy rains in the summer time, are discoloured with peat, and if used for washing, stain the coarsest linen and dim the bright colours of printed goods. This water is also bad for making tea, and spring water of a somewhat *harder* character (about 4 degrees of hardness) is used in preference for this purpose; because, as the inhabitants express it, such very soft water draws out the leaf of the tea, and spoils the flavour.

It may be noted that M. Soyer (p. 66 of Report) states as the result of his experiment upon tea making, that "the softest or distilled water had an "extraordinary power in obtaining a quick extract; *the result showed* "*perhaps too high a power, for it draws out the woody flavour.*" It is some years since my attention was first practically drawn to the fact that water might be too soft for the making of tea, and M. Soyer's evidence accords with popular experience in this respect.

It may not be out of place to mention here that carbonate of soda, when added to a solution of tea, deepens the colour of the tea, without either improving the flavour or the strength; any one may prove this by pouring out a cup of tea and separating it from the grouts; if a small quantity of carbonate of soda be added to such a solution, the colour will be sensibly deepened, although it is quite evident that the strength of the tea is no greater after the addition of the soda than before. This fact may account for M. Soyer stating (p. 67 of Report) that the water procured from the deep well of the Reform Club and Trafalgar Square fountains (both of

which waters contain a quantity of carbonate of soda) ranks number one for tea making; M. Soyer being doubtless misled by the *colour* of the infusion. His taste, being habituated to a water containing soda, would not be offended by the taste of this alkali.

As we see, then, water may be "soft" and free from organic matter, and yet, from the presence of a large quantity of alkaline salts, be unfitted for nearly all domestic uses. Water may also be "soft" from the almost entire absence of salts, and yet from its high extractive power be unfitted for tea making, while such water, especially in summer, when collected from the drainage of land covered with peat, or even vegetation of any kind, takes greedily in solution organic matter, which renders it unwholesome for drinking, and, when discoloured with peat, quite unfitted for washing purposes.

It is only when "soft" water is free from alkaline salts, and devoid of organic matter in solution, that it can be considered as fitted for domestic purposes. Spring water issuing from the millstone grit, and other primitive formations, is often of this character; but the soft surface water collected in reservoirs, and used to supply Preston, Bury, Ashton, and other towns in Lancashire, is not good drinking water, owing to its containing, in the summer, organic matter; and it is a pity, that when Dr. Sutherland was directed to make his "local investigations" in Scotland and Lancashire (page 111), that he was not instructed to enquire particularly into the amount of organic matter contained during autumn and summer weather in the "soft" water collected in reservoirs for the use of town populations; had he done so he would have discovered what is well known to all practically acquainted with the subject—that the great bulk of such waters, at these seasons, are impregnated with organic impurities.

The term *hard* water is equally indefinite as *soft* water. "Hard" water may be "hard" from holding in solution (as explained in the body of the Report) a certain amount of either lime salts or magnesian salts, and the character of a lime salt, or magnesian salt, again varies according as it may be combined with carbonic acid, on the one hand, sulphuric acid, nitric acid, or any other acid, on the other hand. The quality and adaptation of a "hard" water for domestic purposes is very different, according as it may be "hard" from the presence of magnesia or lime, or of both these salts; so that it is only by knowing the amount and character of the mineral matter from which a water derives its "hardness" that its wholesomeness or unwholesomeness, and its adaptation for domestic purposes, can be predicated.

Again, "hard" water may be contaminated, especially when warm, with excremental or organic matter in solution, although it is not so readily poisoned with these impurities as "soft" water when free from alkaline salts.

To give a practical illustration: spring water derived from wells sunk

in the chalk, the bottom of which are *above* the level of the sea, contain in solution about 21 grains of saline matter per gallon, 18¼ grains of which are bicarbonate of lime, and less than one-half of a grain of carbonate of magnesia. This water, by mere exposure to the air in deep reservoirs, parts with a portion of the carbonic acid, which enables it to hold lime in solution, and thus without difficulty loses in ten or twelve days 4 or 5 grains of lime per gallon, and although it is even then what is popularly termed a "hard" water, it is admirably adapted for most domestic purposes. It is an excellent water, and most highly esteemed by the inhabitants supplied with it for *drinking* purposes, owing to its *entire freedom from organic impurity* and the *wholesome* character of its chief saline constituent — bicarbonate of lime. It is also *admirably* adapted for making tea, perhaps *excelling any other water in this respect.* The reason is that such water upon being boiled rapidly parts with its carbonic acid gas, the lime is precipitated on the side of the tea-kettle or boiler, and in a very short time is almost freed from the lime it held in solution and becomes a soft water, varying from 4 to 5 degrees of hardness; such water in a boiling state is the best adapted for tea-making, *because it does not draw out the leafy or woody flavour of the tea, and yet extracts the whole of the aroma contained in the tea-leaf;* this water, as far as relates to its saline constituents, is very similar to the New River, the Thames, and the Lea water, which waters also soften in a similar manner upon boiling. In M. Soyer's experiments upon tea making, published p. 67 of Report, this ingenious person states, that next after distilled water (which it must be remembered he also remarks, "*draws out the woody flavour of the tea*"), the New River water stands in excellence for tea-making, and those who have any extensive experience upon the quality of water containing bicarbonate of lime in solution, know that this water is everywhere highly esteemed, and considered a first-class water for tea making.

The great bulk of the water used for washing clothes is boiling water, which, as we have seen in the case of the Thames and New River water, softens by the process of merely boiling, while various expedients are resorted to, such as soda, and a kind of powder, termed washing powder, to soften the cold water used in washing clothes. That a soft "water" when cold, containing but 3 or 4 grains of chalk per gallon, or of 3 or 4 degrees of hardness, consumes less soap, and is more agreeable to use, may be readily acknowledged, but the evidence on which the use of soft water is recommended by the Board, is made ridiculous by its exaggerations; for instance, Mr. Stirrat (page 110 of Report) says, "In "Liverpool the water is very hard;" I could wash at home (Paisley) as well "*without soap*, as at Liverpool *with soap.*" At page 79, it is stated that "A lady recently come to reside in London has found the difference "in the quantities of soap and soda required to wash the clothes of the

"same household. In the country rain-water was used, in London water "from the Chelsea Water Works is used.

COMPARATIVE COST.

Material and Labour.	Country, with soft water.			Town, with water from Chelsea Water-Works.		
		s.	*d.*		*s.*	*d.*
Soap	½ lb. at 6*d.* =	0	3	1½ lb. at 6*d.* =	0	9
Soda	¼ lb. at 1½*d.* =	0	0⅜	1¼ lb. at 1½*d.* =	0	1⅞
Labour, say	. . . . .	5	0	. . . . .	10	0
		5	3⅜		10	10⅞

At another portion of the Report (page 237), it is stated, "We have "been unable to determine how much of the dust which penetrates book "cases, collects on all kinds of household furniture, and befouls the linen "and the person in the metropolis is composed of this road dust, and how "much of soot" (a nice subject for enquiry). "But the compound cer- "tainly occasions clothes and linen to be dirtied *at least twice* as fast as in "the rural district, or, in other words, subjects the population to a "*double expense* to obtain the same amount of cleanliness." Again, at page 80 of Report, the Board say, "Persons engaged in washing linen "on a large scale, state that it is dirtied in the crowded parts of the "metropolis *in one-third* the time in which the like degree of uncleanliness "would be produced in a rural district." Now, if the above last quoted extracts be true, the extra amount spent upon soda and *labour*, by the lady when residing in London, compared with the country, is at once accounted for, without any reference to the "hardness" of the Chelsea water.

(F.)

SUPPLY OF WATER TO THE METROPOLIS.

A CHRONOLOGICAL SUMMARY OF THE THIRTY YEARS' WAR BETWEEN THE PEOPLE OF LONDON AND THE PRESENT SYSTEM.

"In 1820 the war cry was raised, and

"In 1821 hostilities were commenced by the appointment of a Select Committee of the House of Commons to inquire into the subject. The Committee, after investigation, reported that the system of the supply of water was not subject to the usual laws which govern supply and demand, and that it 'indispensably required legislative regulation;' but '*no legislative regulation*' followed;—AND SO ENDED THAT CAMPAIGN *.

* Second Report, Health of Towns, p. 75.

"In 1827 the people of London were again in arms, and accordingly,

"In 1828, 'Commissioners were appointed by his Majesty to enquire into the state of the Supply of Water in the Metropolis.' They investigated, and concluded an elaborate and able Report, with a record of their opinion, 'that the constant and abundant supply of pure water is an object of vital and paramount importance to the inhabitants of this vast metropolis; that the dispensing of such a necessary of life ought not to be altogether left to the unlimited discretion of companies possessing an exclusive monopoly of that commodity; and that the interests of the public require that, while they continue to enjoy that monopoly, their proceedings should be subjected to some effective superintendence and control.'

"This Report, together with a petition from the inhabitants of the western parts of the Metropolis, was referred to a Select Committee of the House of Commons, which, after further investigation, concluded with a recommendation, 'that Mr. Telford should be employed to make the requisite surveys to enable him to recommend a practicable and efficacious plan of supplying the whole of the Metropolis with pure and wholesome water;' but *no 'effective superintendence or control' was provided*, nor was anything heard of Mr. Telford or his plan until the year 1834;—AND SO ENDED THAT CAMPAIGN *.

"In 1834 the people of London, having recruited their forces, again made head against the present system, and another Select Committee of the House of Commons was appointed, to whom was referred Mr. Telford's Report. The Committee examined witnesses, 'but the lateness of the Session having precluded them from bringing the enquiry to a close, they recommended the renewal of the Committee in the then next Session;' *but the Committee was not renewed;*—AND SO ENDED THAT CAMPAIGN †.

"In 1840 the people of London again took the field; a Select Committee of the House of Lords sat and heard evidence, but separated without making any Report; no remedial measures followed;—AND SO ENDED THAT CAMPAIGN ‡.

"In 1844 sanitary regulations occupied much of the public attention, and active measures were resumed by the appointment of a Royal Commission to enquire into the Health of Large Towns. The Commissioners, to use the words of an accomplished writer, 'accumulated evidence of a want of water in the dwellings of the poor absolutely frightful,' and they wound up an elaborately-detailed Report by a record of their opinion, 'that to improve the operation of the present system, it would appear to be necessary that the Legislature should enable the Water Companies to raise additional funds for the improvement of their works, and as far as practicable protect them from ruinous competition; and on the part of the

* Report of Commissioners, p. 12. (Printed 21st April, 1828.)
† Report of Committee, p. 4. (Printed 19th July, 1828.)
‡ Report of Committee, p. 3. (Printed 7th August, 1834.)

public it may be fairly required that the system of supply should be greatly improved, and a more regular and liberal supply insured to the poorer classes;' *but no measure followed 'to insure a more regular and liberal supply to the poorer classes;'*—AND SO ENDED THAT CAMPAIGN *.

"In 1848 the approach of the Cholera was announced, and the attention of the public was once more called to the water supply, and a plan was perfected and,

"In 1849 submitted to Parliament by a Joint Stock Company—the London and Henley Water Works and Navigation—to pour through every dwelling in London a continuous flow of water; the Bill was course opposed by the Water Companies, and having been thrown out on second reading, all investigation into the real merits of the plan was prevented;—AND SO ENDED THAT SKIRMISH.

"In the summer the Cholera did make its appearance, and with such virulence that the public were startled into active measures. Coroners' juries by their verdicts, public meetings by their resolutions, the press by its able articles, all sounded the war cry, and accordingly, Metropolitan Water Associations, Parochial Water Associations, and Joint Stock Companies, were formed, and various plans for improving the present system, and also for substituting a new and better system, were devised and matured for the consideration of the legislature, and so

"In 1850 the campaign opened, and the contest was ripe for decision;—but investigation is still the order of the day;—the question is now subjected to a new inquisition;—the Board of Health has it under consideration; and the people of London, taught by bitter experience, naturally dread another fruitless Report, instead of an Act of Parliament, and that so, THIS CAMPAIGN, like its predecessors will terminate WITHOUT ANY PRACTICAL RESULT."

The above statement was circulated at the commencement of this year by the promoters of the Metropolitan Water Works (or Henley-on-Thames and London Aqueduct) Bill. Not only has their prediction been fulfilled that the Parliamentary Session of 1850 would close without any practical measure being carried, for procuring a purer and further supply of water to the metropolis, but the effect of governmental interference has only been to hinder private enterprise from remedying those evils. Although the Government and the legislature *by wisely and well-considered general regulations* can effect much good, all experience proves that whenever the Government attempt to execute detailed works of any description, they invariably and signally fail. This is practically exemplified in the government dock yards, the government establishment for the repairs of marine steam engines, and the manufacture and repair of marine steam engine boilers and machinery, as well as at the government arsenals, in all of which places the miserable results of governmental management, as compared with private enterprise, is well exemplified.

* Report of the Commissioners, p. 75.

(G.)

DETESTATION OF THE "REGULAR" PRACTITIONER BY THE BRITISH COLLEGE OF HEALTH AND THE GENERAL BOARD OF HEALTH.

"No case—abuse the plaintiff's attorney."—*A Brief of Mr. Brougham's.*

"In point of fact, doctors have, for their profit, misled the people on this question of public health. Whether their practice in not using purgatives was aimed as a blow at the British College of Health we know not, but we can tell them that it has very little effect, for the people will *now enquire*, and enquiring, they are sure to find out the *truth*. No doubt doctors have reaped a rich harvest out of the cholera by frightening people, but we do not envy their gains. Heaven and earth cry aloud for justice on behalf of the people in this question !! Who was it that headed the temperance cause, from which so many thousands have been rescued from death and misery?—NOT the doctors ! Who was it that liberated alleged lunatics from their prisons?—Not the doctors ! Who was it that protested against the grave-yard nuisance?—*Not* the doctors, for they live by *disease* and not by *health!!* All these great measures have been obtained by the people, the doctors held on as long as they could against them ! ! Who was it that introduced the deadly poisons, in order to prop the Guinea trade, by which so many have been sent into the next world? —Why the doctors !"—*British College of Health.*

It is impossible to answer any of the following base insinuations of the Board, because the persons attacked are not named.

At page 166 we find it stated—"The evidence of the same professional "witness has been given before one Parliamentary Committee in favour of a "constant supply, and before another against it—advocating in the latter an "intermittent system. Another witness has in different committees during "the same session of Parliament given evidence in favour of a supply "obtained by pumping from the red sandstone, and even from limestone, "in preference to a collection from gathering grounds; and in another "committee he appears as a witness for a scheme of supply by gathering "grounds as opposed to one for pumping; *and opposed, not according to* "*any essential or real variation in the necessities of the case, but according* "*to the incident of the retainer.*" (!!) At page 168 it is said—"These eco- "nomic as well as engineering failures, we find generally result from "the *trading* habit amongst persons who promote and then undertake "such works of resolving all doubts on the side of expense. This is "ascribable to the circumstance that failure on the part of payers, whether "shareholders under a private Act, or ratepayers under a Corporate Act, "is no failure to the professional and *trading* promoters of such works, "who are commonly benefited, indirectly as well as directly, in propor- "tion to excessive expenditure." (!!) Again at same page—"The like state "of empirical knowledge, supplying motives *to cover* ignorance, or resolve "all doubts on the side of expense, has extensively prevailed in respect to "drainage works." (!!) At page 272 it is stated—"To sanction the invest- "ment of new capitals for the introduction of new works, whilst there "are existing works capable of rendering the service as well, or nearly "so, and at reasonable prices, is merely to give a licence to the enterprise

" of professional persons, *who gain in any event, even in that of great* " *public loss.*" At page 60 we find it stated—" But for the *obstinate pre-* " *judice of professional men and builders in favour of the most expensive* " *materials*, (!!!) *earthenware would have been manufactured and used for* " *the distribution of water.*"

(H.)

THE MODE IN WHICH EVIDENCE IS MANUFACTURED TO SUPPORT THE PURPOSES OF THE BOARD OF HEALTH.

In a work lately published by Mr. Toulmin Smith *, attention has been specially called to the mode in which evidence is manufactured in order to make out cases in support of the foregone conclusions of the Board of Health and other central boards. I applied to that gentleman to know if he could point out any special instances which would illustrate the subject of the present Report, and was favoured by him with the following reply.

" HIGHGATE, 31ST JULY, 1850.

" MY DEAR SIR,—

" I shall be happy to afford you any assistance in my power towards making the public understand the manner, equally unconstitutional and dangerous, in which it is now being systematically attempted to annihilate the power and spirit of individual and joint enterprise, and of local self-government, and to bring everything within one swallowing vortex of an all-grasping ravenous centralization.

" You ask me as to the mode in which evidence (as it is called) is got up by the Board of Health, and allude to some passages in my book on " Government by Commissions," bearing upon this subject. I think the most satisfactory answer I can give to your questions, that it may be obvious that the answer is not now made to suit your purpose, will be by referring you to specific facts and passages which I have already put in print.

" In my work on Government by Commissions, I enter, at full length, into what is the only constitutional and legal method of making inquiries into all and any matters affecting person and property, which are the matters peculiarly affected by all the modern central boards. Among other principles I have there demonstrated that one rule is (p. 159) " that no " *inquiry* or adjudication can be made except in open court, whither all " persons may resort, and in no chambers or other private places." This is a

* " Government by Commissions illegal and pernicious. The Nature and Effects of all Commissions of Inquiry and other Crown-appointed Commissions; the constitutional Principles of Taxation; and the Rights, Duties, and Importance of Local Self-Government. By J. TOULMIN SMITH, Esq., Barrister-at-Law." Sweet, Chancery Lane.

fundamental principle; the most important one to the prevention of wrong; and affords the only means by which the manufacture of *ex parte* evidence can be effectually checked. Any system which disregards this principle must necessarily be set down as adopted for some *other* purpose than the getting at the truth. Not entering now into other collateral requisites to the obtaining of *true* evidence, and the prevention of *ex parte* manufactured evidence, I will proceed at once to the method adopted by the Board of Health, and by the body which was used as the principal machine for fixing that board in its place.

"On pages 212, 233, &c., of my work you will find some general illustrations of the system of manufacturing evidence, now so extensively employed under the centralizing policy which is being daily more and more fastened upon this country. Those illustrations refer to other boards. I now confine myself to your immediate topic.

"All the evidence taken by the body called "the Metropolitan Sanatory Commission" (the most active members of which are identical with the owners of signatures to the Report on water-supply of the Board of Health, and which commission constituted the machine above mentioned), was taken illegally, in secret, and in private chambers, to which the public was not admitted, and where there was no opportunity of cross-examination, and from which no evidence taken was allowed to go forth to the world but such as suited the purpose of the secret crown-appointed board. (See "*Government by Commissions*," p. 185, &c.) The case is exactly the same now with the Board of Health; and of course, by such means, any case whatever can be easily made out; and the only wonder is that the case sought to be made out in the Report on Water-Supply is so transparently self-contradictory, incomplete, and absurd.

"I can speak, from actual experience, of the mode of conducting examinations in these secret chambers, and by these secret crown-appointed boards; of how the person examined is sought to be entangled and entrapped into admissions which may, when convenient, be represented as "evidence" given by him, although what he really intended to say, and did urge, was precisely the reverse. I shall quote from the before-named work upon this subject (see page 220).

"'I am enabled to speak, from personal knowledge, of the way in which '*ex parte* statements are foisted on the public by such bodies, and in which '"evidence" is manufactured. On the 28th of April, 1848, I was ex-'amined for upwards of five hours, before this commission. The examination 'was so conducted that I felt it absolutely necessary, on the following morn-'ing, to protest against it as at variance with the spirit of impartial in-'quiry, and calculated to present an erroneous view of my statements and 'conclusions. The determined attempt from beginning to end was to 'extract admissions in support of the *ex parte* case eagerly sought to be 'made out. *I was stopped, rudely and peremptorily, when I sought to ex-'plain points on which artfully-framed questions would necessarily lead to a*

'*misunderstanding of my reply without explanation.* I have already stated, 'publicly and in print, that I had certainly not before conceived it possible 'that, under the name of an *inquiry*, an examination of a witness could, 'vicious as the system is, be made so entirely *ex parte*, and so completely 'calculated to smother the truth, and prevent its full and fair investigation. 'No retained counsel, with counsel on the opposite side to cross-examine, 'would be allowed by any judge to put such directly leading questions, 'and to attempt such an entire prejudicing of the case to the jury and the 'public, by laying down, under the name of "questions," absolute pro-'positions and positive allegations relating to the very subject-matter of 'inquiry. The want of power of perception of logical connection, and of 'that first essential to the discovery of truth—the clear apprehension of 'the difference between accidentals and essentials—was, in the greater part 'of the questions asked, as marked as was the want of any real knowledge 'of the subject; both which wants were supplied by a very unhesitating 'begging of the question upon every point.'

"In the same work (p. 359), I give some extracts from my examination on this occasion; of which, with great difficulty, I obtained a copy, though not a word of it has ever been given to the public, except by myself. These extracts illustrate the above remarks, and it will be sufficient for me to refer you generally to them. I will only now call your special attention to the answer which I gave to one question, which will show you that I then and there expressed myself as emphatically to the face of this pretended 'commission' as I have ever done elsewhere, or in any other way.

"A question was asked me which begged every point. After I had stated that I did not admit a case so stated to be a fair instance, it was thus put:—'*Supposing it to be so, supposing* all the rest of the courts and alleys to be in the like condition, or nearly so, (!!) occupied by the labouring population, in that state of filth, and with that subdivision of tenements, *that* in your mind would afford not the slightest ground for doubt, either as to the state of administration or the sufficiency of the law?' To this I gave the following reply:—'That is quite a different thing. You first make a postulate, and then ask my opinion. I do not admit the postulate. I cannot have my evidence asked for, and then a set of postulates stated, *not one of which I admit.* UPON PREMISES WHICH ARE NOT CORRECT YOU MAY FOUND ANY CONCLUSION WHATEVER. I utterly deny and dispute every one of these postulates. * * * * * *Such sweeping assumptions merely amount to a total denial of evidence.*'

"You will, perhaps, think it to the point if I close this rather long letter by quoting one or two more of the remarkable *begging-the-question* interrogatories put to me on the above occasion, as specimens of the mode in which the *water* subject is dealt with by these secret crown-appointed commissions, when setting to work to make out a case for central interference. I give the questions, together with my answers. Neither have

been yet published. I should state that the 'inquiries' alluded to in the questions themselves constitute one of the most extraordinary instances on record of the unblushing effrontery with which unscrupulous and hungry partizanship will seek to get up a case. I have alluded to it on p. 225. These so-called 'inquiries' themselves have not a shadow of trustworthiness belonging to them.

"'*Q.* Supposing the area to be constituted, and the local authority appointed, have you consulted the evidence of former inquiries with relation to the expenditure on local works? Take the statements and answers from the towns to which such inquiries have been directed. It appears that in only six instances could the arrangements and supplies be deemed in any comprehensive sense good, while in thirteen they appeared to be indifferent, and in thirty-one so deficient as to be pronounced bad; and, so far as it was examined, the water was frequently inferior in purity.'

"'*A.* I have directed my attention to most of these matters generally.'

"'*Q.* That is a Report upon an examination of the water-works of the country; *that being so*, that, in thirty-one instances out of some fifty, the money which has been laid out and invested in water-works may be said to have been thrown away. If Parliament is giving authority for a new expenditure, *consulting such experience as that*, (!!) is not it a duty to guard against future waste by the like local authorities who committed the waste here reported?'

"'*A.* Undoubtedly that is a duty; but it seems to me that you might just as well pass an *Act of Parliament* that steam-engines should not be made upon a certain principle.'

"'*Q.* Does not that waste, in the majority of instances, suggest a high and superior duty to Parliament, to take care, in issuing new powers of expenditure, that they are not attended with the like waste for the future?'

"'*A.* Undoubtedly Parliament should constitute powers in such a way that waste should in the least possible degree take place; but no human being can define the word *waste*.'

"'*Q.* Do you think that it passes human intelligence, or legislative intelligence, so to provide, as that out of fifty grants of powers, two thirds, or thirty-one of them, shall not be waste and loss? Do you consider it quite impossible to diminish the waste, if it be utterly impossible to prevent it entirely?'

"'*A.* It may be what persons living at one period may consider to be waste. Parliament has been existing for a great number of years; it has been continually, from time to time, issuing, to the best of its "legislative intelligence," powers for the very works now denounced as so bad, and has considered that it had the requisite wisdom to do it. But we find that what has been done in former years has become, by the improvements of modern science, imperfect; and so we shall go on to the end of the chapter.'

" You will not, I think, be surprised that this secret crown-appointed Board has not thought it well to publish, up to the present day, the evidence which was thus given by me before it upwards of two years ago. It consists of thirty-six closely printed folio pages; but would by no means help the object of those '*cases*,' which (like all other *Commissions of Inquiry* and *General Boards*) that Commission and the present 'Board of Health' have it as their business to '*get up*,' for the misleading of the public, under the imposing title of '*Official Reports*.'

" I remain, my dear Sir,

" Yours faithfully,

(Signed) " J. TOULMIN SMITH.'

" S. C. HOMERSHAM, ESQ., C.E."

(I.)*

After the text of my Report is in type, I observe in p. 321 of the Board's Report that they say, " The saving in soap from the use of soft " water, in the operation of washing . . . . . would be probably (on the " population of the metropolis) equivalent to the whole of the money ex- " pended at present in the water-supply." From which we infer, that about 400,000*l.* worth of soap is saved (see p. 36 of my Report.) Now since, according to the Board, p. 284, one-half of the soap is saved, the whole soap consumed would be 800,000*l.* worth, according to the Board, or but a little above one and a half of the higher quantity, 540,000*l.*, or double the lower quantity, 432,000*l.*, given in evidence to them†. The careful reader will not fail to observe, that the saving in soap, according to the Board, is very near equal to the whole soap now consumed, according to so excellent a practical authority as Mr. William Hawes (432,000*l.*). Again, if 500,000*l.* per year is the total saving by soft water, according to the Board, and 400,000*l.* their saving in soap, the difference 100,000*l.* is produced by saving two-fifths of the tea now consumed, and in other culinary operations " in like proportion." Calling this a saving in tea alone, the whole tea consumed in London would be 250,000*l.* worth, or about one million of pounds weight, or half-a-pound weight per head per year, which is probably less than a quarter of the true quantity.

In the text of my Report I have argued as if the

Whole soap consumed were	500,000*l.*	instead of	800,000*l.*
The soap saved were	250,000*l.*	„	400,000*l.*
Tea, &c., saved	250,000*l.*	„	100,000*l.*

The numbers in the text are much the more feasible; but I have not thought it worth while to change them, because the change would only put

* See pages 11–15 of my Report. † See page 11.

the Board a little farther in the wrong; but I have made this note in order to show how difficult it is to gather any precise or accurate statement from the Report of the Board.

(K.)

At page 14 of the Report, the following remarks occur:—"*At the opening of the investigation an array of witnesses was presented, on opposite sides*, offering testimony of a most conflicting character. On the one side were consumers of water, resident chiefly in the poorer districts, complaining of the essentially bad quality of the water delivered into the metropolis by the trading companies, and, in proof of the truth of their allegations, producing specimens of dark and foul water, abounding in visible animalculæ; *on the opposite side were the officers and witnesses on behalf of the water companies*, asserting the entire untrustworthiness of the testimony on which such complaints were made, maintaining as unquestionable the purity of the water supplied by them, alleging, indeed, that it is of unexampled excellence, *and presenting specimens with the analyses of eminent chemists.*

"At the first view of this conflict, the impression might be entertained that *there must be misrepresentation, and even mendacity, on the one side or the other;* and as *much of the opposition to the companies evidently originated with the promoters of rival schemes*, the testimony of their assailants was open to the *primâ facie* suspicion of fabrication." Again, at page 15, it is stated—"Accepting and believing the respectability and intended veracity of the directors, officers, and witnesses of the companies."

Any one reading this portion of the Report could hardly come to any other conclusion than that "the promoters of rival schemes," the "directors," "officers," and "witnesses of the companies," new as well as old, to say nothing of the "public," were not only heard and examined, but, notwithstanding their "respectability" and "intended veracity," they gave such evidence as made the Board suspect them of "misrepresentation" and even "mendacity."

I know, and am authorized to state, that the promoters of the rival schemes that were before Parliament, and the directors, officers, and witnesses of at least three water companies, and I have reason to believe the whole (with, perhaps, the exception of the Grand Junction and Southwark Companies), gave no evidence whatever to the Board as to the purity of their waters; and every one knows the public were never invited by the Board to hear or to give any evidence on the quality of water supplied to them. On the contrary, the very nature of their scheme was kept a profound secret, and their examinations of witnesses were private and one-sided.

(L.)

EARTHENWARE PIPES.

At page 60, and other portions of the Report by the General Board of Health on the supply of water to the metropolis, earthenware pipes are recommended to be used for the distribution of water; and professional men are blamed for not using this material for such a purpose, as if it were possible to prevent its introduction for general use if adapted for the uses proposed. Every possible contrivance, for some reason known to themselves, has been used by the Board, and the late Metropolitan Sanitary Commission, to *force* the introduction of this material. At page 428 of the first Report and Evidence of the Metropolitan Sanitary Commission (published 1847), J. Billing, Esq., among other things, is stated to say, in answer to the following questions:—

"*Commissioners.*—Did you find earthenware pipes in use and in course "of introduction anywhere for the distribution of water?—Yes, at "Ashton.

"*C.* That is to say, under the constant system of supply at a pressure "of 150 feet, was it not?—Yes.

"*C.* Will you describe the material and the sizes of the pipes?—The "pipes were of a common coarse fire-clay, 3 inches in diameter, and three "quarters of an inch thick, with sockets joined with Roman cement; "from these were one-half inch pipes for the house supply."

On reading the above evidence soon after it was published, I was much surprised to find such a statement, for I knew the Ashton Water Works Company had no earthenware pipes in use for the distribution of water for domestic consumption; but supposing there *must* be some foundation for the statement, I requested Mr. Hibbert to ascertain if earthenware pipes were used by the millowners, who raise water from the river Tame for condensing purposes, and received the following answer:—

"Water-Works Office, Ashton-under-Lyne,
"2nd August, 1850.

"Dear Sir,

"In reply to your letter of the 31st ultimo, relative to the use of earthenware pipes in this town for the distribution of water, I beg to inform you that there are no earthenware pipes in use here for that purpose, either by the Water Works Company, or by the millowners, who pump water from the river for condensing purposes. I have had many inquiries from various parts of the country of a similar nature to yours, and in some instances reference has been made to the Report of the Metropolitan Sanitary Commission, where, I understand, it is stated that such pipes are in use here. This, however, if so stated, is erroneous.

"Believe me, dear Sir, yours faithfully,
(Signed) "HENRY HIBBERT, Secretary."

"S. C. Homersham, Esq.
"19, Buckingham Street, Adelphi, London."

(M.)

ORDNANCE SURVEY OF THE METROPOLIS.

At the commencement of the year 1848, it was determined by the Metropolitan Commissioners of Sewers, two out of the four of the present members of the General Board of Health being then active members of that Board, to procure a block-plan and levels of London extending about eight miles round St. Paul's; the execution of this work was entrusted to the Ordnance Office. Referring to this subject, it is stated in the Report by the General Board of Health on the supply of water to the metropolis, page 303—

"According to an estimate of some civil engineers, the execution of this "measure was to cost a quarter of a million of money, and according to "another was to have required an expenditure of 100,000*l*., and have "occupied between six and seven years in its completion. By the elimi- "nation of non-essential work, and the postponement of details not imme- "diately necessary, *the survey is in a fair way to be completed in about "one-third the time, and at little more than a quarter the expense originally "estimated*, and it may now be made the means of extensive economics."

The accusation in the above extract against "some civil engineers" renders it impossible to meet it fully, but the following petition by the Surveyors' Association, adopted unanimously at a meeting held in London, on the 19th of April, 1850, authoritatively answers the allegation made by the Board.

"To the Honourable the Commons of the United Kingdom of Great Britain and Ireland in Parliament assembled, the humble Petition of the undersigned Land Surveyors respectfully

"Sheweth—That your Petitioners, a large and useful class of Her Majesty's subjects, desire to make known to your Honourable House certain grievances under which they are suffering.

"That the Scientific Branch of the Ordnance Department, a purely Military body, and instituted for the purpose of constructing and maintaining the National Defences and superintending the Government Surveys, by extending its operations to local and private Surveys, has now assumed a position which, interfering with the legitimate work of your Petitioners, threatens to completely supersede them in their rightful employment.

"That your Petitioners have reason to believe, that the Government and Local Authorities have been greatly prejudiced against them, by evidence tending to show that in the case of extensive Surveys, the work of the Ordnance Surveyors is more cheaply, more speedily, and more correctly executed, than that of your Petitioners. With reference to the first, your Petitioners beg respectfully to call your attention to the returns of the expenditure of the Ordnance, presented to your

Honourable House, which show the cost of the Survey of Ireland to be 10*d.* per acre; that of the six Northern Counties of England, 1*s.* 4½*d.* per acre, and of part of Scotland (surveyed in 1847), 1*s.* 6*d.* per acre, for maps drawn upon the small scale of 13 chains to an inch, neither showing minute details, nor furnishing quantities and references of the separate inclosures. Whereas the first-class maps of Parishes surveyed by your Petitioners, for the purpose of Tithe Commutation and Poor Rate assessment, have not exceeded an average cost of 11*d.* per acre, although drawn upon the larger and more useful scale of 3 chains to an inch, showing every detail. With reference to the second, as to time, it appears almost unnecessary to direct the attention of your Honourable House to the case of the Metropolitan Survey, subsequently alluded to. And as to accuracy, it will be, it is hoped, sufficient to refer to the number of first-class maps executed by your Petitioners, and tested and verified by the Tithe Commissioners.

"That the inhabitants of the north of England and Scotland (whose numerous memorials testify the necessity for the national surveys being completed) are seriously complaining of the injury they suffer by the abstraction of the Ordnance Force from those surveys, which, having been authorized by Parliament, and made chargeable upon the national funds, ought to be completed at once.

"That in the spring of the year 1848, the Ordnance Department having furnished to the Metropolitan Commissioners of Sewers an estimate for a block-plan and levels of London, amounting to 19,945*l.*, exclusive of 4,270*l.* for the triangulation, and the large additional cost of the military pay of the parties employed, *received instructions to proceed with the work, upon the understanding that they could complete it within six months, as the Commissioners of Sewers had previously passed a resolution in the same year, stating that even one week's delay in the sanitary improvements would involve a loss to the public equal to that large sum.*

"That the estimates of the Ordnance Department hitherto doubled in every case, and often nearly trebled, by their actual expenditure, as stated in their own returns, were equally erroneous in this instance, as was predicted by your petitioners—*the survey being now incomplete, although a period of* TWO YEARS *has elapsed, and the drainage of London has been delayed in consequence.*

"That your petitioners acting in concert, and upon an uniform system, under the title of 'The Surveyors' Association,' were very desirous to perform this work, and submitted to the Commissioners of Sewers a memorial and estimate, *undertaking to complete it correctly in* SIX MONTHS, *or suffer heavy penalties, and to give approved security that they would do so for the sum of* 18,200*l.* (*being many thousand pounds less than the expenses incurred by the Ordnance*), *and that, previous to payment, their maps were to receive the approval of examiners properly qualified to test the same;* and your Petitioners humbly assure your Honourable House,

that had they been entrusted with the survey, there is no reasonable doubt they would have fulfilled their contract, and the Commissioners of Sewers would have been in possession of accurate data upon which to found their calculations before the end of the year 1848.

"That more recently, viz. in 1850, the Commissioners of Sewers determined to fill in the details of this block-plan, and that your petitioners, through the Surveyors' Association, then applied for permission to compete for the same, but were informed that the Commissioners had already made exclusive arrangements for the execution of this more strictly civil work.

"And your petitioners therefore humbly pray your Honourable House to avert the ruin with which they are threatened, by withdrawing the Ordnance Surveyors from local works and replacing them upon the National Survey, which will fully occupy them for many years to come, and from which they were removed to survey the Metropolis, and for other civil work, to the great disadvantage of the public, and the injury of your petitioners, who have thus been deprived of their employment, while they have to contribute towards the maintenance of that body which has so unfairly superseded them.

"And your Petitioners will ever pray."

(N.)

THE SEWAGE OF LONDON.

The following description of the sewage of London is taken (page 57) from a valuable work entitled, "A Microscopic Examination of the Water "supplied to the Inhabitants of London and the Suburban Districts." By Arthur Hill Hassall, M.B., F.L.S., &c. &c. London, Samuel Highley, 32, Fleet Street, 1850.

"In the preceding pages, the word sewage has been frequently em- "ployed; of the nature of this most persons have some general notion; "but it is probable that but few have fully realized to their own minds its "actual and loathsome composition. The sewage of London consists, "then, of the contents of the closets and urinaries; dirty and waste waters "of various descriptions; the washings of our persons and clothes; the "refuse of gas, chemical, and a host of other works and manufactories, "some of which are of the most unclean and offensive description,—as "those of bone-crushers, the makers of glue and catgut, soap-boilers, tan- "ners of leather, &c.; the gore and filth of the slaughter-house, the "knacker's yard, and the dissecting room; the purulent discharges, cata- "plasmata, and other rejecta of the sick of our hospitals. The picture is "already horrid and disgusting enough without further portraiture; it is "proper, however, that, in a matter of so much importance, there should

" be no concealment, but that the truth, the whole truth, fearful and tre-
" mendous as it is, should be known and publicly declared.

" Well, this mingled and manifold corruption, termed sewage, passes
" from the sewer into the Thames, and from the Thames it returns to the
" public.

" Now this is not a mere assertion, but an undoubted fact, admitting of
" demonstration. Thus I have shown that various matters, animal and
" vegetable, connected with sewage, including some of those of the fæces,
" are at all times to be detected in Thames water; and further, that the
" same substances exist in the waters of several of the companies as sup-
" plied to the public: the chain of evidence is complete and conclusive.
" Thus the muscular fibre of the meat, as well as the more indestructible
" parts of the vegetable tissues consumed, have been repeatedly traced from
" the closet to the sewer, from the sewer to the Thames, from this to the
" companies' reservoirs, and from these back again to the public."

(O.)

The evidence of Professor Clark before the Commission on the Health of Towns in 1843, will be found only in the first or folio edition of the Report of that Commission. An 8vo edition, conveniently classified for reference, was afterwards printed for general circulation. In this edition, the Professor's evidence was entirely omitted. His evidence related to the quality of water; it was indeed the only evidence on that subject given to that Commission. But the crotchet *then* was *quantity* not *quality*. Accordingly, in the first place, no notice whatever was taken of his evidence in the Report of that Commission, and, in the second place, it was entirely omitted in the edition of evidence printed at the public expense for general circulation. Nothing was even said of quality. But *now*, when *quality*, and especially *softness* is the crotchet, the evidence is carefully culled to suit the immediate purpose of the General Board of Health.

G. Woodfall and Son, Printers, Angel Court, Skinner Street, London.

THE WATER SUPPLY OF THE METROPOLIS.

On Saturday a deputation waited on the General Board f Health from the Metropolitan Water Supply Association, nstituted to procure to London and its suburban districts a constant supply of pure soft water to all classes. The asso- iation had applied to Sir George Grey to receive a deputa- ion from them, and he had referred them to the General Board of Health.

The members of the board present were Lord Ashley, E. Chadwick, Esq., and Dr. Smith; Professor Owen was also present as one of the metropolitan sanitary commissioners.

Mr. Graham and others having stated the object of the deputation,

Mr. Chadwick said he might, as a member of the sanitary commission, explain to the deputation that before the General Board of Health had been appointed, her Majesty's government had issued a commission, which was called the Metropolitan Sanitary Commission, of which Lord R. Grosvenor was the chairman, who were charged in the terms which he would read to them. It was, that a commission should be issued "for inquiring whether any and what special means may be requisite for the improvement of the health of the metropolis, with reference more particularly to the better house, street, and land drainage, street cleansing, and paving; the collection and removal of soil and refuse; and the better supply of water for domestic use; for flushing sewers and drains, and cleansing streets; and also to the best means of using existing works, and of erecting new works requisite, and of maintaining them in good action; and also to the most equitable provisions for regulating the charges, or assessing, collecting, and paying the moneys requisite for such purposes, more especially in the districts chiefly inhabited by the poorer classes of the population." Of this commission Lord Robert Grosvenor was the chairman. Their first labours were devoted to the investigation of the drainage of the metropolis and the suburbs, on which they had made two reports, recommending various measures, of which the chief were, the consolidation of the several district sewers, and the carrying out a new and general survey, which might serve not only as a basis for future drainage works, but for water distribution, and other connected public works. That survey was, he believed, on the eve of completion, and other works recommended by that commission were in progress. The commission were

HOLLAND.

THE HAGUE, No

BELGIUM.

BRUSSELS, Nov

The Belgian Government intends to erect
telegraphs in Belgium. Mr. Nothomb, the I
envoy at Berlin, has entered into negociati
this subject with Mr. Siemens. The latter
the superintendence of the introduction of the
telegraph in Prussia.—*German Reform.*

PERSIA.

Oct.

The English Consul, Mr. Stevens, has succ
in making peace between the Khans of the
independent tribes Djelly Haideranly and Zi
amongst whom there is almost incessant warfar
Princes Hanza Mirza, Stadtholder of Asserb

The Lloyd.

60,000 Russian soldiers are placed in cantonn
along the railway line from Warsaw to the M
station, ready to march at a moment's notice."