Sewer rivers : minute of Committee on the practicability of purifying the water flowing from the River Medlock into the Duke of Bridgewater's Canal / Manchester and Salford Sanitary Association.

Contributors

Manchester and Salford Sanitary Association.
Smith, Robert Angus, 1817-1884.
McDougall, Alexander.
Calvert, Frederick Crace, 1819-1873.
Royal College of Surgeons of England

Publication/Creation

Manchester : Cave & Sever, printers, 1856.

Persistent URL

https://wellcomecollection.org/works/utj25khc

Provider

Royal College of Surgeons

Wellcome Collection
183 Euston Road
London NW1 2BE UK
T +44 (0)20 7611 8722
E library@wellcomecollection.org
https://wellcomecollection.org

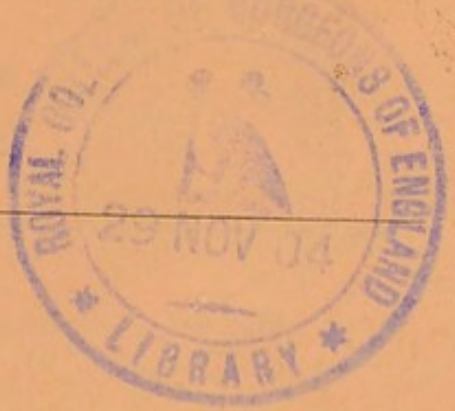
3.

Manchester and Salford Sanitary Association.

SEWER RIVERS.

MINUTE OF COMMITTEE

ON THE PRACTICABILITY OF PURIFYING THE WATER FLOWING FROM THE RIVER MEDLOCK INTO THE DUKE OF BRIDGEWATER'S CANAL.



MANCHESTER:
CAVE & SEVER, PRINTERS, PALATINE BUILDINGS, HUNT'S BANK.
1856.

Manchester and Salford Sanitary Association.

SEWER RIVERS.

MINUTE OF COMMITTEE

ON THE PRACTICABILITY OF PURIFYING THE WATER FLOWING FROM THE RIVER MEDLOCK INTO THE DUKE OF BRIDGEWATER'S CANAL.

MANCHESTER:
CAVE & SEVER, PRINTERS, PALATINE BUILDINGS, HUNT'S BANK.
1856.

MANCHESTER AND SALFORD SANITARY ASSOCIATION.

Committee and Officers for the Year 1855-56.

Patrons.

The Right Honourable the EARL of DERBY,
The Right Honourable the EARL of DUCIE,
The Right Honourable the EARL of ELLESMERE,
The Right Honourable the EARL of WILTON, G.C.H.

President.

The Right Reverend the LORD BISHOP of MANCHESTER.

Vice-Presidents.

The Worshipful the MAYOR of MANCHESTER,
The Worshipful the MAYOR of SALFORD,
The Very Reverend the DEAN of MANCHESTER.

Sir BENJAMIN HEYWOOD, Bart.,
Sir ELKANAH ARMITAGE,
Sir J. BARDSLEY, M.D.,
Sir JOHN POTTER,
J. HEYWOOD, Esq., M.P., F.R.S.,
J. BRIGHT, Esq., M.P.,
J. BROTHERTON, Esq., M.P.,
W. ENTWISLE, Esq., LL.D..
J. KERSHAW, Esq., M.P.,
Colonel CLOWES,
W. FAIRBAIRN, Esq., F.R.S.,
JOSEPH WHITWORTH, Esq., C.E.

Treasurer.

ARTHUR H. HEYWOOD, Esq.

Chairman.

Rev. CANON RICHSON, M.A.

Committee.

Rev. T. R. BENTLY, M.A.,
Mr. D. BELLHOUSE,
Mr. J. BERESFORD,
Mr. E. W. BINNEY, F.G.S.,
Mr. W. BOOTH,
Mr. J. BOUTFLOWER, F.R.C.S.,
Mr. T. F. BROWNBILL, F.R.C.S.,
Rev. C. BURTON, LL.D.,
Mr. F. CRACE CALVERT, F.C.S., M.R.A.T.,
Mr. C. E. CAWLEY, C.E.,
Mr. D. CHADWICK,
Mr. A. Mc. DOUGALL,
Mr. J. DUNN,
Mr. J. FERNLEY,
Dr. E. FRANKLAND, F.R.S.
Rev. W. GASKELL, M.A.,
Mr. G. GREAVES, M.R.C.S.
Mr. J. HATTON, F.R.C.S.,
Mr. J. HENRY,
Mr. I. HOLDEN,
Mr. I. HOLDEN, Jun.,
Mr. J. W. JACKSON,
Rev. W. JOHNSON,
Mr. C. H. KNIGHT,
Mr. J. W. MACLURE,
Mr. Councillor MOTTRAM,
Mr. J. A. NICHOLLS,
Rev. J. N. POCKLINGTON, B.A.,
Mr. G. POWLSON,
Mr. E. REUSS,
Mr. Alderman RADFORD,
Dr. T. RADFORD, F.R.C.P., F.R.C.S.,
Mr. W. RADFORD,
Mr. T. G. RICHMOND, F.R.C.S.,
Mr. M. ROSS,
Mr. S. SALT,
Mr. W. H. SHAW,
Dr. R. A. SMITH, F.C.S.,
Mr. W. SMITH. M.R.C.S.,
Mr. G. FEREDAY SMITH,
Rev Canon STOWELL,
Mr. J. TEALE, M.R.C.S.,
Mr. T. TURNER, F.L.S., F.R.C.S.,
Rev. J. G. VANCE, M.A.,
Rev. H. H. WESTMORE, M.A.

Honorary Secretaries.

Mr. G. BOWRING, M.R.C.S.,
Mr. F. H. WALMSLEY, M.R.C.S.,
Mr. W. ROYSTON.

Collector.

Mr. EASTWOOD,
Leamington Place, Brook Street.

OFFICES,
4, York Chambers, King Street.

MANCHESTER AND SALFORD SANITARY ASSOCIATION.

SEWER RIVERS.

MINUTE of COMMITTEE *(Monday, March 17th,* 1856,) on the EXPERIMENTS made by *Dr. R. A. Smith* and *Alexander Mc. Dougall, Esq.*, and also by *Crace Calvert, Esq.*, in relation to the practicability, or otherwise, of purifying so much of the WATER of the RIVER MEDLOCK as passes therefrom into the *Duke of Bridgewater's Canal* at Knott Mill.

The urgent importance of removing, or at least diminishing the nuisance of the Sewer Rivers of Manchester, has for some time engaged the attention of this Committee.

In a paper read by *Mr. Crace Calvert,* Sept. 11th, 1854, an ingenious mode of facilitating the deposit of the river Medlock, in its curves and angles, was suggested; lime being proposed as a precipitant.

In consequence of this suggestion, a Sub-Committee was appointed on the whole subject of Sewer Rivers, of which *C. E. Cawley, Esq.*, C.E., was Chairman.

At an early stage of the Sub-Committee's proceedings, a paper was read by *Dr. R. Angus Smith*, suggesting a method for preventing the impurities of the sewers from going into the river at all, by precipitating them in reservoirs, "the disinfection occurring in the drains, and so being prepared for precipitation as soon as the sewage reached the reservoir, out of which the water should flow pure again into the river."

Two plans were now before the Sub-Committee; one for purifying the river, the other for acting upon the sewage before it was discharged into the river; but they determined on fully testing, in the first instance, the effect of lime upon the *running stream of the Medlock.*

Considering the quantity of water in motion, they concluded that no portion of the River would afford greater facilities for their experiments, than that connected with the supply of the BRIDGEWATER CANAL.

They accordingly communicated their views to this Committee, *May 7th,* 1855, and received authority to apply to the Duke of Bridgewater's Trustees upon the subject.

Before applying to the Trustees, a detailed and well-defined plan for making the experiments was prepared by *Mr. Cawley.*

The Trustees consented to adopt the plan; and provided the necessary apparatus at their own expense.

The direction and superintendence of the Experiments, involving chemical and analytical questions, were entrusted by the Sub-Committee to *Mr. Crace Calvert, Dr. R. A. Smith, and Mr. Mc. Dougall;* and here the Committee desire to record their high appreciation of the liberality of the *Duke of Bridgewater's Trustees,* and the eminent services of *Mr. Cawley, Mr. Calvert, Dr. R. A. Smith,* and *Mr. Mc. Dougall,* in reference to the experiments, and to *Mr. W. Booth,* in rendering much practical assistance; and to express to them their sincere thanks.

The object of the experiments was not to purify the Canal, but to obtain DATA from which to determine whether or not the water it receives from the Medlock could be purified in its course as a stream. Hence the results, however valuable, in a practical point of view, must be regarded as only preliminary to more extensive operations.

Various causes rendered it inconvenient for the Chemists to make their experiments at the same time; but this circumstance, as furnishing the Committee with separate and independent testimony, is to be considered rather as advantageous than otherwise.

Two REPORTS have therefore been presented to this Committee; one (denoted in this Minute by the letter A) from *Dr. R. A. Smith* and *Mr. Mc. Dougall* conjointly; the other (denoted by C) from *Mr. Crace Calvert* alone.

The arrangements for conducting the experiments must not be considered as exemplifying a perfect and complete mechanical apparatus for the purpose; but only such as the circumstances under which the experiments were to be made permitted.

The following description is given by *Mr. Cawley*:—

"1. The water of the Medlock is admitted into the Canal at Knott Mill, and passes underneath two archways, which support the street, and thence along two basins, underneath the old warehouse; the basins being continuations of those formed by the archways.

"2. The quantity of water so admitted is regulated by permanent sluice gates, placed across the stream, at the higher end of the archways; the water not required passing away through an overflow basin into a tunnel, which conveys it into the river at a point lower down.

"3. The larger of the basins, under the archway and warehouse, was employed for the experiments.

"4. The construction of the apparatus was as follows:—

"i. Two wooden vats, each 13 feet square and 3 feet 10 inches deep, were placed over the overflow basin, and near the side of the river. In these vats, the lime was mixed with water.

"ii. From each of these vats, the solution of lime was discharged at pleasure into a trough, having a perforated bottom, and which extended across the Medlock, at an elevation of several feet above the water.

"iii. About 12 feet higher up the river than the permanent sluices, a dam was constructed across the stream, forming a weir, over which the water had to flow into the depositing basin, and was so placed that the solution of lime, falling from the perforated trough, mingled with the river water, as it passed over the dam.

"iv. To regulate the quantity of water operated upon, a series of slides were fixed along the top of the dam, which could be raised or depressed at pleasure.

"v. At the opposite end of the basin under the warehouse, another dam was fixed across the canal; the top of which was about 8 inches below the top of the dam in the Medlock.

"vi. The space between the two dams thus became a separate basin, about 142 feet long, 27 feet wide, and 8 to 10 feet deep; divided into two compartments of very unequal size, by the permanent sluice gates.

"vii. The water therefore passed over the upper dam, where it received the lime, into the small compartment; whence it passed underneath the permanent sluice gates, into the larger one.

"5. The isolation of the depositing basin was however rendered imperfect; 1st, by the managers of the canal letting the river water into the smaller compartment at times when the experiments were suspended, for the purpose of supplying a water-wheel; and, 2ndly, by the contents of a sewer entering beneath the warehouse.

"6. The lime was mixed in the vats by manual labour."

To save the expense and labour of pumping water from the river, the "*Waterworks Committee*" of the Town Council kindly permitted the use of the town's water gratuitously, to the extent of 30,000 gallons, for which the Committee desire to record their sincere thanks.

The deposit basin, which was the largest under the circumstances that could be obtained, was much too small to test the full value of the experiments: "a large subsiding area, where the precipitate could be kept longer in suspension" (A.) was evidently required.

I.—Experiments at Knott Mill:—

To ascertain the quantity of Lime necessary for precipitation in the apparatus provided.

The effect of the admixture of lime with the river water is thus described (A.):—"When lime is thrown into the river Medlock it produces what may be familiarly called 'curdling,' which results from the formation of a very flocculent precipitate. This precipitate is formed by the combination of the lime with the carbonic acid, organic matter, and other substances held in solution and suspension in the water. It separates into large and distinct portions, which subside very rapidly.

"Careful observations, repeatedly made, show that the precipitate falls at the rate of about 1 foot in 8 minutes, or about 1½ inches per minute.

"When the lime is mixed in the river itself, this curdling can easily be observed, even at the distance of many feet, instantly to take place, and the precipitate is seen hastening to the bottom through the clarified water." (A.)

The following Experiments were made on the Water *as it flowed through the Deposit Basin* into the Canal.

By *Dr. R. Angus Smith* and *Mr. Mc.Dougall.*

"One of our first experiments was to test the greatest rapidity of the current, compatible with complete subsidence of the precipitate in the space allowed us; or in other words, to ascertain the quantity of water which could be clarified in the space, consistent with complete collection of the precipitate.

"We commenced our trials with 125,000 gallons per hour, but found that this quantity did not allow nearly sufficient time for subsidence, the water passing muddy over the dam at the extremity of the basin, taking the precipitate along with it into the Canal. We therefore gradually reduced the quantity to 41,000 gallons per hour, or nearly 1,000,000 gallons per day, which we found to be the maximum quantity allowing of ordinary subsidence in the basin.

"The quantity of lime found to produce instant precipitation without excess or causticity was 17 cwt. for 1,000,000 gallons. The precipitate so made contained no caustic lime; the water ran also free from caustic lime.

"We were desired by the Sub-Committee to use our own powder, called 'Mc.Dougall's Disinfecting Powder,' instead of lime, to compare its efficiency with that of lime; but did not do so, as it would be far too expensive for the treatment of rivers, and could only be used by itself where the liquids were strong solutions. For this reason we used only a small quantity to remove smell and prevent decomposition, leaving the work of precipitation entirely to the lime." (A.)

By *Mr. Crace Calvert.*

Mr. Calvert in his experiments had the help of *Mr. Davies*, one of his assistants, whose acquirements and professional skill he strongly commends.

After six experiments, numbered consecutively, and detailed in the appended report, *Mr. Calvert* arrives at the following conclusions:—

"Experiment vii. By means of 10 cwt. of lime, mixed with 6,620 gallons of town's water:—Gallons of river water purified, 467,606; time, 4¼ hours.

"Result:—Water so far purified that all the impurity was separated as a flocculent precipitate, but all was not deposited before passing into the Canal.

"Experiment viii. 10 cwt. of lime, 6,270 gallons of town's water:—River water purified, 349,634 gallons; time, 4 hours.

"Result:—Water clearer than No. vii., but all impurity not subsided

"The object of this experiment, as also that of Nos. x. and xi., was to try to completely remove the impurity from the water by using excess of lime and diminishing the amount of water. It was found, however, that the Deposit Basin was not long enough to allow all the precipitate to subside, and therefore this trial and Nos. x. and xi. must be considered merely as experiments.

"Experiment ix. 10 cwt. of lime, 5,178 gallons of town's water:—River water purified, 485,944 gallons; time, 4 hours 25 minutes.

"Result:—Similar to No. xii., but rather better." (C.)

For Experiments x. and xi., see report.

Mr. Calvert represents the following as sources of error, in regard to the experiments, for which due allowance must be made in computing the effect of any given quantity of lime upon the water flowing from the River into the Deposit Basin:—

"1st. The imperfect state of the sluice gates, which admitted a constant stream of impure water, between the experiments, into the purified water remaining in the Deposit Basin; thereby rendering it necessary each time, not only to purify the water passing from the River, but also the amount of dirty water penetrated into the Basin.

"2nd. From the same cause during the experiments the water from the mixing tank passed rapidly into the Deposit Basin, thus preventing the intimate admixture of the lime with the water in the space allotted for the purpose; and to this must be added the imperfect construction of the slides under the mixing trough, which allowed a large quantity of dirty river water to pass into the Deposit Basin without being properly mixed with the lime in its progress.

"3rd. There was also a large discharge drain tube, of the diameter of 9 inches, pouring dirty drainage water into the Deposit Basin." (C.)

In reference to the experiments as actually made, *Mr. Calvert* remarks—"Notwithstanding all these causes of defect, I believe that the following results are highly encouraging, and deserve the serious attention of the Association:—

"In experiment vii., 467,606 gallons of river water were purified by 10 cwt. of lime.

"And in experiment ix., 485,944 gallons by the same quantity." (C.)

To guard, however, against an assumption that the number of gallons given above are all that can be purified by 10 cwt. of lime, applied under more favorable circumstances, *Mr. Calvert* adds—"These results

are far from representing the exact amount of water which can be purified by 10 cwt. of lime; as, to the above sources of error must be added the following insurmountable obstacles:—

"1. The deposit basin was only 140 feet long, instead of three or four times as long; from which cause part of the matter in suspension passed over the dam into the canal, not having had sufficient time to deposit.

"2. The imperfect mode of mixing which I had to adopt, and inability to try other methods."

Mr. Calvert therefore concludes, "that if the above sources of error were removed, and the exact mode of operating were ascertained, from 800,000 to 1,000,000 gallons might be purified with 10 cwt. of lime; the quantity which was used in the above detailed experiments." (C.)

Recapitulation of Results.

The experiments of *Dr. R. A. Smith* and *Mr. Mc. Dougall* had reference to *the quantity of lime required* to produce speedy precipitation in 1,000,000 gallons of water passing from the Medlock into the Deposit Basin, and the result given is—

17 cwt. to 1,000,000 gallons (A.),

which is after the rate of 10 cwt. to 588,285 gallons.

Mr. Calvert's experiments had reference to *the quantity of water that could be purified*, under the disadvantages of the apparatus, *by 10 cwt. of lime*, and the result given is—

Experiment vii.—10 cwt. to 467,606 gallons. (C.)

" ix.—10 cwt. to 485,944 gallons. (C.)

But he believes that under more favorable circumstances, and in an enlarged basin, the result would be—

10 cwt. to 800,000 or 1,000,000 gallons. (C.)

II.—Laboratory Experiments.

To ascertain the quantity and effect of Lime used for precipitation.

By *Dr. R. A. Smith* and *Mr. Mc. Dougall.*

In respect to the *quantity of lime* to be used "very careful experiments made in the laboratory gave the following results (A.):—

"13.8 grains of lime were needful to precipitate 1 gallon of the river water, or 1,971 lbs. for 1,000,000 gallons.

"17 cwt. are equal to 1,904 lbs.

"*So that the agreement between the two sets of experiments is complete*, fully confirming both." (A.)

In regard to the *appearance of the water Dr. Smith* and *Mr. Mc. Dougall* observe—

"The water of the Medlock, as is well known, is of a dark bluish tinge, somewhat resembling ink at a distance, and ceases to be transparent when more than an inch deep. The clarified water is transparent through several feet, and when standing in a glass, cannot be perceived to be impure." (A.)

By *Mr. Crace Calvert.*

As to the *effect of the lime process*; [see Tables 1, 2, 3, 4, (C.) for the several experiments.]

i. *Medlock water* (matter in suspension).

Water was taken from the Medlock, before admixture with lime, which, by FILTRATION, produced (on the mean average) of *Organic and Inorganic Matter combined, in suspension,*

6·65 *grains* in every gallon.

By analysis, the proportions in this quantity were found (Table 2 C.)—

	Per Cent.	In Grains.
Organic Matter.....	53·69	3·57
Inorganic "	46·31	3·08
	100·00	6·65

ii. *Purified water* (matter in suspension).

By the like process of FILTRATION, on the same days, after the application of lime, the quantity of *Organic and Inorganic Matter combined, in suspension,* was found, on the average, in the water passing over the outer dam into the canal,

4·67 *grains* in every gallon. (Table 3 C.)

which by analysis gave—

	Per Cent.	In Grains.
Organic Matter.....	24·61	1·14
Inorganic "	75·39	3·53
	100·00	4·67

From which it appears that the application of lime had caused a precipitation, independently of its own weight, of 2 grains per gallon, or about 30 per cent. of extraneous matter, and had reduced the proportion of organic (corruptible) matter flowing into the Canal *in suspension,* from 53·69 per cent. to 24·61 per cent., or from 3·57 grains to 1·14 grains.

On the same occasions as above, and in order to ascertain the total amount of extraneous matter in the water, both in solution and suspension, before and after the lime process, the filtered water, in both cases, was evaporated, and found to contain on the average:—

iii. *Medlock water* (matter in solution).

1. Filtered water from the River—

Organic Matter, per gallon ..... 8·54 *Grains.*
Inorganic " " " ..... 23·19 "

Total..... 31·73

iv. *Purified water* (matter in solution).

2. Filtered water from the Outer Dam—

Organic Matter, per gallon ..... 3·50 *Grains.*
Inorganic " " " ..... 22·26 "

Total..... 25·76

The result of *Mr. Calvert's* investigations is as follows:—

Before the Application of Lime.			*After the Application of* Lime.		
Organic Matter. In suspension	3.57	grains.	*Organic Matter.* In suspension	1.14	grains.
Organic Matter. In solution ..	8.54		*Organic Matter.* In solution ..	3.50	
		12.11			4.64
Inorganic Matter. In suspension	3.08		*Inorganic Matter.* In suspension	3.53	
Inorganic Matter. In solution ..	23.19		*Inorganic Matter.* In solution ..	22.26	
		26.27			25.79
Total.....		38.38	Total.....		30.43

From which it appears that the application of lime reduced the extraneous *Organic matter* from 12.11 *grains* per gallon to 4.64; upon which *Mr. Calvert* remarks that—

"The value of lime in purifying the water of the Medlock is clearly demonstrated, for it does not only remove the dirty black matter in suspension, and consequently clarify the water, but it also removes the greater portion of organic matter in solution; the quantity of which, separated by the lime, is 59.02 per cent., taking the average of the five experiments.

"To appreciate fully the value of lime, it is necessary to draw attention to the following important fact; namely, that if we take the average amount of organic matter *in suspension and solution* as 12.11

grains, there remains after treatment by lime, only 3.5 grains per gallon *in solution;* or in fact, a quantity less than exists in many river waters which are used for domestic purposes." (C.)

General Results of the Laboratory Experiments.

1. The proportion of the 17 cwt. of lime to 1,000,000 gallons to ensure speedy precipitation, in comparatively still water, was confirmed.

2. The appearance of the clarified water is found transparent.

3. A large proportion of organic and inorganic matter in suspension and solution has been removed, notwithstanding the imperfection of the apparatus; and the inference was confirmed that a much larger proportion would have been removed under more favourable circumstances.

III.—Removal of the Offensive Smell of the Water.

The full effect of the application of lime as regards the *Smell of the Water* was not sufficiently ascertained, owing to the imperfection of the apparatus and arrangements.

On this subject *Dr. Smith* and *Mr. Mc. Dougall* remark:—"We found that the smell of the water of the Medlock was not entirely removed by precipitation with lime, or if removed, that it soon returned; we therefore used a disinfecting agent to the amount of 2¼ per cent. of the lime used. We used for this purpose our own powder." (A.)

The same is shown practically by the results of *Mr. Calvert's* experiments, where it is found that above 4½ grains of organic (*or corruptible*) matter passed with each gallon of water over the outer dam into the Canal; but this *Mr. Calvert* mainly attributes to the inadequacy of the Deposit Basin for a perfect precipitation.

On this point he observes:—"If the Deposit Basin had been sufficiently extensive, *I should have had only mere traces of matter in suspension to record;* for if the water, after the lime process, were allowed to stand for a short time it became perfectly clear; whilst the dirty black matter in suspension in the river water itself would not deposit, even after several days. The result of the lime process in this respect deserves special attention, as it not only appears to put a stop to the putrefaction which is constantly going on in the Medlock, bnt also removes from the water the noxious gases which it evolves, and which render the neighbourhood of this river so destructive to life in summer.

"This fact was clearly demonstrated during the experiments. For previously to their commencement the atmosphere under the warehouse

which covered the deposit basin was most offensive; whilst during the experiments the whole, or nearly the whole, of the stench was removed, and the air was rendered sufficiently pure to enable a person to remain there without inconvenience." (C.)

IV.—The Quantity of Lime required for Precipitation,

Time and the motion of the water being considered.

Efforts were made to obtain approximately *the quantity of lime per million gallons* which would be required to purify the water passing into the canal, under more favorable arrangements than those at present at command.

By *Dr. Smith* and *Mr. Mc. Dougall.*

Here they observe—"We thought it an important thing to devise some means of reducing the quantity of lime.

"With this view we tried whether the lime which had once been used according to the method described, had really done all the duty that it was capable of performing, or if it were still capable of precipitating more impurity. We therefore added a quantity of the precipitate, in a flocculent state, to a quantity of water equal to what it had before precipitated, and found that, after a short time, it fell, carrying the impurities with it, and leaving the water as clear as on the first precipitation.

"We then added this precipitate to a third quantity of water, with a similar result; and to a fourth, with nearly equal advantage. This was the utmost it would bear.

"*This fact* is of very great importance, as it *will enable us to divide by four* the amount of lime used in the ordinary mode of precipitation.

"In this mode of using the precipitate the proportion of phosphates remained unchanged.

"To apply this fact it will not be necessary to lift out the precipitate and remix it, as we did, but merely to keep it longer in suspension, and to allow it a larger subsiding area.

"This will give us an opportunity of passing the water with greater rapidity. This was the main cause, no doubt, that the effects of the experiments made themselves sensible at least a mile and a half below Knott Mill. *The canal boats were the means of keeping the matter in suspension.*" (A.)

By *Mr. C. Calvert.*

Mr. Calvert, in his paper of the 11th of September, 1854, states, as the result of experiments in the Laboratory, made at that time, to ascertain the *minimum quantity of lime* required to remove the odour

and colour of the water of the Medlock, that 2 *grains* of lime per gallon, or

About 3 *cwt.* of lime per million gallons,

are sufficient for this purpose, if only a short time be allowed for the precipitation.

Comparing this original statement of *Mr. Calvert's* with the conclusion at which *Dr. Smith* and *Mr. Mc. Dougall* had arrived, and remembering the different state of the water at different times, and that *Mr. Calvert's* experiments were made 12 months previously to those of *Dr. Smith* and *Mr. Mc. Dougall*, the coincidence is as remarkable as the result is important.

Results.

The *minimum amount of lime* which, under suitable arrangements, would precipitate the extraneous matters in the Medlock, at per MILLION GALLONS, is given—

By *Dr. Smith* and *Mr. Mc. Dougall*, as ..... 4¼ cwt.
By *Mr. Calvert*, as .... 3 "

Taking the mean of the above quantities, it may be concluded that—

3¾ *cwt. of lime* will purify 1,000,000 GALLONS of the *Medlock water.*

This proportion it is true was not found sufficient in the actual experiments in the Deposit Basin; but the failure must be attributed to the inadequacy and incompleteness of the apparatus and arrangements.

V.—QUANTITY OF WATER FROM THE MEDLOCK,

Required for the Navigation purposes of the Canal.

It has been ascertained,—

1. That a much larger quantity of water is ordinarily admitted into the Canal than its use actually requires.
2. That the water admitted on Sundays, containing less offensive matter than during the week, is admitted in full stream from the Medlock to wash as much as possible of the dirty water over the waste gates; but this quantity of water is not required for navigation purposes on that day.
3. The full stream of the river is also ordinarily admitted during the night for the like reasons.
4. During the day the supply is commonly shut off for five or six hours at a time.

5. On Saturday afternoons the supply is wholly shut off; but this is intended to assist in cleansing the bed of the river near the sluice gates previously to the Sunday supply.

It may, therefore, be concluded that not nearly one-half the ordinary volume of the stream is required for navigation purposes during six days in the week, and very little if any on the Sunday; and that the weekly quantity required to be artificially purified would be affected occasionally by floods.

It has been further ascertained that the ordinary average flow of the river Medlock may be taken at 16,000,000 gallons per day.

It may, therefore, be assumed that—

50,000,000 gallons of water per week would considerably exceed the supply of Medlock water ordinarily required by the Canal for navigation purposes.

VI.—Cost of the Lime Process.

The cost of applying the lime process, according to the Estimates obtained in Sections IV. and V., would be as follows:—

For lime, at 3¾ *cwt.* per million gallons of water; 50 *million gallons of water* per week requires 9 tons 7½ cwt. of lime,—

9 tons 7½ cwt., at 10s. 6d. per ton = £4. 18s. 5¼d., the cost per week;

And therefore £255. 18s. 9d. *a-year*, the cost of lime.

If the purification should be accomplished by lime only, the cost, exclusive of labour and wear and tear of apparatus, would therefore

Not exceed £256. a-year.

If, however, some additional disinfecting agent should be required in proportion of 2¼ per cent. of the lime,—that is about 12 tons—an additional expense would be incurred, amounting to nearly £100. a-year; but this, under the improved arrangements contemplated, might not be required; or if required, not in so large an amount.

VII.—Chemical Properties and Commercial value of the Deposit,

As precipitated during the Experiments in the Deposit Basin.

The commercial value of the deposit after the application of lime has been investigated

By *Dr. Smith* and *Mr. Mc.Dougall.*

Here they observe—"The precipitate when kept at the temperature of boiling water gave out no ammonia; it will therefore bear drying without injury.

"The dried precipitate contained,—

1st portion	1.39	per cent.	Phosphate of Lime.
2nd "	1.32	"	"
3rd "	1.84	"	"

"Or it contains on an average—

Phosphate of Lime	1½ per cent.
Organic and Volatile Matter	22 "
Ammonia	0.525 "

"The remaining portion, when burnt, consisted chiefly of Carbonate of Lime.

"The Organic matter contained, according to the above, 2.38 per cent. of Ammonia.

"The amount obtainable from 1,000,000 gallons is rather more than double the amount of lime used. (A.)

By *Mr. Calvert.*

The extraneous matters in the river water, being very different in their relative quantities on different days, *Mr. Calvert* reports the result of investigations accordingly.

The following table represents the *mean average* composition of *five* of his investigations. *(See Report,* C.)

		Per Cent.
Organic Matter...	Vegetable	19·51
	Animal	5·05
Phosphoric Acid		0·62
Matters insoluble in Acids	Silica, abundant	9.66
	Sulphate of Lime, very small quantity	
Matters soluble in Acids	Carbonate of Lime, exceedingly abundant	65·16
	Carbonate of Magnesia, small quantity	
	Oxide of Iron, abundant	
	Alumina, traces	
	Manganese, traces	
Results		100·00

Dr. Smith and *Mr. Mc. Dougall* state, that "the precipitate has a certain value as a manure; although not a great one. It may be advantageously used near the banks of the Canal, but at the distance of even a few miles, it could not be used economically by farmers; as it would not bear the cost of transport.

"It must be remembered, too, that when removed from the Canal, it will contain a larger per centage of water, making the value much less than the above calculation.

"We, however, calculate on no receipts from products. The Bridgewater Trustees yearly remove 13,000 tons of deposit from the Canal; and although they give it freely, can scarcely get it removed by farmers. It is not probable that this deposit will be much inferior to that by artificial precipitation. At any rate, the value of our precipitate cannot be reckoned higher than seven shillings and sixpence per ton. It is worth the labour of spreading on the adjoining land, but not of carting to a great distance; although more valuable and agreeable to use than the town's manure, which is at present sent as far as Lincolnshire." (A.)

Mr. Calvert remarks—"Although this deposit cannot be considered as a valuable manure, still it might be employed in many cases with advantage; and if we consider the Medlock as a highway of Manchester, its refuse is superior to ordinary street sweepings."

Upon the whole, therefore, particularly as the value will be reduced in some proportion to the diminution of lime, it is obvious that—

No great commercial value can be attributed to this deposit.

VIII.—Conclusion.

From what has now been stated, on the authority of the Reports laid before this Committee,

It may be considered as proved—

1. That the water received into the Bridgewater Canal can be purified by the application of lime.
2. That this can be accomplished at an annual cost of from £300. to £400.
3. That the deposit will have some commercial value as a manure, although not a very great one.

It also follows by legitimate deduction—

1. That to obtain complete precipitation with the minimum quantity of lime within a separate basin, so that the water should flow into the canal clear and purified, it would be necessary to provide a basin having a capacity of about 3,000 cubic feet for each 1,000 gallons of water purified per hour.
2. But it is not necessary for the purpose of purification that the process should be completed before the water passes into the canal, as the precipitation would take place with equal certainty within the canal, notwithstanding the agitation caused by the boats; provided the lime were properly mixed with the water previously to its entering, which, in a permanent arrangement, would be easily accomplished by mechanical means.
3. The matter deposited in the canal in the latter case would be increased in quantity by the amount of lime used, but would be deprived of its noxious and offensive qualities.

Whatever benefit the community may derive from these investigations in relation to the CANAL, must depend on the Corporation, the Owners of the Canal, and the Inhabitants and Owners of Property on its banks.

APPENDIX (A).

EXPERIMENTS *made by* Dr. R. ANGUS SMITH *and* Mr. MC. DOUGALL, *on a Method of Purifying the River Medlock and the Bridgewater Canal.*

GENTLEMEN,

Being appointed by the Sub-Committee on Sewer Rivers, &c., to make the necessary experiments for ascertaining the practicability of purifying the river Medlock, we commenced in August and finished in September of this year with the following results :—

When lime is thrown into the water of the Medlock, it produces what may be familiarly called 'curdling,' which results from the formation of a very flocculent precipitate. This precipitate is formed by the combination of the lime with the carbonic acid, organic matter, and other substances held in solution and suspension in the water. It separates into large and distinct portions, which subside very rapidly.

Careful observations, repeatedly made, shew that the precipitate falls at the rate of about 1 foot in 8 minutes, or more than an inch per minute.

When the lime is mixed in the river itself, this curdling can easily be observed, even at the distance of many feet, instantly to take place, and the precipitate is seen hastening to the bottom through the clarified water.

The water of the Medlock, as is well known, is of a dark bluish tinge, somewhat resembling ink at a distance, and ceasing to be transparent when more than an inch deep. The clarified water is transparent through several feet, and when standing in a glass, cannot be perceived to be impure.

One of our first experiments was to test the greatest rapidity of the current, compatible with complete subsidence of the precipitate in the space allowed us; or, in other words, to ascertain the quantity of water which could be clarified in the space, consistent with complete collection of the precipitate.

The settling tank is 142 feet long, 27 broad, and 10 deep. We commenced our trials with 125,000 gallons per hour, but found that this quantity did not allow nearly sufficient time for subsidence, the water passing muddy over the weirs, and taking the precipitate along with it into the canal; we therefore gradually reduced the quantity to 41,000 gallons per hour, or nearly 1,000,000 gallons per day, which we found to be the maximum quantity allowing of ordinary subsidence in the basin.

A tank of a much greater area would be needed to collect the precipitate from the whole of the water supplied by the Medlock, as at least fifteen times the above quantity runs into the canal.

The quantity of lime found to produce instant precipitation, without excess or causticity, was 17 cwt. for 1,000,000 gallons. The precipitate so made contained no caustic lime; the water ran also free from caustic lime. The precipitate, when kept at the temperature of boiling water, gave out no ammonia. It will therefore bear drying without injury. The dried precipitate contained—

1st portion	.....	1·39 per cent.	Phosphate of Lime.
2nd "	.....	1·32 "	"
3rd "	.....	1·84 "	"

Or it contains, on an average, 1½ per cent. of Phosphate of Lime :—

Organic and Volatile matter.....	22 per cent.
Ammonia.....	0·525 per cent.

The remaining portion, when burnt, consisted chiefly of Carbonate of Lime.

The Organic matter contained, according to the above, 2·38 per cent. of Ammonia.

The amount obtainable from 1,000,000 gallons is 35 cwt., or rather more than double the amount of lime used.

Very careful experiments made in the Laboratory, gave the following results :—

13·8 grains were needful to precipitate 1 gallon, or 1,971 lbs. for 1,000,000 gallons. 17 cwt. are equal to 1,904 lbs., so that the agreement between the two sets of experiments is complete, fully confirming both.

It will be seen from the above, that the precipitate has a certain value as a manure, although not a great one. It may be advantageously used near the banks of the canal, but at the distance of even a few miles, it could not be used economically by farmers, as it wonld not bear the cost of transport. It must be remembered too, that when removed from the canal, it will contain a large per centage of water, making the value much less than the above calculation.

The average quantity of water supplied to the canal from the Medlock, is 15,000,000 gallons per day. This, according to the above, would require 12 tons of lime. The largeness of the quantity would, we feared, prove an entire obstacle to its use. We thought it therefore an important thing to devise some means of reducing it. With this view, we tried if the lime, which had once been used according to the method described, had really done all the duty that it was capable of performing, or if it were still capable of precipitating more impurity. With this view, we added a quantity of the precipitate, in a flocculent state, to a quantity of water equal to what it had before precipitated, and found that after a short time it fell, carrying the impurities with it, and leaving the water as clear as on the first precipitation. We then added this precipitate to a third quantity of water, with a similar result, and to a fourth, with nearly equal advantage. This was the utmost it would bear. This fact is of very great importance, as it will enable us to divide by four the amount of lime used in the ordinary mode of precipitation, making only 3 tons necessary for the purification of 15,000,000 gallons of the Medlock water.

In this mode of using the precipitate, the proportion of phosphate remained unchanged. To apply this fact, it will not be necessary to lift out the precipitate

and re-mix it, as we did, but merely to keep it longer in suspension, and to allow it a larger subsiding area. This will give us an opportunity of passing the water with greater rapidity. It was the main cause no doubt that the effects of the experiments made themselves sensible at least a mile and a half below Knott Mill. The purification of merely $\frac{1}{15}$th of the water passed in at Knott Mill would scarcely have produced such a result. The canal boats were the means of keeping the matter in suspension.

We found that the smell of the Medlock water was not entirely removed by precipitation by lime, or if removed, that it soon returned. We therefore used a disinfecting agent, to the amount of 2½ per cent. of the lime used. We used for this purpose our own powder, called "Mc. Dougall's Disinfecting Powder." We were desired to use it instead of lime, in order to compare its efficiency with that of lime, but did not do so, as it would be far too expensive for the treatment of rivers, and could only be used by itself where the liquids were strong solutions. For this reason we used only a small quantity, to remove smell and prevent decomposition, leaving the work of precipitation entirely to the lime.

As to the expense of purifying the Canal, we have made the following calculations :—

Let us suppose that the bed of the canal shall be the subsiding tank, as it is at present, representing the simplest, if not the most elegant method of procedure ; then the precipitation can be made at the following cost per annum :—

1,095 tons of Lime, at 10s. 6d.	£574	17	6
Disinfecting Agent, such as we used, about 25 tons	200	0	0
Labour	100	0	0
For the whole Medlock	£874	17	6

The present apparatus, with little modification, might be used, and with interest of the money necessary to make any changes, would probably not bring the sum much above £900. This is supposing the canal to use all the water of the Medlock. If it uses only half, the sum may be reduced to little more than £400. In fact this sum of £900. represents the purification of the whole river.

We can, however, calculate on no receipts from products. The Bridgewater Trustees remove at present 13,000 tons of deposit from the canal, and although they give it freely, can scarcely get it removed by the farmers. It is not probable that this deposit will be much inferior to that by artificial precipitation. At any rate, the value of our precipitate cannot be reckoned higher than 7s. 6d. per ton. It is well worth the labour of spreading on the adjoining land, but not of carting to a great distance, although more valuable and agreeable to use than the town's mannre, which is at present sent as far as Lincolnshire.

The increase of deposit in the canal by this treatment, would be about 2,000 tons of dried material, or in reality, 4,000 tons at least of the moist. This is not a very serious increase. But if only half the Medlock be used, as we are informed, then the total increase will only be 2,000 tons.

To have the plan carried out to perfection, a large depositing reservoir would require to be made,—where or how, it is not for us to inquire,—and especially as we do not think that the purification of the Medlock in this way is the proper method of grappling with the evil.

We have endeavoured to shew that the river can be purified, and that cheaply; but the result is of little advantage to Manchester, if undertaken at Knott Mill; and if undertaken higher up the river, it will become impure again before it leaves the town. We do not, then, see the great interest that Manchester can have in purifying the river as soon as it leaves the city and ceases to do it much mischief. Our belief is, that the impure water must be operated on before entering the Medlock, thus keeping the water pure, and at the same time ensuring a strong manure, more apt to pay its collection. This is even more necessary with Manchester than most towns, as it has shewn no inclination to make any progress in introducing the water-closet system, and the peculiar manner in which its streams are polluted, demands a more than usually effective treatment.

There are many points which we should have treated of in this report,—some connected with theoretical, some with practical questions,—had we not considered that they might appear more suitably elsewhere, and that in this case, an account of our experiments should be given as short as possible.

We are, Gentlemen,

Your obedient Servants,

ROBERT ANGUS SMITH,
A. Mc. DOUGALL.

Manchester, October 1*st*, 1855.

APPENDIX (C).

Second Report, *presented by* F. Crace Calvert, F.C.S., M.R.A. of Turin, &c. &c.

To the Manchester and Salford Sanitary Association.

Gentlemen,

I beg to lay before you my second Report respecting the application of Lime to the clarification and purification of the water of the river Medlock; and as I explained in my first Report (presented the 11th Sept., 1854), the action which lime has when employed for the above purpose, and the probable quantity which it would require per 1,000,000 gallons,—I shall, in this second Report, simply give the results of the experiments made at Knott Mill during October, 1855, with the view of ascertaining, on a practical scale, the value of the plan proposed by me in my first Report.

	Height of the water as it passed over the weir.			
	Inches.	Inches.	Inches.	Inches.
Experiment No. 1.				
Milk of lime was run in for half an hour, to purify the water in the settling basin. Then lime water was set running from three syphons at 2-40 p.m. Allowed to run one hour. Lime water used, 2,062 gallons. Water going over the weir, 33,007 gallons. Gauge all the time	1	⅜	⅜	⅜
Result.				
Water in mixing tank after one hour was very turbid; a large quantity precipitated, but the precipitate was not flocculent. Water going over the weir; slight precipitate; liquid very turbid.				
Experiment No. 2.				
Used milk of lime with syphons. Began at 9-45 a.m. Ran for one hour with two sluices. Water going over weir, 107,580 gallons. Gauge.....	1⅞	1⅜	1⅛	1¼
Result.				
Water scarcely acted upon in mixing tank. Precipitate not flocculent.				
Experiment No. 3.				
Used syphons. Ran milk of lime two hours. Gauge all the time	1½	1¼	1¼	⅞
Water going over the weir, 144,255 gallons. Water used to mix lime in Experiments Nos. 2 and 3, 4,100 gallons.				
Result.				
Water better than in No. 2, but not sufficiently purified.				
Experiment No. 4.				
Put 6 cwt. of lime in one of the lime tanks. Used the paddle to let the lime out of the tank. Began at 9-0 a.m. Worked four hours. Gauge at commencement	1½	1¼	1¼	⅞
Gauge at the end	1¼	1⅛	1⅛	¾
Result.				
Water much better. Precipitate flocculent, but took long to settle. Water purified, about 276,727 gallons. More than 1 cwt. of lime left in the tank. Water ran over the weir tolerably clear. Not quite enough lime used.				

	Height of the water as it passed over the weir.			
	Inches.	Inches.	Inches.	Inches.
Experiment No. 5.				
Put 10 cwt. of lime in each lime tank. Began at 7-15. Worked until 9-0, when was obliged to stop, in order that the wheel in the warehouse might be worked. Resumed work at 11-10, and worked with both lime tanks until 5-0. Was obliged to stop for want of water to mix lime. Lime not nearly exhausted. Gauge at 7-15	1⅞	1½	1½	1¼
Gauge at 12-0	1¾	1⅜	1⅜	1⅛
Gauge at 4-0	1⅞	1½	1½	1¼
Result.				
Good, especially in the afternoon, when the beams under the water near the weir were clearly visible.				
Experiment No. 6.				
Plugholes having been substituted for the paddles in the lime tanks, greater command over the delivery of the lime was obtained. This experiment was made to see how they would work. Gauge	2	1⅜	1⅜	1¼
10 cwt. of lime were worked for three and a half hours. Lime not exhausted.				
Good results.				
Experiment No. 7.				
10 cwt. of lime put in the lime tank. Began at 11-0. Gauge all time	2	1⅜	1⅜	1¼
Took samples of water from river, mixing tank, and weir at 2-0. Stopped at 3-15. Water used to mix lime, 6,620 gallons. Water purified, 467,606 gallons.				
Result.				
Water so far purified that all the impurity was separated as a flocculent precipitate, but all was not deposited at the weir.				
Experiment No. 8.				
Used 10 cwt. of lime. Began at 10-0. Stopped at 2-0. Gauge all time	1¾	1⅜	1⅜	1
Used 6,270 gallons of water to mix lime. Amount of water purified, 349,634 gallons.				
Result.				
Water clearer than in No. 7, but all impurity not subsided. The object of this experiment, as also that of Nos. 10 and 11, was to try to completely remove the impurity from the water by using excess of lime and diminishing the amount of water. It was found, however, that the settling tank was not long enough to allow all the precipitate to subside, and therefore this trial, and Nos. 11 and 12, must be considered as experiments.				

	Height of the water as it passed over the weir.			
	Inches.	Inches.	Inches.	Inches.
Experiment No. 9.				
Used 10 cwt. of lime. Began at 8-45. Stopped at 1-10. Gauge all time	2	1⅜	1⅜	1¼
Amount of water used to mix lime, 5,178 gallons. Water purified, 485,944 gallons.				
Result.				
Similar to No. 7 Experiment, but rather better.				
Experiment No. 10.				
Used 10 cwt. of lime. Began at 7-45. Stopped at 12-15. Gauge all time	1¾	1⅜	1⅜	1
Water used to mix lime, 5,385 gallons. Water purified, 393,339 gallons.				
Result.				
Similar to No. 8 Experiment.				
Experiment No. 11.				
Began at 1-10. Stopped at 5-35. Gauge all time ..	1¾	1⅜	1⅜	1
Used 10 cwt. of lime. Town's water used to mix lime, 3,712 gallons. Water purified, 386,055 gallons.				
Result.				
Similar to Experiment No. 8.				

It will be seen, by reading over the record of the experiments made by Mr. E. Davies (whose assistance and general professional acquirements I have great pleasure in mentioning here), that it took six trials before I could, with the incomplete means which I had at my disposal, arrive at a method which would give me approximative results.

In my opinion, the results obtained must be considered as only preliminary, owing to the following sources of error:—

1. The imperfect state of the flood-gates of the reservoir, which admitted a constant stream of impure river water, between the experiments, into the purified water remaining in the reservoir, thereby rendering it necessary each time not only to purify the water passing from the river through the mixing tank, but also that amount of dirty water which had penetrated into the reservoir.

2. From the same cause, during our experiments, the water from the mixing tank passed rapidly into the reservoir, thus preventing the intimate admixture of the lime with the river water; and to this must be added, the imperfect construction of the sluices of the mixing tank, the consequence being that a large quantity of dirty river water constantly passed into the reservoir without being properly mixed with the lime.

3. That there was a large discharge drain tube of the diameter of 9 inches, pouring into the reservoir dirty drainage water.

Notwithstanding all these causes of defect, I believe that the following results are highly encouraging, and deserve the serious attention of the Association; for in

Experiment No. 7, 467,606 gallons were purified by 10 cwt. of lime.
" No. 9, 485,944 " " " "

Therefore, I believe that if the above sources of error were removed, and the exact mode of operating were ascertained, from 800,000 to 1,000,000 gallons might be purified with 10 cwt. of lime, the quantity which was used in the above detailed experiments.

These results are far from representing the exact amount of water which can be purified with 10 cwt. of lime, as to the above sources of error must be added the following insurmountable obstacles:—

1. The settling tank being only 140 feet long, instead of three or four times as long; from which cause, part of the matter in suspension passed over the weir into the canal, not having had sufficient time to deposit.
2. The imperfect mode of mixing which I had to adopt, and inability to try other methods.

I shall now lay before you some results, showing the chemical action which lime exerts in removing the impurities from water. To enable me to ascertain this point, I operated in the following manner:—

A gallon of water taken from the river before being mixed with the lime, was filtered, and found to yield—

TABLE No. 1.

Experiment	No. 7.	No. 8.	No. 9.	No. 10.	No. 11.
Grains per gallon	5·62	6·18	6·40	6·70	8·36

And I found the above quantities to consist of—

Organic matter..... 53·69 per cent.
Inorganic " ..... 46·31 "
100·00 "

I also found that the quantity of matter in solution was represented by—

TABLE 2.

Experiment	No. 7.	No. 8.	No. 9.	No. 10.	No. 11.
Organic Matter, per gallon..	8·40	6·65	7·35	10·85	9·45
Inorganic " " ..	32·90	20·30	21·35	20·65	22·75
	41·30	26·29	28·70	31·50	32·20

The same series of experiments was repeated with the water as it passed over the weir, and I obtained the following figures:—

TABLE No. 3.

Experiment	No. 7.	No. 8.	No. 9.	No. 10.	No. 11.
	4·64	5·08	4·60	4·58	4·48

If the tank had been sufficiently extensive, I should have had only mere traces of matter in suspension to record; for if the water was allowed to stand for a short time, it became perfectly clear, whilst the dirty black matter in suspension, in the river water (see Table No. 1), would not deposit even after several days; and it is necessary to add, that there is a great difference of composition between the matter in suspension in No. 1 Table and that in No. 3, the former being composed (as seen above) in great part of organic matter, whilst the latter, passing over the weir, was as follows:—

Organic matter.....	24·61	per cent.
Inorganic "	75·39	"
	100·00	

I also evaporated a certain quantity of the water from which the above deposit had been separated, and I obtained the following figures, per gallon:—

TABLE No. 4.

Experiment	No. 7.	No. 8.	No. 9.	No. 10.	No. 11.
Organic Matter, per gallon..	3·5	2·8	4·2	3·5	3·5
Inorganic " " ..	26·6	25·2	22·4	15·4	21·7
	30·1	28·0	26·6	18·9	25·2

It is chiefly in comparing this Table with Table No. 2, that the value of lime in purifying the water of the Medlock, is clearly demonstrated, for it does not only remove the dirty, black matter in suspension, and consequently clarify the water, but it also removes the greater portion of the organic matter in solution; for if we represent as 100 the organic matter in solution, the quantity of it separated by the lime is 59·02, taking the average of the five experiments.

To appreciate fully the value of lime, it is necessary to draw your attention to the following important fact, viz.: that if we take the average total amount of organic matter in suspension and solution as 12·11 grains per gallon, there remains after treatment by the lime only 3·5 grains per gallon, or, in fact, a quantity less than exists in many river waters which are used for domestic purposes.

Another valuable result arising from the lime process, and which deserves the special attention of this Association, considering the bad sanitary condition of the dense population living on the banks of the river, is, that the lime process not only appears to put a stop to the putrefaction which is constantly going on in the Medlock, but also removes from the water the noxious gases which it evolves, and which render the neighbourhood of the river so destructive to life in summer.

This fact was clearly demonstrated during the experiments; for previously to their commencement the atmosphere under the archway which covered the reservoir was most offensive, whilst during the experiments the whole, or nearly the whole, of the stench was removed, and the air was rendered sufficiently pure to enable a person to remain there without inconvenience.

This mode of purifying the Medlock deserves the serious consideration of the manufacturers who use the water to supply their boilers; for the amount of

mineral matter, as shown in Tables 2 and 4, remains nearly the same, and consequently the lime process does not increase the amount of mineral matter in the water; and if the composition of the deposit thrown down by the lime is considered, the advantage of the lime process becomes evident; for I find in the deposit (see Table No. 5) three substances, viz., organic matter in large quantities, oxide of iron in large quantities, and sulphate of lime, which three matters are liable to form most destructive incrustations in boilers; whilst the water merely containing a little lime, will not prove injurious, and even any chance of incrustation would be prevented by adding to the water supplying the boilers a small amount of sal ammoniac.

I also analysed the deposit produced by adding lime to the water of the Medlock, and found it to have the following composition :—

		No. 7.	No. 8.	No. 9.	No. 10.	No. 11.
Organic Matter	Vegetable	22·01	20·47	18·07	17·17	19·81
	Animal.....	4·89	4·73	4·89	5·15	5·59
Phosphoric Acid		·56	·60	·68	·68	·56
Matter insoluble in Acid	Silica, abundant..... Sulphate of Lime, very small quantity.....	10·98	7·76	8·80	9·76	11·04
Matter soluble in Acids	Carbonate of Lime, exceedingly abundant..... Carbonate of Magnesia, small quantity ..... Oxide of Iron, abundant... Alumina, traces ..... Manganese, traces.....	61·56	66·44	67·56	67·24	63·00
		100·00	100·00	100·00	100·00	100·00

Although this deposit cannot be considered as a valuable manure, still it might be employed in many cases with advantage; and if we consider the Medlock as a highway of Manchester, its refuse is superior to ordinary street sweepings.

F. CRACE CALVERT.

Royal Manchester Institution,
March 6th, 1866.

Cave & Sever, Printers, Palatine Buildings, Hunt's Bank, Manchester.