REPORT

OF THE

Chief Engineer of the Department

FOR

SUPPLYING THE CITY WITH WATER,

ON THE

CONDITION OF THE WORKS

UNDER HIS CHARGE.

Made to Councils April 19, 1855.

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1855.

REPORT.

To the Select and Common Councils
of the City of Philadelphia:

GENTLEMEN,—In compliance with the requirements of the ordinance regulating the "Department for Supplying the City with Water," and defining the duties of the Chief Engineer, the following report of the condition of the works now under my charge, up to the present date, is respectfully submitted; together with an account of the expenditures of the Fairmount Works, which were under my charge previously to consolidation, brought up to the 31st day of December, 1854, and the account of the warrants issued by me for payment of bills due for the several works, from the date of my election until the 31st of December, 1854.

Hereafter the required report will be made upon the first meeting of Councils after the 1st day of January. For obvious reasons, it was found impossible to do so this year.

As many of the members of Councils may not be familiar with the several Water Works now supplying our extended

city, a very brief description of each is given, that they may be better able to judge of their condition and magnitude, and therefrom form an idea of what will be required to keep them fully efficient.

They will be considered under the following heads:

FAIRMOUNT WORKS,

Which supply the old city, and the late Districts of Southwark and Moyamensing; now comprised in the first ten wards of the consolidated city.

SCHUYLKILL WORKS,

Which supply the late districts of Spring Garden, Northern Liberties and Penn; now the Eleventh, Twelfth, Thirteenth, Fourteenth, Fifteenth, Twentieth, and part of the Sixteenth Wards.

DELAWARE WORKS,

Which supply the late Districts of Kensington and Richmond; now the Seventeenth, Eighteenth, Nineteeth, and part of the Sixteenth Wards.

TWENTY-FOURTH WARD WORKS,

Intended to supply late West Philadelphia; now the Twenty-fourth Ward.

Each work will be described under the heads of Power, Storage and Distribution.

FAIRMOUNT WORKS,

Obtain their power by the erection of a timber dam, extending diagonally across the river, having a total length of over-fall, of eleven hundred and forty-eight feet, a height to the bottom of the river of thirty-two feet in the deepest, and eight feet six inches in the shallowest part of the river. It is built by sinking cribs of hemlock timber, which reach to low tide; above that it is built of white pine, with a deck of white oak, the whole filled solid with stone, and covered with a backing of earth paved with stone, extending nearly one hundred feet up stream. There is also, in addition to the length above stated, a mound dam over which the water does not flow, of two hundred and seventy feet, making the total length of the dam fourteen hundred and eighteen feet. The dam was originally built upon timber cribs from twenty to fifty feet long up stream, sunk in the river, which having become much decayed in that part above low tide mark, were rebuilt from that point upward, in the years 1842 and 1843. It is an exceedingly substantial structure, and since its erection in 1822, has withstood many very violent freshets; upon one occasion, a sheet of water nearly eleven feet in perpendicular depth, flowed over it, without causing any apparent injury. A slight settlement, however, has been noticed in a part of the structure near the eastern stone pier, where the water is the deepest; this settlement has taken place very gradually indeed, and has been going on since its re-erection. It amounts to but a few inches, and no fear of failure is anticipated, as such settlement is proba-

bly not more than might be expected to take place when the large mass of timber at this point is considered, and when we remember that besides its own weight, it has been subjected to the enormous pressure of nearly eleven feet in depth of water upon it; the old cribs, moreover, were not as well put together as they might have been, and some stone may have escaped from the front of the works. As early as the stage of water in the river will permit, an examination, as complete as it is possible to make, will be instituted; and should it be found necessary, such repairs as will then suggest themselves will be made.

A forebay, two hundred and fifty-three feet long and ninety feet wide, protected by head-gates, conducts the water to the flooms, nine in number, (also guarded by their own head-gates,) through which the water passes upon and gives motion to nine water wheels; eight of them being what are termed "breast wheels," and the ninth a "jonval turbine." One of the breast wheels is fifteen feet diameter; three are sixteen, and four eighteen feet diameter; all of them fifteen feet wide on the buckets, and working under a head and fall of six feet six inches at high, and eight feet six inches at low tide. The tide rising two feet upon the lowest part of the rims or cants of the wheels, stops them and causes serious delay; sometimes amounting to a loss of from four to six hours of the twenty-four. Three of the wheels are constructed of wood, the others are of cast-iron, with wooden buckets and soleing.

The turbine is made of cast-iron, with wrought-iron buckets; is enclosed in a water-tight case and runs horizontally; is seven feet in diameter, ten inches deep in the buckets, and

drives its pump by means of two bevel and two spur wheels. It has a head and fall of six feet six inches when the tide is full, and ten feet when it is low. The power of this wheel is rather greater than the largest of the breast wheels; as its pump forces the water through a longer main than any of the others, and it is capable of running faster than they do. It also has the advantage of not being retarded by the ordinary high tides, and in consequence may work the whole twenty-four hours; this is an advantage which is every day becoming of more importance as we approach the maximum, that the present wheels are capable of raising. All of the pumps are double-acting, sixteen inches in diameter, and vary in the length of their stroke from four feet six inches to six feet, according to the size of the wheel to which they are respectively attached. They are placed almost horizontal, and each has its own distinct main ascending to the reservoir, of the same diameter as the pump; the longest is that attached to the turbine, 433 feet in length; the shortest is only 183 feet long. The pumps attached to the breast wheels, if run twenty-four hours, are capable of raising about 12,216,168 standard gallons, and that to the turbine 1,685,016 more; making together 13,901,184 gallons per day.

The wheels and pumps are all in excellent order, and unless some unforeseen accident occur, will require no other repair than the renewal of a bucket or a start.

The mill building of stone, two hundred and thirty-eight feet long and fifty-six feet wide, is of the most substantial character, and in a good state of repair. The roofs of what was formerly the boiler houses of the old engines, now occupied as

dwellings for the workmen, require renewal; a sum has been included in the annual appropriation made to the department, for the purpose of putting new roofs upon them. The garden and grounds attached to the works, favorite resorts of our citizens, are in good order, and will not require any expenditure, other than what is necessary to keep them so. The grounds owned by the city and enclosed at Fairmount, have an area of about thirty acres, and that upon which the new reservoir is situate, and the lots north and south of it, comprise an area of about twenty-one acres, including streets not yet opened.

THE STORAGE

Of these works consists of four Reservoirs at Fairmount, constructed at different periods, as it became necessary, and are all built with side walls of stone, in the most substantial manner. They will contain, when full, to the depth of twelve feet three inches, 26,896,636 standard gallons; the water level in them is ninety-four feet fourteen hundreds above city datum, fifty-one feet above the highest and ninety-one above the lowest regulated curb height in the old city proper. There is also supplied from these works, a reservoir, situate between Twenty-second street and Corinthian avenue, and Poplar and Parrish streets; it is formed of earth embankments, lined with bricks, and will contain when full, sixteen feet deep, 20,321,392 gallons; making, with those at Fairmount, a storage of 47,218,028 standard gallons; which is equal to about six days of the average supply furnished in the year 1854.

The water level is one hundred and ten feet above city datum, one hundred and seven feet above the lowest, and sixty-seven above the highest curb regulation of the city proper.

This reservoir, being higher than those at Fairmount, is supplied by means of a stand pipe, fifty feet high and four feet diameter, erected at the latter place; the pumps being so arranged that the water may be pumped by one or all of them, either into the reservoirs at Fairmount, or into the stand pipe, and through it to the higher reservoir.

This reservoir is in perfect order; those at Fairmount will require some small repairs to the flag-stones above the walls at the water level, which have been somewhat damaged by the heavy ice of the past severe winter.

THE DISTRIBUTION

Of the old city proper, although arranged in 1819, before any other in this country, is very perfect, the system originally laid down having been strictly adhered to. The city is crossed upon the highest streets, running north and south, by two supply mains of twenty inch diameter each; and in the opposite direction, through a central street, runs a main of thirty inches diameter; the whole plot is then circumscribed by mains sixteen inches diameter, reducing to twelve and ten inches, and it is crossed north and south at intervals of about twelve hundred feet by mains of ten and twelve inches; these again crossed east and west by several mains of sixteen, twelve and ten inches diameter, (all connected at proper intervals, and making a complete net-

work of mains or feeders,) supply the remainder of the distribution, which consists of six, four and three inch pipes. The arrangement is quite complete, the only source of regret being that any pipes so small as three inches should have been used; but at the very early date when the distribution was devised and commenced, they were considered more than sufficient. Many new water works, however, executed within a very short period, and long after those of the old city, have, notwithstanding the advice and experience of Fairmount Works, fallen into the same error, and are now suffering from the want of large pipes and mains. It is proper to mention, that no pipe of three inches diameter is ever extended beyond one square, or say, three hundred and ninety-six feet, without being connected at either or both ends with larger mains.

I regret very much that I am unable to give as good an account of the distribution of the late Districts of Southwark and Moyamensing, supplied from Fairmount; a lamentable want of system is apparent in both of them, and a sad want of feeders and proper circulation is noticeable in each.

I have information of pipes having been laid upon one street, in a continuous line, in the following manner: commencing at the feeder with pipes of six inch, for one or two squares, then reducing to four inch, then a length of three inch, and finally enlarging again and running several squares of six inch. A most injurious practice has also prevailed in both the districts; that of allowing (in fact requesting) the property owners to lay in public streets their own private pipes, the result being an entire disorganization of all system. Pipes have been put down of a light, defective character, and

laid in a cheap, imperfect manner, causing frequent leaks, and requiring much attention to keep them in proper order, attended with additional expense to the city, and sometimes by loss of water. Again, parties who laid down pipes under these conditions, when they were the owners of the bulk of the property upon the streets so laid, when the houses changed owners have refused to allow the new owners to attach to their pipes. Such privilege will on no account be granted hereafter. Many of the stop-cocks of these districts are found to be defective in plan and execution, some of them being almost useless. Every effort will be made to improve the distribution of the districts, but from what has been said above, it will be seen that it will not only require much time, but much money.

SCHUYLKILL WORKS,

Situated on the east side of the Schuylkill, about three-fourths of a mile above Fairmount, have now three low pressure condensing engines in use, and a full Cornish engine almost ready for action. Two of the engines have vertical steam cylinders, thirty-six inches diameter and six feet stroke, with lever beam and fly wheels eighteen feet diameter and eighty-four hundred pounds weight; the pumps, placed vertically immediately under the steam cylinders, are eighteen inches diameter and six feet stroke. The other engine has a vertical steam cylinder, thirty-six inches diameter and six feet stroke, driving by means of a half beam or bell crank, a double acting pump, placed nearly horizontal, twenty-two and one-half inches diameter and four feet stroke.

The steam for the three engines is generated in four tubular and flue boilers thirteen feet eight inches long each, containing three flues, eighteen inches diameter, and ninety-four tubes two and three-quarters inches diameter each.

The engines, pumps and boilers of these works, from over work and very great want of the proper attention, were found to be in most miserable condition in every part. One of the engines has been completely overhauled, and is now in excellent order; the second has been partially repaired and is in reasonably good order, but time has not yet been afforded to repair it completely, or to commence the repairs to the third engine.

The engines were not provided with steam pressure, or vacuum gauges, or in fact any of the usual means of ascertaining their good or bad working condition, and very little precaution was observed for retaining and economizing the heat and preventing the condensation of the steam.

I have had proper gauges made, and provided each of the engines with counters to register the number of strokes made by them, and adopted other means to ascertain if the engines do their duty.

I have also caused the steam pipes, steam drums, cylinders, and other exposed parts of the engine to be covered with thick hair felting, whereby much steam, and consequently fuel, may be saved, particularly in cold weather.

The boilers have had the brick work of their furnaces completely remodeled and rebuilt, from which considerable advantage has been derived in the freedom with which the fires now burn. The flues, which were found to be choked

up and almost filled by long accumulated dirt, have been completely cleaned, and the tubes repaired; the boilers may now be said to be in good working order.

The new engine has a steam cylinder sixty inches diameter and ten feet stroke, working at the opposite end of the lever beam, a single-acting plunger pump, thirty inches diameter and ten feet stroke; the steam will be generated in four boilers, fifty-four inches diameter, thirty feet long, having two heaters running in the direction of its length under each, twenty-six inches diameter and twenty-two feet long.

I have caused these boilers to be connected to the old vertical engines as well as to the Cornish engine, so that should any accident occur to the old boilers, the old engines could still be run with the new ones.

The Cornish engine is comparatively new in this country, but as it has long been admitted in Europe to be the best adapted to the work of pumping water, much advantage will undoubtedly be derived from its use. Its action differs from the ordinary steam engines in this, that the steam acts only upon the upper side of the piston, and by depressing it, thereby raises the plunger of the pump upon the opposite side of the lever beam; the plunger is made of sufficient weight to force the water to the reservoir and overcome its friction in the ascending main; it will be seen that the engine expends no more power than what is just sufficient to lift this weight, the water being forced up by the fall of the weight alone. Expansion of the steam is carried to great extent in these engines;

condensation is very perfect, and every possible precaution is used by clothing the steam pipes, cylinder, and boilers with non-conducting substances, that no steam shall be lost. For this purpose the engine will first have its cylinder surrounded by a second cast-iron cylinder, called a jacket, leaving a space between the two into which a small amount of steam is admitted; this jacket will be inclosed in thick hair felting, around which will be built a brick wall, which will be surrounded by a wooden case; the steam pipes will all be felted and the boilers are covered to a considerable depth with loam. The contractors for building the engine have guaranteed a duty of fifty million of pounds raised one foot high, with one hundred pounds of coal; and when it is mentioned that the other engines at these works have never done a duty of more (if they ever done as much,) than twenty-five millions of pounds raised one foot high with one hundred pounds of coal, a comparison of the economy of the two kinds of engine can easily be made.

It is much to be regretted, however, that this engine will labor under very great disadvantage from the want of a proper ascending main; and its duty will undoubtedly be restricted thereby. The arrangement of the ascending mains at these works is very objectionable; the four pumps are connected by two mains of twenty-five inches, and two of eighteen inches, with a large cast-iron box six feet wide by ten feet long, from which two ascending mains of eighteen inches, and one of twenty inches diameter, are carried to the reservoir, a distance of three thousand two hundred and fifty feet, so that the four pumps have but three mains; it is therefore obvious that

should an accident occur to the box into which they enter, (and from its large flat sides it is much exposed,) the entire means of pumping into the reservoir would be completely cut off, and as much time might elapse before a repair could be effected, there would be great danger of the supply of water to the district failing. To obviate this risk, as far as is now possible, I have caused a main of twenty inches in diameter to be laid, connecting with one of the twenty-five inch mains below the box, and by running around it attaching to the twenty inch main above it; by this arrangement, should the box unfortunately burst, we will have at least one main to use whilst repairs are being made. This main I shall attach to the Cornish engine, as danger must be anticipated if we pump into the box with a single-acting pump at the same time with those that are double-acting.

The main is, however, only twenty inches diameter, whilst the Cornish pump is thirty; each pump should have its own main, for many reasons, which must be obvious.

The Cornish pump should raise about 4,018,636 gallons, and the others together, 6,177,600, making a total of 10,196,236 standard gallons per twenty-four hours; all the engines raise the water one hundred and fifteen feet perpendicular.

The pumps all receive their supply from a subsiding reservoir between the river and the engine-house, four hundred and forty-four feet wide, supplied by a tunnel two hundred and twelve feet in length.

The buildings are of stone, of substantial character and in good repair—a railroad track is brought in from the Reading Railroad, to extensive coal shutes, offering every facility for

receiving a supply of coal from that source. The engine house has two ornamental brick chimney stacks, one eighty-five feet, and the other one hundred and six feet in height. The grounds attached to the works have an area of about eight acres.

Previous to my taking charge of the works, a wharf had been built and sunk on the river front of the works, but not filled in; I have caused it to be filled in, sufficiently to insure its safety: but, as earth was exceedingly difficult to obtain at reasonable cost, I have left a large space, which it is intended to fill gradually with the cinder from the fires, of which considerable quantities are formed. I cannot but think the building of the wharf in the direction, and to the distance in the river to which this has been extended, as injudicious. It has been carried to within fifty feet only of the eastern pier of the Girard Avenue bridge, causing a great contraction just at the point where the tunnel, which conducts the water into the subsiding basin, commences — exposing it, as well as the wharf, to danger. During the past winter the ice jammed and sunk by its weight at the mouth of the tunnel, almost to the bottom of the river, very much endangering the flow of water into it, and causing much labor and constant attention, to prevent its being dammed up and entirely closed by the ice. The wharf does not appear likely to be very useful. A new railroad track and weigh scale, of larger size than the one formerly in use, has been put in, and new coal shutes are now erecting, in which from six to eight hundred tons of coal can be stored, and from which a railroad track will be carried into the boiler houses.

THE STORAGE

Of these works consists of one reservoir of the embankment kind, lined with bricks, and divided into two equal parts by a partition bank; it contains, when full, nine million, eight hundred thousand gallons, equal to a little less than two and two-third days of the average supply of the year 1854, and about two days only of the average supply of the month of July in that year. It is quite evident that the reservoir is too small; as, should any accident occur to prevent pumping for two days, (which might happen, should the box abovementioned unfortunately burst,) the portion of the city supplied from these works, would be without water. Provision should, I think, be made for an increase of storage, at no distant day.

The best means of doing this becomes a very difficult matter, indeed, to decide. The city owns a property north of the present reservoirs, which was purchased for an additional one, but as the ground does not admit of a reservoir of any greater altitude being built upon it than that now in use, (which is evidently too low to supply properly much of the district for which it is intended,) it becomes a very serious consideration whether it will be advisable to erect reservoirs upon it or to seek for higher ground for that purpose. The great difficulty, if the latter course was taken, is the necessity of very many material and expensive changes in the whole pumping machinery and in the supply and distributing mains. The subject is one requiring a very close investigation. I am clearly of the opinion that it will scarcely be ad-

visable to erect new reservoirs upon the site selected. The necessity for the possession of a higher point than that now used may be seen from the fact that there is an intended curb regulation in a portion of the city, which these works will have to supply, which is not more than five feet below the water level of the present reservoirs. The reservoir appears to be in very good order.

THE DISTRIBUTION

Of the late District of Spring Garden, as far as I have been able to judge, is in good condition. The feeders, however, are rather limited both in number and size, and the principal supply mains have been heretofore much too small for so extended a district, there being but two mains of sixteen inches diameter each. During the last summer, the District laid down a new supply main thirty inches diameter, but it was not attached to the reservoir; I have recently, however, cut through the embankment of the western section and made the attachment. Whilst the bank was open for the purpose, a second thirty inch main was laid in the same opening, and a stop-cock placed upon it, which may hereafter be used as an additional pumping main. The new thirty inch main is however too short, and has too few attachments of sufficient size for it to be very serviceable, unless further extensions be made and the connections enlarged.

It can only be considered as a partial relief from the complaint of deficient mains. I think also, had it been laid after, instead of before consolidation, a position would probably

have been found, where it would have been more generally available than it is likely to be at present. The water has been let into the main, but two of the pipes have burst, although at points where the head of water upon them was very limited; in one case causing considerable damage before the water was stopped. The distribution of the late District of Northern Liberties is the best, as regards system and completeness, of any of the districts surrounding the city proper; it may almost be said to be a finished work, very little more pipe being required to complete it entirely; the pipes, cocks, plugs and other fixtures, appear to be in exceedingly good condition. In the late District of Penn, a considerable amount of pipe has been laid, and the distribution, as far as I have been able to judge, appears to be in fair condition and available, except that sufficient feeders are wanted.

DELAWARE WORKS,

Are situated upon the Delaware river, at the foot of Wood street, late District of Kensington. The power consists of one high pressure horizontal steam engine, thirty inches diameter and six feet stroke, working a horizontal double acting force pump, eighteen inches diameter and six feet stroke, by means of a vertical lever beam eighteen feet in length; the pump being placed eighteen feet below the steam cylinder. A connecting rod at the upper end of the beam, gives motion to a fly-wheel twenty-two feet diameter and eight and one half tons weight. The pump attached to this engine is a very good one, and in excellent order; the engine,

however, requires some repairs to the valves, which will be attended to when opportunity offers. There is also a low pressure condensing engine, with steam cylinder forty-two inches diameter and six feet stroke, with lever beam and fly-wheel; the pump is placed horizontal, and is nineteen and seven-sixteenth inches diameter, and six feet stroke; the piston rod of the steam cylinder passes through its bottom, and drives a bell crank or half beam, by means of which the pumps are driven. The engine is now in very good working order, the pump chamber, however, has been cracked, and may give out at any moment; a new one will be provided, so that should an accident occur, there may be as little delay as possible, in making the repair.

Both the pumps draw their water through twenty-five inch pipes, about four hundred feet in length; they are provided with air chambers on the discharge pipe, of very large size, containing about two hundred and thirty cubic feet; there are also small air chambers on the receiving side of the pump.

The low pressure engine is driven by a tubular boiler, which works well, and is in fair condition.

The high pressure engine was driven by a gang of six cylinder boilers, forty inches diameter, and forty-six feet in length; but finding them very badly set, and exceedingly wasteful of fuel, and feeling satisfied that they might be much improved, I have directed their alteration by cutting them off to a length of twenty-six feet, and placing a heater under each, thirty inches diameter, and sixteen feet six inches long; this change is now being made.

When we were obliged to run the high pressure engine and

boilers recently, it was found that the extra cost for fuel beyond what would have been necessary to run the low pressure engine and boilers, amounted in two weeks to two hundred and seventeen dollars; and the cost, by trial, when the low pressure engine was run, with the cylinder boiler, was at least eight dollars per day more than when the same engine was driven by the tubular boiler. It is believed that the alteration now making will make the cylinder boilers equal, if not superior, in point of economy to the tubular one now in use. The two engines have but one ascending main, eighteen inches diameter, and the very great length of thirteen thousand two hundred and sixty feet, or about two and one-half miles. The engines would be very much relieved, and considerable danger of accident to the works avoided, by the erection of an overflow stand pipe at the engine house. The length of the main is unprecedented in this country, and the additional head caused by the friction of the water forced through it is very considerable, varying from twenty-one to thirty-five feet, according to the velocity at which the pumps are worked.

The water is raised to a perpendicular height of one hundred and twelve feet.

The engine and boiler house is a substantial brick building, in good repair.

The reservoir of the Delaware Works, situated at the corner of Sixth street and Lehigh avenue, is of the embankment kind, divided into two sections, and will contain, when filled to the depth of twelve feet, nine million two hundred and eighty-four thousand gallons; equal to nearly five and one-half days of the average supply of 1854. They are in reasonably good condition,

although evidently erected in a defective and careless manner. The water level, when they are full, is one hundred and fourteen and a quarter feet above city datum.

Much of the distribution of late Richmond and portions of Kensington, is in a very defective condition; not only in regard to its small size, but on account of the manner in which it has been laid down—the lead joints being so small, in many cases, as scarcely to deserve the name, causing great trouble and expense. Scarcely a day passed last winter but one or more of them leaked or was blown out; joints have been taken out of six-inch pipes which were not more than a fourth of an inch in depth, and of course totally inadequate to withstand the pressure. This condition of affairs is evidently the result of laying pipes by contract, in which manner many of the pipes laid in the districts supplied from Delaware Works, have been done. The situation of the engine-house of these works is very unfortunate, it being but a few hundred feet below the mouth of Gunner's Run, a small stream already very much contaminated by its passage through the district, and by the factories now situate on it. As the district becomes more thickly built up, the wharves extended, and the factories increased in number, the bad selection of the site becomes more apparent, and the more to be regretted, and must eventually cause the works to be abandoned or removed.

TWENTY-FOURTH WARD WORKS,

Now being erected, under a contract made with the late Commissioners of West Philadelphia, are situated on the west

side of the Schuylkill, a short distance above Fairmount Dam. A basin has been excavated on the river, one hundred and sixty-five feet long and seventy-five feet wide, with sixteen feet depth of water at ordinary stage of the river. This is supplied from the river through a brick tunnel and a thirty-inch pipe; upon the western end the engine and boiler houses are situate. The power will be two of what are called "Bull Cornish Engines," or such as are direct-acting, the pump being placed immediately under the inverted steam cylinder, without the usual lever beam. They have a steam cylinder of fifty inches in diameter and eight feet stroke, with a plunger pump of seventeen inches diameter and eight feet stroke. Steam will be generated in two gangs of two each, of full Cornish boilers, six feet diameter and thirty-two feet long, with an internal flue in each of four feet diamter, in which the fire is made.

No reservoirs for storage were contemplated by the originators of the design for the works; reliance being placed entirely on a stand pipe now erected. It is made of boiler plate iron, five feet diameter and one hundred and thirty feet high, surrounded by a stone base with a spiral stair case, and is quite ornamental. It was intended that the water should be pumped in at the bottom, and discharged at a point sixteen feet above the bottom. Considering this an objectionable plan, as it would admit of an oscillation of the column of water from that height to the top of the pipe, I have directed a pipe of eighteen inches in diameter to be placed inside of it, extending from the base to the height of at least one hundred feet; this will insure a constant head of not less than one

hundred feet, which is more to be desired when Cornish engines are employed, than with any other, as it is actually necessary that the plunger of the pumps should be weighted to a nearly uniform head.

Stand pipes, where a constant supply of water is required, are very uncertain and unreliable, it being obvious that the supply must depend upon the constant motion of the engine; which presupposes their always being in good repair, and the positive watchfulness of the enginemen.

They are, moreover, an expensive means of supply, as, without a retaining reservoir, the engine is obliged to be worked continually, which might, for a considerable length of time be unnecessary, if a reservoir was used, as the pump would probably raise in a few hours in each day, or a few days in the week, all the water required to supply the district, without the necessity of running constantly, or at all events, at night.

Another disadvantage in the system is, that the amount of draught upon the mains is limited to the capacity of the engines, although the mains might be capable of delivering, in a given period, a much greater quantity of water under the constant head produced by a reservoir, than the engines could possibly pump up in the same time.

This might prove a very serious disadvantage in case of extraordinary large demand for water, occasioned by extensive conflagrations, or other causes.

The stand pipe, to say the least, will be an exceedingly unsatisfactory arrangement, and one that can only be at all useful whilst the demand for water is limited to a quantity of considerably within the capacity of one of the pumps to deliver.

The position of the engines and pumps is very badly chosen, being in a cove of the river, where much dirt is deposited by every freshet; there is now, directly in front of the tunnel leading to the basin of the works, a bar extending out from the shore some three or four hundred feet, there being upon it now an average depth of water not exceeding three feet.

In consequence of the formation of this bar, the Schuylkill Navigation Company propose converting it into an island, by dredging a canal through it; they also intend making changes in the line of the towing path. On this account, it has become necessary to extend the tunnel intended to supply the subsiding reservoir to a point at least forty feet beyond what was originally intended. This work is now being done.

It is the more unfortunate that this point should have been selected, inasmuch as there is a position about fifteen hundred feet further up the river, where a depth of water of eighteen or twenty feet can always be obtained with hard rock bottom, at which place the strong current caused by a contraction in the river, and by its passage around a point, will never allow the formation of a bar or obstruction.

Much money has been expended on these works in the construction of a subsiding reservoir on the river, which I believe to be almost, if not quite, unnecessary, as it is not of sufficient size to serve long as a subsiding basin, and can be of little use in any other respect. A tunnel, and a sufficiently large well in the engine house, would have answered every purpose; and the money which has been expended upon the so called subsiding basin, would have gone far towards building what would certainly have been much more useful, a proper retaining and distributing reservoir.

So large a sum of money had been expended upon the works, and they had progressed so near completion when they came under my charge, that very little could be done to improve their situation or plan. Anything tending to prevent their being put into operation early, beside being a positive disadvantage to the citizens of the ward, prevented the city receiving repayment of a considerable sum for the distributing pipe laid, as well as a revenue from water rents. It was therefore thought advisable to get the works started as early as expedient in their present form, and to erect a proper retaining reservoir on some suitable point, hereafter, which, if the pumping machinery be retained at the present site, can be filled through the medium of the stand pipe, for which purpose it will then be a useful auxiliary.

As I have no confidence in the availability of the stand pipe as a permanent means of supply, I would strongly urge upon Councils the purchase of a proper site, and the erection thereon of a suitable retaining reservoir.

The severity of the past winter prevented the completion of the masonry of the works as early as was contemplated. The basin is now completed; the engine and boiler house are erected; one of the engines and pumps can be finished in a few weeks, and the other soon after; the brick chimney stack is now being erected; and a portion of the main to the stand pipe will soon be laid. Some detention to the starting of the works will occur from the fact that the street through which the ascending main must pass, is not yet graded, or dedicated to public use; it is believed, however, that this may soon be done, when one of the engines, at least, can be started.

DISTRIBUTION.

About eleven miles of distributing mains have been laid. At several points, the pipes have been carried to their termination, considerable distance without cross-attachments, producing what are technically called dead ends, and a want of proper circulation, which will undoubtedly cause trouble at those points, unless corrected. Which, however, cannot be accomplished immediately, as it will entail some expense and require time; it will, however, be done as soon as opportunity offers.

RECAPITULATION.

POWER.

	PER DAY.	
Fairmount Works, nine wheels and pumps capable of raising - - -	13,901,184	galls.
Schuylkill Works, Four Steam Engines, do	10,196,236	"
Delaware Works, Two do do	4,026,240	"
Twenty-fourth Ward, Two do do	1,780,272	"
Together.	29,903,932	"

STORAGE.

Fairmount Works, - -	47,218,028	standard gallons.
Delaware Works, - -	9,284,052	" "
Schuylkill Works, - -	9,800,000	" "
Together,	66,302,080	" "

DISTRIBUTION.

FAIRMOUNT WORKS.

Old City,	has	87⅜	miles and	135	feet of pipes laid, and	683	Fire Plugs.
Southwark,	"	21⅞	"	414	"	115	"
Moyamensing,	"	14¾	"	441	"	154	"
Fairmount W'ks,		123¼	"	330	"	952	"

SCHUYLKILL WORKS.

Spring Garden,	has	39⅛	miles and	281	feet of pipe laid, and	351	Fire Plugs.
Northern Liberties,	"	18	"	297	"	187	"
Penn,	"	10⅜	"	135	"	102	"
Schuylkill Works,		68⅛	"	53	"	640	"

DELAWARE WORKS.

Kensington,	has	33⅞	miles and	000	feet of pipes laid, and	279	Fire Plugs.
Richmond,	"	5½	"	357	"	49	"
Delaware Works,		39⅜	"	357	"	328	"

24th Ward has 10⅞ miles and 371 feet of pipe laid, and 105 Fire Plugs.

Fairmount Works	has	123¾	miles and	330	feet of pipe laid,	952	Fire Plugs.
Schuylkill Works,	"	68⅛	"	53	"	640	"
Delaware Works,	"	39⅜	"	357	"	328	"
24th Ward Works,	"	10⅞	"	371	"	105	"
Together,		242 3-16	"	121	"	2,025	Fire Plugs.

Size of Pipes laid in the Old City Proper.

1½	inch diameter,	2,258	feet,
3	"	123,409	"
4	"	26,269	"
6	"	183,200	"
8	"	9,745	"
10	"	50,668	"
12	"	23,832	"
16	"	10,553	"
20	"	*20,245	"
22	"	*2,661	"
30	"	*18,735	"
		461,575	" equal 87⅜ miles & 135 ft.

Late District of Spring Garden, has laid

3	inch diameter,	2,174	feet,
4	"	43,318	"
6	"	109,182	"
10	"	35,865	"
12	"	3,940	"
16	"	*10,562	"
30	"	*4,460	"
		209,501	" equal 39⅝ miles & 271 ft.

* Supply Mains from Reservoirs.

Late District of Northern Liberties.

3	inch diameter,	4,167	feet,
4	"	28,161	"
6	"	38,859	"
8	"	600	"
10	"	23,750	"
		95,537	" equal 18 miles & 297 ft.

Late Penn District.

4	inch diameter,	15,923	feet,
6	"	39,117	"
		55,040	" equal 10⅜ miles and 135 ft.

Late Richmond.

4	inch diameter,	1,415	feet,
6	"	19,274	"
10	"	8,708	"
		29,397	" equal 5½ miles and 357 ft.

Twenty-fourth Ward.

4	inch diameter,	14,984	feet,
6	"	11,491	"
8	"	11,226	"
10	"	10,296	"
12	"	9,774	"
		57,771	" equal 10⅞ miles & 371 ft.

ACCOUNT OF THE CONSUMPTION OF WATER AND OPERATION OF THE FAIRMOUNT WATER WORKS, DURING THE YEAR 1854.

MONTHS.	Total Quantity of Water pumped during the year, Ale Gallons.	Average amount pumped per day, Ale Gallons.	Total Number of hours the Breast Wheels worked.	Average Number of hours each wheel runs per day.	Total Number of hours the Turbine worked.	Average daily work of the Turbine.	Average depth of water flowing over the dam.	Rain Fall during the year.	Average temperature of the month.
							Inches.	*Inches.*	
January, - -	138,573,520	4,470,113	1,986	7.80	296½	9.56	16.22	2.33	32.35
February, - - -	108,386,070	3,870,931	1,548	6.90	168	6.00	21.25	4.20	31.05
March, - - -	166,771,186	5,379,714	2,818½	9.34	368	11.70	18.29	1.62	43.00
April, - - -	160,076,480	5,335,882	2,819½	9.66	271½	9.05	18.93	7.75	51.25
May, - - -	187,428,983	6,045,935	2,875	11.59	396	12.79	20.19	6.94	65.00
June, - - -	222,735,260	7,424,509	3,113	12.97	447	14.90	15.26	2.39	71.86
July, - - -	263,083,420	8,486,562	3,815½	15.38	467½	15.08	11.22	3.02	78.83
August. - - -	260,846,208	8,414,398	3,788½	15.25	417½	13.46	10.95	0.84	75.75
September, - -	238,547,110	7,951,570	3,384½	14.10	457	75,23	10.93	3.80	69.05
October, - - -	215,797,175	6,961,199	3,155½	12.72	546	11.16	13.32	1.54	58.77
November, - -	178,332,440	5,944,415	2,680	11.16	129½	4.31	16.00	2.84	45.04
December, - - -	145,829,425	4,704,175	2,368	9.55	48	1.55	15.21	2.91	31.00
Totals,	2,286,402,222	6,264,115	33,302	11.40	3,807½	10.43	15.64	40.18	54.51

The greatest amount of water running over the dam, was 5 feet 6 inches, on Sunday March 27, 1854.

ACCOUNT OF WATER PUMPED BY ALL THE WORKS, IN THE YEAR 1854.

MONTHS.	TOTAL AMOUNT OF WATER PUMPED EACH MONTH.			AVERAGE PER DAY FOR EACH MONTH.			Total pumped by all the Works, each month.	Average per day pumped by all the Works.
	FAIRMOUNT.	SCHUYLKILL.	DELAWARE.	FAIRMOUNT.	SCHUYLKILL.	DELAWARE.		
January, - -	138,575,520	88,653,304	49,006,729	4,470,113	2,859,784	1,580,862	276,233,553	8,910,759
February, - - -	108,386,070	64,069,324	41,610,424	3,870,931	2,645,333	1,450,372	214,065,818	7,966,636
March, - - -	166,771,136	93,630,323	50,429,608	5,379,714	3,020,333	1,626,761	310,831,067	10,026,808
April, - - -	160,076,480	92,499,990	49,231,168	5,335,882	3,083,333	1,641,039	301,807,638	10,060,254
May, - - -	187,423,983	116,250,000	54,177,086	6,045,935	3,750,000	1,747,648	357,851,069	11,543,583
June, - - - -	222,735,260	136,291,770	57,593,704	7,424,509	4,543,059	1,913,123	416,620,734	13,880,691
July, - - -	263,083,420	148,584,705	76,651,857	8,486,562	4,793,055	2,472,640	488,319,982	15,752,257
August, - - -	560,846,203	145,183,354	41,764,051	8,414,393	4,683,334	1,347,227	447,793,608	14,444,954
September, - -	238,547,110	143,583,420	54,177,786	7,951,570	4,786,114	1,805,936	436,308,316	14,543,620
October, - - -	215,793,175	142,082,827	55,213,004	6,961,199	4,583,317	1,781,064	413,093,006	13,325,580
November, - -	178,332,440	108,124,560	49,005,162	5,944,415	3,604,152	1,752,365	335,462,162	11,300,932
December, - - -	145,829,425	87,057,982	39,512,542	4,704,175	2,808,322	1,274,598	272,399,949	8,787,095
Totals,	2,286,402,222	1,366,011,559	618,173,121	6,264,115	3,742,497	1,693,625	4,270,786,902	11,700,786

The average supply from all the Works, in the month of July, was rather over forty-six gallons per day for each of the population of the portion of the city supplied with water.

ACCOUNT OF COAL CONSUMED AT SCHUYLKILL WORKS,

During the year 1854.

January,	213 tons	1 cwt.	2 qrs.	0 lbs.
February,	176	12	1	0
March,	215	16	0	0
April,	213	17	3	14
May,	227	17	3	0
June,	287	14	3	0
July,	330	18	1	27
August,	320	2	3	0
September,	329	4	1	0
October,	274	18	6	0
November,	262	4	2	0
December,	196	17	1	0
	3,049	6	3	13

Being an average of 8 tons, 7 cwt. 0 qrs. 9 lbs per day.

The account of Coal consumed at Delaware Works, had not been kept with sufficient accuracy to warrant its insertion here.

The comparative Cost of Pumping by each of the Works, per Accounts of 1853, *was as follows:—*

The cost of each includes Wages, Fuel, Packing, Oil, Tallow, and Repairs to the Machinery, Boilers, Engines, Wheels and Pumps, without including interest on the cost of the Works in either case.

FAIRMOUNT WORKS.

Nine wheels and pumps, cost to run, $9.35 per day, to pump an average of 6,231,395 gallons per day.

SCHUYLKILL WORKS.

Three engines and pumps, cost to run, $51.48 per day, to pump an average of 3,851,388 gallons per day.

DELAWARE WORKS.

Two engines and pumps, cost to run, $28.59 per day, to pump an average of 1,574,317 gallons per day.

Of which was expended for repairs to all the Machinery, Engines, Boilers, etc.

Fairmount Works,	$83 36	for the year.
Schuylkill Works,	2,563 63	"
Delaware Works,	360 09	"

The cost per above, including repairs, per million gallons of the average raised per day, is as follows:—

Fairmount Works,	$1 50	per million gallons raised.
Schuylkill Works,	13 36⅔	" "
Delaware Works,	18 16	" "

Account of the Expenditures

FOR

FAIRMOUNT WATER WORKS,

FOR THE YEAR 1854.

ABSTRACT OF PAYMENTS MADE FOR ACCOUNT OF THE FAIRMOUNT WATER WORKS,

From January 1st, 1854 *to December* 31st, 1854, *both included.*

Distribution.	*Dolls.*	*C.*	*Dolls.*	*C.*
Wages of workmen during the year, to November 30, 1854,	2522	53		
Ground Rent on Shop lot,	26	66		
Force Pump,	25	00		
Hydrant pumps and pump-boxes,	165	00		
Horse cover,	5	75		
Closet at Cherry street Office,	9	00		
Lead pipe,	16	72		
Red padding for plug packing,	16	56		
Hay for cart horse,	47	75		
Horse feed for cart horse,	47	03		
Shoeing for cart horse,	6	75		
Pump leather,	89	32		
Zinc paint,	11	00		
Lumber for cock-boxes, etc. etc.,	321	48		
Hardware and nails,	27	87		
Wrought-iron,	13	20		
Bricks,	18	00		

Plumbers' work,	27 80		
Paints and oils,	31 66		
State tax on shop lot,	10 92		
	—	3440	00

Iron Pipes.

Wages of workmen to November 30, 1854,	2100	23	
Smiths' Coal,	56	00	
Sheathing stop-cock spindles,	51	10	
Iron pipes and branches, etc. etc.	2821	15	
Cast iron plug cases,	1999	34	
Lumber,	71	00	
Hardware,	38	00	
Chandlery, yarn, etc.	4	42	
Wrought-iron,	103	26	
Brass ferrule and cock castings,	197	93	
	—	7442	43
Amount carried forward,		10882	43

	Dolls.	C.	Dolls.	C.
Amount brought forward,			10882	43
Fairmount Works.				
Wages of workmen,	1853	80		
Taxes on all the property of the works,	998	00		
Coal for heating mill-house,	57	75		
Lumber,	119	49		
Removing sunken boat from the dam,	30	00		
Painting house, Twenty-second and Brown streets,	57	75		
Papering house Twenty-second and Brown streets,	12	46		
Giving grade stakes for footways at New Reservoir,	32	00		
Cleaning marble work of fountain,	20	00		
Carpenters' work,	141	95		
Hydraulic cement,	12	50		
Repairs to wheel No. 8, and for new crank-wheel,	284	27		
Filling up footways Corinthian avenue,	120	00		
Mowing reservoir banks,	15	00		
Lime,	12	60		
Hardware,	13	21		
Plumbers' work,	50	70		
Black varnish for pumps,	6	25		

Blacksmiths' work,	10 05		
Sundry small articles for use of Works,	10 92		
		3858	70

Water Power.

Wages of workmen,	1894 00		
Oils,	602 79		
Chandlery,	31 25		
Paints,	9 80		
Repairs,	5 85		
		2543	69

Salaries.

Engineer,	2603 76		
Register,	2000 00		
Messenger,	700 00		
		5303	76
Amount carried forward,		22588	58

	Dolls.	C.	Dolls.	C.
Amount brought forward,			22588	58
Incidentals.				
Fees for professional services—suit versus Hart, - - - - -	3500	00		
Payment of Witnesses, - " " - - - - -	325	00		
Desk and table, Office Cherry street, - - - - - -	36	00		
Small bills Register's Office, - - - - - - -	50	00		
Analyses of the water, - - - - - - - -	35	00		
Lithograph of fire plug, and mounting the same, - - - - -	135	00		
Sundries for Corporation, Annual Celebration, April 28, 1854, - - -	645	90		
Carriage hire, - - - - - - - - -	80	00		
Printing Annual Report, and for books and stationery, - - - -	665	87		
Payment of water discoveries, - - - - - - -	51	24		
Awning for Register's Office, - - - - - - -	7	00		
Small articles, use of works and offices, - - - - - -	28	49		
			5559	50
			28148	08

Recapitulation.

Distribution,	3440	00
Iron Pipes,	7442	43
Fairmount Works,	3858	70
Water Power,	2543	69
Salaries,	5303	76
Incidentals,	5559	50
	28148	08

The above account only includes payments made up to and including November 30, 1854, no appropriation having been made to this department after that date, in 1854. This, therefore, leaves a sum due, strictly chargeable to the expenses of 1854, but as it could not be paid until 1855, it is not included in the above account.

Sums Paid into the Treasury, from Dec. 31, 1853 to Dec. 31, 1854.

			Dolls.	C.
Jan'y	19	Rent of wharf, Fairmount, due January 1, 1854,	100	00
May	30	Rent of lot south side New Reservoir,	12	50
June	5	Sundries, old articles sold,	10	02
July	10	Rent of wharf and the two lots north and south of the New Reservoir,	127	50
Sept.	29	For expense of shifting fire plug,	12	30
Oct.	4	Rent of lots north and south of New Reservoir,	27	50
Oct.	28	Wharfage, etc., received from Kensington Works,	52	00
Nov.	9	Wharfage, etc., received from Kensington Works,	11	50
Dec.	29	Wharfage from Cumberland Coal & Iron Company, for wharfage for Nov. & Dec.,	60	00
			413	32

ACCOUNT OF IRON PIPES LAID IN THE OLD CITY.

	FEET.
Pipes laid in former years, from October 1819 to Dec. 31, 1853,	458,203

PIPES LAID IN 1854.	SIZE.	FEET.	FEET.	
Carver street, westward to Sixteenth street,	3 in.	170		
Factory street, from Willow to Beach, - -	"	318		
Carbon street, from Lombard, northward, -	"	303		
			791	
Oak street, from Filbert to High street, - -	4 in.	330		
To six Fire Plug connections, - - - - -	"	150		
			480	
Beach, from Cedar to near Pine, - - - -	6 in.	595		
Lombard street, west to William, - - - -	"	240		
Twentieth street, north to Arch, - - - -	"	128		
Arch, from Twentieth St., west to Fire Plug,	"	280		
Cherry St., east from Twentieth, to do. -	"	180		
Filbert St, from Broad to Fifteenth, - - -	"	415		
Locust street, from Beach, eastward, - -	"	263	2101	
				3,372
Being 135 feet more than 87⅝ miles,	- -	- -	- -	461,575

Placed six new Fire Plugs,
And removed from the streets 27 hydrant pumps, leaving 222 pumps.

NUMBER OF NEW ATTACHMENTS MADE IN THE OLD CITY, IN 1854.

MONTHS.	½ inch holes.	⅝ inch holes.	¾ inch holes.	1 inch holes.	Total number of holes drilled each month.	Water shut off from Main, for repair to private pipes.
January, - - -	9	4	1	0	14	6
February, - - -	10	8	0	0	18	8
March, - - -	38	7	5	0	50	11
April, - - - -	40	14	1	2	57	6
May, - - - -	56	12	1	0	69	13
June, - - - -	45	14	2	0	61	4
July, - - -	39	4	0	2	45	7
August, - - - -	41	10	3	3	57	13
September, - -	37	17	4	0	58	5
October, - - -	36	5	5	0	46	11
November, - -	34	9	3	0	46	4
December, - - -	9	2	0	0	11	5
Together,	394	101	25	7	527	98

Account of Warrants

DRAWN BY

THE CHIEF ENGINEER

FOR

PAYMENT OF DEBTS DUE AND EXPENSES OF THE WORKS,

FROM THE DATE OF THE

ORGANIZATION OF THE DEPARTMENT

FOR SUPPLYING

THE CITY WITH WATER, UNTIL THE 31ST DAY OF DECEMBER, 1854,

INCLUDED IN APPROPRIATIONS APPROVED

November 24, 1854,—November 27, 1854—and December 29, 1854.

SCHUYLKILL WORKS.

Warrants drawn under appropriation of Nov. 24, 1854.

No. of Warrant		Dolls.	C.	Dolls.	C.
1	Firebricks at engine house, Schuylkill Works, on account, - - -	158	00		
2	Samuel Ogden & Co., for repairs to tools and iron castings, - - -	423	51		
3	J. Thornley, for steam packing, - - - - - - - -	8	00		
4	J. L. Glenthworth, for hardware, - - - - - - -	85	16		
5	Butchers' Melting Association, for tallow, - - - - - -	145	82		
6	Wm. Shane, for packing yarn, - - - - - - - -	41	60		
8	Scott & Monegan, for stone, on account, - - - - - -	100	00		
9	Thos. Irvin, on account, for bricks, - - - - - - -	600	00		
11	Wm. Schwepenhiser, for superintending building boiler-house, - -	200	00		
12	C. S. Smith, for hydraulic cement, - - - - - - -	91	50		
13	D. Carrick, for blasting powder, - - - - - - -	67	11		
14	C. S. Carpenter, for ice for Register's office, - - - - -	14	76		
15	J. S. Watson, for pine wood, - - - - - - - -	342	50		
16	J. H. Fisler, for salary for October, 1854, - - - - - -	66	67		
17	Wm. Stuard, for funeral expenses of man accidentally killed, - -	30	52		
18	T. H. Chase, do do do - -	5	50		
19	J. A. & W. A. Markle, for carriage hire, old Watering Committee, -	11	00		
20	J. Donohue, for carriage hire, old Watering Committee, N. Liberties, -	20	00		
54	J. Everall, for masons' work on new boiler-house, day's work, - -	195	75		

55	J. Everall, on account, do do do per contract, - -	3,339	50
56	J. W. & J. F. Starr, on account of thirty inch main and castings, -	5,460	92
58	J. Lounsberry, for building wharf, per contract, on account, - -	2,384	10
59	Wages of Workmen employed at Schuylkill Works, September 29 to October 31, 1854, - - - - - - - - - -	816	50
61	J. P. Morris & Co., on account, second payment for Cornish engine, -	5,000	00
62	Wm. Willson, on account, laying thirty inch main, - - - -	1,000	00
63	Wm. Metts, for bricklayers' work, September and October, - - -	640	50
64	Moore, Cain & Co., for coal, per agreement, - - - - -	2,505	80
65	Do do do balance due former contract, - - -	429	29
66	Do do do do do do - - -	310	80
67	Wages of workmen in streets, for October, - - - - -	171	42
68	C. Johnson, for wages of engineman, for October, - - - -	66	67
69	J. Rue, do do do do - - - -	50	00
70	B. Farrell, do fireman, do - - - -	41	67
71	M. Stinsman, do do do - - - -	37	50
72	P. Barron, do do do - - - -	37	50
73	T. Jones, do do do - - - -	37	50
74	T. Fulmer, do do do - - - -	37	50
75	G. Esher, do do do - - - -	33	33
76	J. Mongan, do cleaner, do - - - -	33	33
77	L. Jackson, do coal wheeler, do - - - -	37	50
78	M. Tierney, do do do - - - -	37	50
	Amount carried forward,	25,116	23

No. of Warrant		Dolls.	C.	Dolls.	C.
	Amount brought forward,				
	Appropriation approved Dec. 29, 1854.				
		25,116	23		
84	Wages of Workmen, November, engineers, etc., - - - - -	472	25		
85	Do do labor at engine house, - - -	1,223	75		
86	Do do streets, Spring Garden, - - -	121	50		
87	Do do do Northern Liberties, - - -	63	50		
91	Wm. Metts, for wages of Bricklayers at new boiler-house, for November,	452	25		
92	J. Everall, for wages of Masons, do do do	266	12		
119	State Tax on engine house and reservoir property, - - - -	186	00		
29	H. Belfield, for brass ferrules for District of Penn, - - - -	9	00		
				27,910	60

FIRST, SECOND, THIRD AND FOURTH WARDS,

(LATE MOYAMENSING AND SOUTHWARK.)

Appropriation, Nov. 24, 1854.

		Dolls.	C.
26	R. Stileman, for stop-cocks, Moyamensing, - - -	307	09
27	Tatham & Bro's., for pig lead, do - - -	40	75

28	D. Craig, for blacksmiths' work, do - - - -	18	12					
52	Wages of workmen, on streets, do - - - -	221	22					
				582	18			
	Appropriation, December 29, 1854.							
88	Wages of workmen, on streets, 1st, 2d, 3d and 4th Wards, Nov.,	115	07					
89	Do do do 1st Ward, November, - -	22	50					
				137	57			
						719	75	
	LATE KENSINGTON AND RICHMOND.							
	Appropriation, Nov. 24, 1854.							
36	Wm. B. Elliott, for coal for engines, Kensington, - - -	2,025	38					
37	G. A. Landell, for tallow do do - - -	121	76					
38	H. Gorgas, for pine wood, do do - - -	12	50					
39	E. H. & H. Gorgas, do do do - - -	90	00					
41	Einwechter & Bro., for brick work to boilers, Kensington, -	11	75					
42	R. Stileman, for stop-cocks, Kensington, - - - -	121	75					
43	J. M'Kenzie, for repairing main, do - - - -	3	12					
44	Reaney, Neafie & Co., for repairs to engines, Kensington, -	710	41					
45	Jacob Rush, for carpenter work on coal bin, .do -	45	82					
	Amounts carried forward,	3,142	49			28,630	35	

No. of Warrant		Dolls.	C.	Dolls.	C.	Dolls.	C.
	Amounts brought forward,	3,142	49			28,630	35
46	Brown & Woelppe, for joist for coal bin, Kensington, - -	13	15				
47	Geo. Warley, for coal, Kensington, - - - - -	807	00				
48	C. Test, for salary of Register, September and October, -	133	34				
50	J. P. Dehaven, wages of engineman, October, Kensington, -	62	50				
53	Wages of firemen, Henry Kunz, do do -	40	00				
57	Wages of firemen, do - - - -	110	18				
60	Wages of firemen and engineman, do - - - -	129	54				
30	Wages workmen, pipes, &c., for August, Richmond, - -	55	50				
31	M. Johnson, making attachments, do - - -	21	50				
32	J. Ronney, driller, do - - -	40	50				
33	L. Walton, smiths' work, do - - -	3	18				
34	S. R. Lyons, oil, do - - -	3	36				
35	C. Peall, salary of Register, for September, do - - -	66	67				
51	Wages of workmen, September and October, do - - -	282	49				
				4,911	40		
	Appropriation, December 29, 1854. -						
83	Wages of workmen, November, Kensington, - - -	446	32				
90	Do do do Richmond, - - -	125	00				
119	State tax on works, Kensington, - - - - -	24	00				
				595	32		
						5,506	72

OLD CITY.

Appropriation, November 24, 1854.

21	R. Hutchinson, for pump leather,	30 75		
22	H. Coleman, for oils,	57 85		
23	F. Graff, salary to November, 1854,	228 76		
24	G. W. McMahan, salary to November, 1854,	166 66		
25	G. W. Harvey, salary to November, 1854,	58 34		
79	Wages of workmen for October,	661 80		
			1,204 16	

Appropriation, December 29, 1854.

82	Wages of workmen for November,	668 06		
93	F. Graff, salary for November,	250 00		
94	G. W. McMahan, salary for November,	166 67		
97	G. W. Harvey, do do	58 33		
104	F. Graff, do December,	250 00		
105	G. W. McMahan, do do	166 66		
	Amounts carried forward,	2,650 72	1,204 16	34,137 07

No. of Warrant		Dolls.	C.	Dolls.	C.	Dolls.	C.
	Amounts brought forward,	1,559	72	1,204	16	34,137	07
114	G. W. Harvey, salary for December, - - - -	58	34				
119	State tax on Fairmount reservoirs and shop, - - - -	970	92				
				2,588	98		
						3,793	14

SALARIES OF OFFICERS NOT INCLUDED IN THE FOREGOING.

Appropriation, November 24, 1854.

95	B. Mann, Principal Clerk, for November, - - - - - -	50	00		
96	A. J. White, Permit Clerk to November 30, - - - - -	37	50		
98	W. Dougherty, Inspector to do 30, - - - - -	21	37		
99	P. Schuyler, do do - - - - - -	35	00		
100	J. Swartz, do do - - - - - -	35	00		
101	E. McGlue, Purveyor to do - - - - - -	46	66		
102	W. Foster, do do - - - - - -	46	66		
103	G. B. Stackhouse, Messenger, - - - - - -	30	00		
106	B. Mann, salary for December, - - - - - - -	83	34		
107	C. Test, do do - - - - - - -	75	00		
108	R. S. Owens, salary to December 31, - - - - - - -	45	00		
109	A. J. White, do do - - - - - - -	75	00		

110	E. S. McGlue,	do	do	66	66	
111	J. Eldridge,	do	do	66	66	
112	Wm. Foster,	do	do	66	66	
113	A. A. Widdis,	do	do	66	66	
115	J. Swartz,	do	do	58	34	
116	P. Schuyler,	do	do	58	34	
117	Wm. Dougherty,	do	do	58	34	
118	G. W. Stackhouse,	do	do	50	00	
						1,072 19
						39,002 40

RECAPITULATION.

Schuylkill, (late Spring Garden and Northern Liberties,)	27,910 60
Moyamensing and Southwark,	719 75
Kensington and Richmond,	5,506 72
Old City,	3,793 14
Salaries for all,	1,072 19
	39,002 40
Special appropriation made to Birkenbine & Trotter, for account of contract for supplying Twenty-fourth Ward. Warrants, Nos. 80 and 81,	27,500 00
	66,502 40

The warrants drawn as above account for old City, are also included in the statement of accounts under head of "Fairmount Works."

The old City, Spring Garden, Northern Liberties and Southwark, have plans of the distributing mains, none of the other districts have any; very little knowledge can be obtained of the sizes and connections of the pipes. The plans of the City and Northern Liberties are the only ones which are entirely and correctly brought up to the present time.

As it is very desirable that a complete knowledge of the underground property of the City should be obtained, plans of all will be made out as early as the laborious nature of the work will admit. Some of the districts have no record books, (or at least none can be found,) of the pipes laid. In these, nothing but an actual examination by digging, can show positively the situation of affairs. Every effort, however, will be made to obtain the necessary information on the subject.

The late date at which the Department was organized, made it impossible to arrange the new water rent books in time; the rents had, therefore, of necessity, to be settled upon the old duplicate books; these, in several of the districts, contained many errors, putting the Department to serious disadvantages, and causing much loss of time in receiving the rents.

The districts north and south of the old city, all had their books arranged alphabetically, which leads to much confusion, not only on account of the multiplicity of similar names, but from the fact that parties seldom take the trouble to transfer property to the proper name, when it is sold. In consequence, we repeatedly find names on the books, which have been there for years, although the property had possibly changed owners very many times in the interval.

The Register is now engaged in arranging all the books in the manner successfully employed by the old city, namely—in blocks or wards, commencing at the corner of a street and proceeding regularly around the block; by this plan the situation of the property is all that is required, and change of owners does not produce confusion.

This, of course, is a work of great labor, but the Register is progressing with it, and it is believed that he can complete it in time for the settlement of the next year's rents.

The collection of the annual water rents has been quite satisfactory; it has shown that the system of adding a percentage, adopted by this department, is more successful than the allowance of a discount, although it be as great as that offered at the Receiver of Taxes' office. We have collected in the first ninety days, seventy-one per cent. of all our duplicate, whilst it is believed very little more than twenty-five per cent. of the taxes have been received in the same time. Much inconvenience was also felt on account of the exceedingly small size of the Register's Office. It is much to be desired that better accommodations should be provided for the public who have to resort in such numbers to this office. Some idea of the number of persons who have recently visited the office may be found from the following statement of the Register:

The number of water rent payers in Jan., was				1714;	the receipts,	$25,886 65
do	do	do	Feb.,	1836;	do	29,660 90
do	do	do	Mar.,	9770;	do	181,650 81
	Together,	- - -		13,320		$237,197 86

From this, it will be seen that 13,320 water tenants have paid their rent at the Register's Office in the past three months. Sufficient room should be afforded to enable us to so arrange the desks that each Clerk might attend to several wards only, whereby much confusion and loss of time would be avoided. I would strongly urge the necessity for more space to this Department.

The report of the Register of Water Rents will be found annexed, and contains much valuable information in regard to the receipts, &c., from the several works.

All of which is respectfully submitted

by your obedient servant,

FREDERIC GRAFF,

Chief Engineer of Water Dep't.

April 19, 1855.

FREDERIC GRAFF, Esq.,
Chief Engineer Water Department.

DEAR SIR,—The following report of the doings of the department under my charge, embodying statements Nos. 1, 2 and 3, setting forth the revenue derived from Fairmount Water Works for 1854; the amount of the water duplicates for 1855, and the amount of water rents for 1855, received from January 1st to April 18th, inclusive, is respectfully submitted.

The late period the department was organized, and the imperfect state the water rent registers of the old districts of the county were in, prevents an extended report being made, consequently the usual statistics, showing the uses to which the water is applied, are omitted for the present year.

It will be the duty of this department the present year to make out and complete new water rent registers for that portion of the city north of Vine street and south of South street, and although one of great labor, I have reason to think will be completed within the required time; if so, there will be nothing wanting but larger office facilities, to accommodate the annually increasing number of water rent payers, and to that I respectfully request your earnest attention.

The net increase of water rents by new permits during the present year, may be safely estimated at $25,000.

Respectfully, your obedient servant,

GEO. W. McMAHAN,

April 19, 1855. *Register.*

STATEMENT

Of the Revenue from Fairmount Works, for the year 1854.

	Dolls.	C.	Dolls.	C.	Dolls.	C.
CITY PROPER.						
Paid by the Collectors to City Treasurer,	113416	87				
Paid by Treasurer of Girard Estate to City Treasurer,	1372	00				
Paid by Register on account of duplicate of 1854, to City Treasurer,	7586	00				
			122874	87		
Paid by Register on new permits, to City Treasurer, issued during 1854,			12542	52		
Paid by Treasurer of Moyamensing to City Treas'r, on account of district duplicate,	4000	00				
Paid by Collector of Moyamensing to City Treas'r, on account of district duplicate,	1253	55				
			5253	55		
Whole amount during the year 1854,					140170	94
The duplicates for 1854 amounted to					175465	67
Paid to City Treasurer as above,	122874	87				
Paid to City Treasurer in December, 1853, in advance for 1854,	1089	00				
Commissions to City Collectors,	4838	13				
Allowances to City Collectors,	744	00				
Amount of City duplicate for 1854,			129046	00		
MOYAMENSING.						
Paid to City Treasurer on duplicate of Moyamensing,	5253	55				
Reductions and allowances on duplicate of Moyamensing,	107	62				
Discount allowed on their duplicate,	2492	14				
Balance unpaid, December 31,	8866	44				
Amount of Moyamensing duplicate for '54,			16719	75		
SOUTHWARK.						
Reductions and allowances on Southwark duplicate,	116	75				
Discount allowed on their duplicate,	4446	83				
Balance unpaid, collected by the District prior to June 1, but not paid over,	25136	84				
			29699	92		
Whole amount,					175465	67

STATEMENT

Of the Revenue to be derived from each of the Water Works belonging to the City of Philadelphia, commencing Jan. 1, 1855.

	Dolls.	C.	Dolls.	C.	Dolls.	C.
FAIRMOUNT WORKS.						
First, Second, Third and Fourth Wards,						
Southwark,	81911	42				
Moyamensing,	18285	41				
Fifth Ward,			50196	83		
New Market,	5681	75				
Pine,	4806	50				
Dock,	5449	50				
Walnut,	4638	50				
Sixth Ward,			20521	25		
Chestnut,	5227	00				
High street,	6439	00				
Lower Delaware,	7820	75				
Upper Delaware,	7052	25				
Seventh Ward,			26039	00		
Spruce, Lombard and Cedar,			23429	75		
Eighth Ward,						
Locust,	11846	75				
South,	9322	00				
Ninth Ward,			21168	75		
Middle,	8391	00				
North,	11884	50				
Tenth Ward,			20225	50		
South Mulberry,	10259	50				
North Mulberry,	14066	00				
			24325	50		
					185906	58
DELAWARE STEAM WATER WORKS.						
Kensington District,	37586	16				
Richmond,	2769	50				
					40355	66
(Comprising the Seventeenth, Eighteenth, Nineteenth, and a portion of Sixteenth and Twenty-third Wards.)						
SCHUYLKILL STEAM WATER WORKS.						
Northern Liberties,			85402	75		
Spring Garden, (Eastern Section,)	27201	50				
Do (Western Section,)	31160	50				
			58362	00		
Penn District,			10794	50		
(Comprising the Eleventh, Twelfth, Thirteenth, Fourteenth, Fifteenth and Twentieth, Wards, and portion of Sixteenth Ward.)					104559	25
Amount of Water Duplicate, Jan. 1, 1855,					330821	49

STATEMENT

Of the Water Rents received in January, February, March, and to April 18, *inclusive, under the system recommended by the Department, and adopted by Councils, December* 26, 1854.

NO. OF PAYERS.		Dolls.	C.	Dolls.	C.	Dolls.	C.
	JANUARY.						
	Annual water rents for 1855, - -			24538	25		
1714	Water rent payers.						
	FEBRUARY.						
	Annual water rents for 1855, - -			28955	50		
1836	Water rent payers.						
	MARCH.						
	Annual water rents for 1855, - -			181956	81		
9770	Water rent payers.						
13320							
	Amount received to March 31, -			235450	56		
	Fractional rents on new permits, received in January, - - -	1348	40				
	February, - - -	705	40				
	March, - - -	677	50				
				2731	30		
	For iron pipes received in March, -			16	00		
	Whole amount received to April 1st,					238197	86
1016	Annual water rents received April 1st to 18th, - - - -			10038	54		
	Penalty, 5 per cent., - - -			501	68		
	Fractional rents received, 1st to 18th,	2444	90				
	Iron pipes, " "	158	00				
	Patrick McDonough, Collector in full of duplicate of 1854, - - -	612	74				
				8215	64		
	Whole amount received in April, from 1st to 18th, - - -					18755	81
	Paid to City Treasurer to April 18th, inclusive, - - - - -					251953	67
1016	Water rent payers in April, - -						

Respectfully submitted,

GEO. W. McMAHAN,

April 18, 1855. *Register.*

REPORT

OF

THE WATERING COMMITTEE

WITH THE ACCOMPANYING

REPORTS

OF

FREDERIC GRAFF, ESQ., SUPERINTENDENT

OF

FAIRMOUNT WATER WORKS,

ON

FILTRATION,

AND

PROFESSORS BOOTH AND GARRETT,

ON

SCHUYLKILL WATER.

PRINTED BY ORDER OF COUNCILS.

PHILADELPHIA:
CRISSY & MARKLEY, PRINTERS, GOLDSMITHS HALL, LIBRARY STREET.
1854.

RESOLUTION

ADOPTED BY THE

SELECT AND COMMON COUNCILS OF THE CITY OF PHILADELPHIA,

MAY 11, 1854.

RESOLVED, That the Watering Committee be, and they are hereby authorized to have five thousand copies of the Report upon the Filtering and Analysis of the Schuylkill Water, printed for distribution.

(Extract from the Minutes.)

EDMUND WILCOX,

Clerk of Select Council.

WATERING COMMITTEE.

JOS. M. THOMAS, *Chairman*,	JOHN AGNEW,
ALBERT G. WATERMAN,	CHARLES ABBEY,
FRANCIS H. DUFFEE,	GEORGE GRISCOM,
WILLIAM WATT,	PAUL POHL.

REPORT.

To the Select and Common Councils of Philadelphia:

In obedience to the annexed resolution of Councils, passed October 27th, 1853, as follows:

"*Resolved*, That the Watering Committee be, and they are hereby directed to inquire into the practicability of erecting at Fairmouut, a Filter of sufficient capacity to filter all the water used in the city, before it enters the distributing pipes."

Your Committee report that they have given the subject that consideration which the importance of it demanded, and herewith submit the report of Mr. Frederic Graff, Superintendent of the Water Works, under whose immediate charge the necessary inquiries and examinations in relation to the matter were made; and also the report of Professors Booth and Garrett, the experienced and eminent chemists who conducted the analysis of the water.

TO THE WATERING COMMITTEE OF CITY COUNCILS:

GENTLEMEN: In compliance with your instructions, I have examined into the expediency of filtering the water supplied from the Fairmount Water Works, and beg leave to make the following report:

In order to ascertain if there was any well founded reason for filtering the water, I thought it necessary to have an analysis of it, made by experienced chemists, whose opinion would be considered valuable in forming a conclusion, whether the water of the Schuylkill has in fact (as has been asserted) depreciated in any important degree from its former acknowledged purity.

The remarks and analysis of Messrs. Booth and Garrett are appended to this report. In it, they compare their analysis, made this year, with those of Professors Boyé and Silliman, made in 1842 and 1845, which gives an excellent opportunity of ascertaining to what extent (if any) deterioration has taken place. For the statement of the details, we refer to the report of those gentlemen, merely inserting in this place their concluding remarks, as follows:

"The analyses exhibit another fact of some importance, that while in 1842 the quantity of organic matter was capable of being determined, and in 1845 was quite large, (although probably less than stated in that analysis,) in 1854 there was not a sufficient amount to admit of exact determination, it is possible that the water may contain more in summer than in winter, but the fact that it is nearly absent, proves that the increase of manufacturing, and of population in the valley of the Schuylkill, and its affluents has not tended to deteriorate the water, in the slightest degree, with organic matter.

"The mineral contents remain the same, and are only varied in proportion. The effects produced upon the water by clearing land, could only be an increased turbidness, from finely suspended mineral matter, or the addition of dissolved matter, in which vegetable matter would form a fair proportion. We believe there are not sufficient data to establish the fact, that turbidness is now more frequent or dense than formerly, and we have shown the absence of dissolved organic matter; we may therefore conclude, that the water is not worse than it formerly was from this cause. It has been supposed, that filtration of the water before its distribution through the city, would be desirable, and should be undertaken by the government of the City. We infer, from analysis, that filtration would scarcely, if at all, diminish the mineral matter in solution, nor is its character or amount such as to justify an attempt at removal.

"The suspended matter in a turbid condition of the water, is finely divided clay, the quantity of which is inconsiderable, and which we do not suppose to exert any injurious influence upon the water. To attempt its separation, would demand so vast an expenditure as would not, in our opinion, be justified by the result, even if it were entirely successful. But there is every reason to believe that the attempt would be attended with at least a partial failure, because the suspended matter is so finely divided, that we doubt if much of it could be removed by any practicable system of filtration.

"We may observe further, that a comparison of our waters with waters used elsewhere in the United States and in Europe, and highly esteemed, may be characterized by its greater purity, and by its being slightly alkaline, and nearly free from organic matter.

"In conclusion, we infer that the Schuylkill water has deteriorated, in no important respects, from its former excellent quality; that from the nature of its small contents of

mineral matter, and its unusual freedom from organic matter, it is superior to most waters for domestic and manufacturing purposes; that from the nature and quantity of its mineral contents, it is unnecessary to adopt a system of filtration to improve its quality; and lastly, a comparison of the past and present, leads to the inference, that no plan of improving the water will be required for many years to come."

The above remarks, made by gentlemen so capable of forming a proper judgment in the case, appear entirely conclusive that there is not really any necessity whatever for filtering the water, and the subject might, it is thought, be safely dropped here; but in order that Councils may be fully able to judge of the purity of the water, a table is inserted below, showing the comparative amount of solid matter contained in one gallon, of a number of the waters supplied, or about to be supplied to cities, in this and other countries:

	grains per gal.
Cochituate, Boston,	3.37
Mill River, proposed for New Haven,	4.00
Gunpowder, proposed for Baltimore,	4 41
Schuylkill analysed by Boye,	4.42
Patroon's Creek, supplied to Albany,	4.72
Pine River, proposed for New Haven,	5.30
Schuylkill, analyzed by Silliman,	5 50
West River, proposed for New Haven,	5.60
Supplied to Detroit,	5.72
Jones' Falls, supplied to Baltimore,	5.85
Schuylkill, analyzed per Booth & Garrett,	6.10
Troy,	6.29
Ohio River, supplied to Cincinnati,	6.73
Hudson River, Albany,	7.24
Passaic, to supply Jersey City,	7.44
Mohawk, Troy,	7.88
St. Charles River, Quebec,	8.10
Lake Ontario, Rochester,	10.00
Croton River, supplied to New York,	10.93
Genesee River, Rochester,	11.21
Average of all the above,	6.54
Average of the three analyses made of the Schuylkill,	5.34

	grains per gal.
EUROPE.	
Lake Geneva,	10.64
Seine, at Paris,	12.74
Rhone, at Lyons,	12.88
Elbe, at Dresden,	21.00
Supplied to London, from Thames, by the Kent Company,	18.7
Supplied to London, by New River,	19.2
" " from Thames, by West Middlesex Co.,	19.5
" " " Thames, by Lambeth Co.,	20.4
" " " Thames, by Grand Junction Co.,	21.00
" " " Thames, by Southwark Co.,	21.5
" " " Thames, by East London,	22.00
" " " Lea River,	23.7
" " " Thames, by Chelsea Co.,	27.2
Hempstead Co., from Wells,	40.
Bristol " "	52.
Average of all the London Companies, from the Thames,	21.46

Wells N. E. corner Fifth and Cherry streets, 115.957 grains to the gallon.

It is well known that filtration only purifies the water by arresting the solid organic matter, while it does not remove the fluid organic matter, the salts, gases and other soluble impurities. A table of several waters is given below, that it may be seen how small the solid organic matter contained in our water really is, and of how little the water would be deprived by filtration:

	Cochituate.	Schuylkill, per Boye.	Schuylkill, per Silliman.	Schuylkill, per Booth and Garrett.	Croton.	Hudson, Albany.	Thames, Chelsea.	Troy.
Solid organic matter, one gallon,	1.16	0.036	1.24	trace.	4.28	2.27	4.2	1.51
" inorganic " "	2.21	4.385	4.26	6.10	6.66	8.46	23.1	4.78
Total solid matter, one gallon,	3.37	4.421	5.50	6.10	10.94	10.73	27.3	6.29

In all the above cases, the Schuylkill water for analysis was taken direct from the river before it was raised into the reservoirs, when of course it would not have had time to deposit its impurities. The water of the Croton was taken from the distributing reservoir in New York City, after it had passed through forty-one miles of aqueduct, giving it every opportunity of depositing some of its impurities; and yet we find it to contain nearly eleven grains of solid matter in one gallon, four and twenty-eight hundredths grains of which are organic matter.

That a more correct idea of the power and actual efficiency of filters on a large scale may be formed, than appears generally to exist, some extracts are here given from a work recently published in London,* upon a microscopic examination

* "Microscopic Examination of the Water supplied to the Inhabitants of London, by Arthur H. Hassall, M. B., F. L. S."

of the waters supplied to that city after passing through the most approved filters used there. The author states "That by placing a gauze bag on the tap of the water cisterns *supplied from the filter beds of the Southwark Water Company*, it was found at the end of a few days, to contain a mass sufficient to fill an egg-shell, consisting principally of the hairs of animals." Again, "The accumulation of solid matter in the main supply pipes, is often so great as to require that they should be frequently cleansed out, this circumstance and the *variation of the earthy matter in accordance with the state of the weather*, show clearly the defective state of the process of filtration adopted, and if solid earthy and inorganic matters are largely contained in the water of the companies as supplied to the houses, it is evident that no reason can exist why the organic and living matter characteristic of impure water should not be present in them in equally large extent."

Again, "The method of filtration to be successful even to a limited extent, must be very different from that pursued by the Metropolitan Companies, for we have seen that the water which they supply after having undergone the process as conducted by them, still contains much *solid organic matter, living, dead and decomposing*, and often of considerable size."

He states further, that the only filtered water supplied to London that even approaches purity, is that of the Chelsea Company, and in this he found upon examination, eight different species of infusoria, and some dead organic matter. The following analysis made by Professor Brande, in 1849, of the water after passing through the filters of the Kent

Water Company, will show how little can be expected from such apparatus:

Carbonate of Lime, - -	grains in one gallon,		9.9
Do Magnesia, - -	do	do	trace.
Sulphate of Lime, - -	do	do	2.5
Do Soda, - -	do	do	1.5
Chloride of Sodium, - -	do	do	3.7
Organic matter and Nitrates, -	do	do	1.1
Total, - - - - -			18.7

It will be seen that the organic matter in the above, amounted to one and one-tenth grains after filtration, whilst Messrs. Booth & Garrett state that the Schuylkill water contains but a trace of organic matter without any filtration whatever, and but six and one-tenth grains of solid residue of every kind; so that the above water is *three times more impure after being filtered by one of the best large filters known in London, than the Schuylkill water is without any filtration whatever.*

And yet the filters used by the Chelsea, Kent and other companies, are of the most approved kind that have been employed upon a large scale; the result, indeed, of experiments made at very considerable expense; and in some form, would be the plan we should be obliged to follow.

Although I consider the above practical results as sufficient to guard us against the adoption of such defective apparatus, I will (in order that councils may have every light upon the subject) investigate the matter further, by examining if our present reservoirs would be adequate for the purpose of intro-

ducing filter beds into them. Most of the works of England where the water is filtered, have large subsiding reservoirs into which the water passes before it goes upon the filter beds, as well as large reservoirs for the pure water after filtration, and also duplicate filters, that one may be cleansed whilst the other is in use. The following table shows the rates at which the most approved of these filters pass the water:

	Gals. passed by each square foot of filter surface, per hour.	Gals. per foot of surface, per 24 hours.	Gals. supplied per day by the Companies.	Square feet, area of filter surface used.	Contents of subsiding reservoirs in gals.
Vauxhall Works, ...	2.09	50.16	6,013,716	120,000	21,000,000
Grand Junction, ...	2.67	64.08	4,500,000	70,078	9,000,000
Southwark, ...	2.74	65.76	2,160,000	174,240	
Chelsea, ...	3.12	74.88	3,136,320	90,000	
Paisley, ...	4.25	102.			
Lambeth, erected 1852, .	3.67	88.08	2,750,000	31,200	15,900,000
Average, ...	3.09	74.16			

It has been found that between the hours of ten and eleven in the morning, at least eight per cent. of the whole day's supply is delivered, and on Saturdays for short periods in the heat of the summer, it is believed the water has been delivered at the rate of twelve per cent. of the whole day's supply, which, as we have frequently supplied 11,000,000 gallons from our works, would be equal to one million three hundred and twenty thousand gallons per hour. At the average rate at which the last three filter beds named in the above list (which are now considered the best) filter the water, namely: three and sixty-

eight hundredths gallons, $3\frac{68}{100}$ per square foot of filter surface per hour, a filter bed of three hundred and fifty-eight thousand six hundred and ninety-six square feet would be required. This should properly be duplicated, that one might be cleansed whilst the other would be in use, making seven hundred and seventeen thousand three hundred and ninety-two square feet for filter beds only, without any allowance whatever, for subsiding or pure water reservoirs. The total area of the Fairmount reservoir is three hundred and twenty-two thousand one hundred and eighty-three square feet; it will therefore be seen how entirely insufficient they would be for the purpose, even for the present supply of water required for the city, which supply must increase every day, and will soon far exceed the limits set down above.

It cannot be denied that filter beds may be made to do their work moderately well; but the maximum speed at which a certain surface will filter the water properly, as obtained from the practice in Europe, is stated above, and from that data it is quite evident that the area required for our works would not be far different from the amount before mentioned, namely, for filter beds and duplicate, 717,392 square feet. The probability is, that this area would have to be exceeded rather than otherwise, unless large reservoirs, in which a supply sufficient for two or three days (say to contain 35,000,000 gallons) should be erected. In which case the filter beds would not require to be duplicated entirely, as by dividing them into sections, one or more of such sections could be cleansed whilst the others were in use, the city being supplied at the same time from the pure water reservoirs.

The process of cleaning the filter beds used in Europe, is by reversing the current of water through them, for instance, if the water has been passing downward, by causing it to flow upward, most of the dirt which has accumulated upon the surface, will be washed and carried off through sluices and culverts made for that purpose. This, however, is found not to be entirely effectual, and therefore in addition, the sand has frequently to be scraped off the surface to the depth of an inch or more; removed, washed and replaced. This, in some of the London works, is required to be done every two weeks, and in some seasons of the year as often as every ten days; it will therefore be seen that the cleaning of such apparatus is attended with considerable labor and consequent expense.

I am fully convinced that no adequate result could be obtained from the enormous expense which it would be necessary to incur in building and keeping in order such large filter beds as we should require, and that probably the certainty of constant supply and efficiency of the works might be impaired by such troublesome and expensive, and I think, needless apparatus.

Very respectfully,

Your obedient servant,

FRED. GRAFF.

May 3, 1854.

Your Committee feel fully convinced by the evidence of the analysis that they have every reason to feel perfectly satisfied with the extraordinary purity of the Schuylkill water. It is quite evident to them that there does not exist any necessity whatever for its filtration; and that the erection of filters to attempt such purpose would require a very large expenditure of money from which no adequate result could be reasonably expected.

They therefore report in conclusion, that they deem the project of filtering the water to be unnecessary and inexpedient, and beg leave to be discharged from the consideration of the subject.

All of which is most respectfully submitted.

JOSEPH M. THOMAS, *Chairman*,
ALBERT G. WATERMAN,
FRANCIS H. DUFFEE,
WM. WATT,
JOHN AGNEW,
CHARLES ABBEY,
GEORGE GRISCOM,
PAUL POHL.

May 3, 1854.

REPORT

ON

SCHUYLKILL WATER.

BY JAMES C. BOOTH AND THOMAS H. GARRETT.

A large number of the upper tributaries of the Schuylkill flowing over the anthracite formation, it has been supposed that the increased activity of mining operations in the coal region, by spreading manufactures on its banks, by increasing the population on the river and the region it drains, and by giving rise to more extensive clearings of forest, has contributed to throw so large an amount of impurity into its water as to render it unfit for domestic use or for manufactures in the City of Philadelphia.

The following analysis of Schuylkill water was undertaken with a view of determining the influence of the above-mentioned sources of impurity, and to suggest a remedy, if necessary. One means of arriving at a part of the conclusion is to compare its present with its former condition, by means of chemical analyses of the water. Two such analyses exist, and although they are avowedly incomplete, they are sufficiently

full for our purpose. We therefore present them before giving our own. They were performed, like our own, upon a quantity of water equal to the common or wine-gallon of 58,372 grains. (At 30″ Bar. and 39.6° Fahr.) The first was performed by M. H. Boyé, in 1842, and the second by B. Silliman, Jr., in 1845.

ANALYSES.

	BOYE, IN 1842.		SILLIMAN, IN 1845.	
	Salts.	Acids, &c.	Salts.	Acids, &c.
Alkaline Chlorides, - -	0.153	0.088	0.147	0.089
Alkaline Sulphates, - -	0.560	0.304		
Alkaline Carbonates, - -	0.185	0.073	1.644	0.683
Chloride of Magnesium, - -			0.009	0.007
Sulphate of Magnesia, - -			0.057	0.038
Carbonate of Lime, - -	2.190	0.964	1.872	0.824
Carbonate of Magnesia, - -	0.484	0.254	0.351	0.184
Alumina and Oxide of Iron, -	0.077			
Silica, - - - - - -	0.395	0.395	0.080	0.080
Organic Matter, - - -	0.036		1.240	
Total grains per gallon, - -	4.080		5.400	
Residue by direct trial, - -	4.421		5.500	

The above analyses are critically compared by Dr. Boyé in the Proceedings of the American Association for the Advancement of Science, for September, 1848. The alkaline chlorides and carbonates in Silliman's analysis are stated by him to be salts of soda alone. As we determined the relative quantities of potassa and soda in our analysis, we have assumed this proportion to be the same, and from these data have calculated the quantities of acid and base in B's analysis,

in order to compare both of these with our own. We determined all the ingredients directly, (except, as usual, the soda,) and some of them by repetition. We further employed different portions of the same water to determine special ingredients, in order to insure greater accuracy in the examination of so dilute a solution as Schuylkill water.

The following table comprises the three analyses:

COMPARATIVE ANALYSES.

	1 Boyé. 1842.	2 Silliman 1845.	3 B. & G. 1854.
Potassa, - - - - -	0.114		0.087
Soda, - - - - -	0.341	1.039	0.261
Lime, - - - - -	1.226	1.048	1.404
Magnesia, - - - -	0.230	0.188	0.696
Alumina and oxide of iron, -	0.077		0.068
Sulphuric Acid, - - -	0.302	0.038	1.417
Chlorine, - - - -	0.086	0.096	0.168
Silica, - - - - -	0.395	0.080	1.080
Carbonic Acid, - - -	1.290	1.690	0.681
Organic Matter, - - -	0.036	1.240	trace.
	4.097	5.419	5.862
Residue found direct, - -	4.421	5.500	6.109

The small difference between the totals of the 1st and 2d analyses, compared with those previously given, arises partly from calculation and partly from an error in the 2d. We remark, upon the above table, that the alkalies in the 1st and 3d are concordant within 0.1 gr., but in the 2d the alkali is 2½ to 3 times as great as it should be. The alkali in the 2d being

also estimated wholly as carbonate of soda, renders the estimate of carbonic acid double what it should be. We believe, that the carbonic in both 1 and 2 was chiefly, if not wholly calculated, while in our own it was directly determined; we must therefore prefer our own. There is every reason to believe the amount of sulphuric acid in the 2d to be too low, from the manner in which it was obtained, from the amount in the 1st, and from our having found, in former trials of the water, a very considerable quantity. We believe the organic matter in the 2d to be far beyond the truth, because it was embraced in the total loss. In our experiments, we have not been able to detect more than traces of organic matter, incapable of being accurately determined; for, upon heating the solid residue of the water, an almost imperceptible darkening was observed, and after calcination below the heat sufficient to expel carbonic acid, no material difference in weight was perceptible. The amount of silica in the 2d is too low, as pointed out by Dr. Boyé in the paper referred to, who believed even his own to be below the truth. We believe our own to be nearly correct, perhaps a shade above the truth.

For the reasons stated, we prefer taking the first analysis as a means of comparison with our own, except in the amount of carbonic acid, which we directly determined; and for the further reason, that there is a wider interval of time between them. But, in justice to the 1st, it should be observed that extreme accuracy was not called for in its execution; and to the 2d, that it seems to have been designed as a mere general

determination, without reference to minute and accurate results.

Upon comparing the two analyses together, the one executed in 1842, and the last in 1854, we observe that, during the last 12 years, an increase has taken place in the amount of solid matter dissolved in Schuylkill water, but that this increase scarcely amounts to $2\frac{1}{2}$ grains per gallon. Of the $2\frac{1}{2}$ grains, about 1 gr. is sulphuric acid, $\frac{5}{8}$ gr. is lime and magnesia, and nearly $\frac{5}{8}$ gr. is silica.

The increase of sulphuric acid is undoubtedly due to the increased activity of the coal trade. Anthracite contains iron pyrites (a compound of sulphur and iron) disseminated through it, which is sufficient, although small in amount, to impart a sulphurous odor to the fumes of the burning coal. Portions of the pyrites are gradually oxidized by the air, in the underground explorations for coal, forming sulphuric acid and oxide of iron, the former, apparently, in more than sufficient quantity to neutralize the latter. For, the waters issuing from some of the mines, are so highly charged with copperas and free sulphuric acid, as to cut out and endanger the steam-boilers employed in the coal region. We know this fact from experiments, made by one of us upon the waters of that region, with the view of ascertaining the cause of injury to boilers, and to suggest a remedy.

Beside the source of sulphuric acid from the natural oxidation of the pyrites in the subterranean workings, and in the coal on the surface, it is also formed by selecting the larger masses of pyrites by hand, and burning them in heaps, where-

by another portion of sulphate of iron is produced, to find its way, with the next rains, into the Schuylkill.

Since so large an amount of sulphuric acid and its salt, with iron, enters the river in the vicinity of the coal mines, that the water has a marked acid reaction, it is interesting to ascertain what becomes of it in the intervening space of 100 miles, between the mines and Philadelphia; for at this city the water has a decided alkaline reaction. Analysis answers the question, by showing a notable proportion of sulphate of lime in the city water. The river, beside rolling over limestone formations through many miles of its course, receives the drainage of extensive limestone districts, whereby carbonate of lime is liberally supplied to it. Carbonate of lime produces, by decomposition with sulphate of iron, the sulphate of lime which remains in solution, and oxide of iron which is deposited. Sulphate of lime, therefore, replaces sulphate of iron before the river reaches Philadelphia.

We believe that nearly all the sulphuric acid entering the river in the coal region, is retained in solution throughout its course, but the water is so largely diluted by numerous streams along the Schuylkill valley, that only a trifling increase is perceptible in the amount of this acid per gallon at Philadelphia, in the course of 12 years, notwithstanding the vast increase in the coal trade. The following statement, drawn from the last Annual Report of the Philadelphia and Reading R. R. Co., exhibits the amounts of coal sent to market, from the Schuylkill mines, in 1842 and 1853:

Tons of coal sent in	1842,	540,892
" "	1853,	2,470,000

The last is 4½ times the former. It is a singular coincidence, that the quantity of sulphuric acid in our analysis (1853) is about 4½ times that of Dr. Boyé's analysis (1842).

Analysis further shows, that there is an excess of alkaline base (including lime and magnesia) in the water at Philadelphia, above what is sufficient for the sulphuric acid, so that the quantity of this acid entering the water is not sufficient even to decompose all the carbonates, which it receives or contains. It appears that only a portion of the carbonates of lime, &c., found in 1842 have been changed to sulphates in 1853, while the total amount of lime aud magnesia has only increased by about ⅝ of a grain per gallon, in the same interval.

The analyses exhibit another fact of some importance,—that while in 1842 the quantity of organic matter was capable of being determined, and in 1845 was quite large, (although probably less than stated in the analysis), in 1853 there was not a sufficient amount to admit of exact determination. It is possible that the water may contain more in summer than in winter, but the fact that it is nearly absent, proves that the increase of manufacturing and of population in the valley of the Schuylkill, and its affluents, has not tended to deteriorate the water in the slightest degree with organic matter. The mineral contents remain the same, and are only varied in proportion.

The effects produced upon the water by clearing land, could only be an increased turbidness, from finely suspended mineral matter, or the addition of dissolved matter, in which vegetable matter would form a fair proportion. We believe

there are not sufficient data to establish the fact, that turbidness is now more frequent or dense than formerly, and we have shown the absence of dissolved organic matter. We may therefore conclude that the water is not worse than it formerly was from this cause.

It has been supposed, that filtration of the water before its distribution through the city, would be desirable and should be undertaken by the government of the city. We infer from analysis, that filtration would scarcely, if at all, diminish the mineral matter in solution, nor is its character or amount such as to justify an attempt at removal. The suspended matter, in a turbid condition of the water, is finely divided clay, the quantity of which is inconsiderable, and which we do not suppose to exert any injurious influence upon the water. To attempt its separation would demand so vast an expenditure, as would not, in our opinion, be justified by the result, even if it were entirely successful. But there is every reason to believe that the attempt would be attended with at least a partial failure, because the suspended matter is so finely divided, that we doubt if much of it could be removed by any practicable system of filtration.

We may observe, further, that a comparison of our water with waters used elsewhere, in the United States and in Europe, and highly esteemed, may be characterized by its greater purity, and by its being slightly alkaline, and nearly free from organic matter.

In conclusion, we infer that the Schuylkill water has deteriorated in no important respect from its former excellent quality; that from the nature of its small content of mineral

matter and its unusual freedom from organic matter, it is superior to most waters, for domestic and manufacturing purposes; that from the nature and quantity of its mineral content, it is unnecessary to adopt a system of filtration to improve its quality; and lastly, a comparison of the past and present, leads to the inference, that no plan of improving the water will be required for many years to come.

JAMES C. BOOTH,
THOS. H. GARRETT.

Philadelphia, 23d March, 1854.

Analysis of the water from the wells of W. H. Horstmann & Sons, N. E. corner of Fifth and Cherry streets; sunk to the rock. Analyzed by Prof. F. A. Genth. Analysis kindly furnished to Frederic Graff, by Messrs. Horstmann & Sons.

	grs. in one gal.
Sand and Silica,	1.563
Bi-carbonate of Iron,	0.290
Bi-carbonate of Magnesia,	23.490
Bi-carbonate of Lime,	21.750
Sulphate of Alumina,	0.309
Sulphate of Lime,	0.014
Sulphate of Potash,	5.755
Chloride of Magnesium,	1.541
Chloride of Sodium,	23.686
Chloride of Potasium,	0.916
Organic and Volatile Substances, as Nitrate of Ammonia,	14.592
Iodine, Phosphoric Acid, Oxide of Manganese,	Traces,
Free Carbonic Acid,*	22.051
Total,	115.957 grs. per gal.
Free Carbonic Acid, and Carbonic Acid forming Bi-carbonates,	40.357
	75.600

* The quantity of Carbonic Acid was determined in water which stood over night.