SECOND ANNUAL MESSAGE

OF

CHARLES F. WARWICK

Mayor of the City of Philadelphia

WITH

ANNUAL REPORT

OF

THOMAS M. THOMPSON

Director of the Department of Public Works

AND OF THE

BUREAU OF WATER

FOR THE

YEAR ENDING DECEMBER 31, 1896.

ISSUED BY THE CITY OF PHILADELPHIA, 1897.

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APPENDIX M.

REPORTS ON COAL-DUST POLLUTION.

Philadelphia, June 30, 1896.

Mr. Thomas M. Thompson,
Director, Dept. of Public Works.

Dear Sir:—I respectfully submit herewith a report upon the pollution of the Schuylkill River and its tributaries by coal dust from the anthracite coal regions.

As stated in my Annual Report for 1895, my predecessor, Mr. John L. Ogden, in his report for 1888, stated as follows:

"After a general rain in the Valley the Schuylkill is at first yellow from the flow of the nearer streams, which run principally through cultivated land. It is afterward dark or black from the washings of the culm piles in the coal regions.

"In January the breaking of the Milldale Rolling Mill dam, one and a half miles above Port Clinton, was the cause of the black appearance of the water at that time. The coal dirt and slush that had accumulated in the dam were brought down by the freshet produced by the break."

In my report for 1895 I again urged that legal measures be taken to prohibit the fouling of the stream in this way, and that, if necessary, the powers of the State Board of Health should be so extended as to give it jurisdiction in such matters.

On January 4th of this year, in my reply to your Reference No. 4, I wrote you in regard to a communication from Mr. English, that that gentleman was undoubtedly right in supposing that the discoloration of the Schuylkill River at that time was caused by particles of coal dust; that this

view was borne out by examinations made at that time by Dr. Bolton, Chief Bacteriologist of the Health Board, but that in my judgment the main source of the trouble was not in the vicinity of the City, but in the Schuylkill anthracite coal region, recent heavy rains in that region having washed down large quantities of coal dust.

On January 6th I transmitted samples of water taken from the forebay at Fairmount and showing a progressive improvement in the character of the water, and remarked that we should, however, be subject to a repetition of the trouble after every heavy rain in the upper Schuylkill until either the coal operators are restrained from throwing their waste into the river or the Department is put in position to provide ample settling or filtering facilities.

On January 8th I wrote you, suggesting an inquiry into the powers and duties of the State Board of Health, in order to secure, if possible, the co-operation of that body in the prevention of the pollution of the river by coal dust.

Eearly in the year the Law Department of the City, at your suggestion, took up the matter and conferred with me upon the subject, and steps were taken looking to a visit to the coal regions for the purpose of gathering information upon the subject.

In May, on motion of Mr. Meehan, Councils passed a Resolution requesting the Law Department to investigate the subject.

On June 22-25, I visited the Schuylkill coal region in company with Mr. J. W. Catharine, Assistant City Solicitor; my Assistant, Mr. Amasa Ely, and Captain A. C. Huckey, who has spent most of his life in the Upper Schuylkill region, and who volunteered to act as guide, spending the entire time in driving through the valleys of Panther Creek, above Tamaqua; of the Schuylkill proper, between Tamaqua and Pottsville; of Mill Creek, above Pottsville; of Wolf Creek, above Minersville, and other

points, including the breaker of the Philadelphia and Reading Coal and Iron Company on the Schuylkill River, below Schuylkill Haven.

In these investigations we sought to obtain information respecting the processes by which the pollution is caused, the means taken to prevent or reduce such pollution, and the names of the parties responsible for it. A report of this visit is submitted herewith.

The coal dust which is washed into the river appears to proceed principally from two sources, namely: First, the recent introduction of water into the breakers for the purpose of washing coal in the various stages of its passage through them, and, second, the establishment of small breakers, called "washeries," for the purpose of working the culm heaps in order to extract from them the small merchantable sizes.

Both of these classes of works discharge streams of water heavily charged with fine coal dust, but in most cases more or less effective precautions are taken to prevent the entrance of this water into the streams.

In spite of these precautions, however, much of the water finds its way into the streams, and the result is that nearly all of the streams in the coal region, and for some distance below, run very black, and their beds and banks are now composed chiefly of coal dust, so that every flood necessarily washes a considerable quantity of this material into the Schuylkill.

So far as we can judge, but little pollution comes from direct washing by rain of the culm heaps themselves. These do not appear to be generally scored by rain, and the ground about them is not covered by coal dust.

The remarks of those whom we met in the coal regions generally confirmed this view, although one or two of the proprietors of washeries, or breakers, charged a considerable proportion of the pollution to the culm banks themselves,

and it is possible that where the culm heaps stand very close to the banks of streams they may be undercut in times of flood and much culm may thus fall into the stream.

Mr. Edwin F. Smith, Engineer and Superintendent of the Canal Division, Philadelphia and Reading Railroad Company, is of the opinion that much of the trouble which has recently been experienced has arisen from the recent abandonment and destruction of the company's dams on the Schuylkill proper between Port Clinton and Schuylkill Haven. These dams had previously become more or less fouled with coal dust, which, upon their destruction, of course passed down the river.

To my mind, it is evident that, even if the further pollution of the streams could be immediately stopped, the coal dust which has already been deposited in them would continue to foul the lower stream after heavy rains for some years to come, although it is quite possible that under these circumstances the trouble would gradually diminish.

The means taken to prevent the flow of coal dust into the streams consist in the construction of dams upon flat pieces of ground, the dams consisting generally of gravel, or fine soft culm, or of broken slate, etc. The dams of gravel or culm, owing to their density, are provided with sluices or weirs through or over which water can drain off, while, when slate is employed in the construction of the banks, the material itself is sufficiently porous to allow the water to filter through it. In the former case sedimentation, and in the latter case filtration, is employed as the purifying agent. Both methods vary greatly in efficiency, the effluent being, in some cases, almost as black as the water fed to the dam, and, in other cases, nearly clear.

The dams themselves, however, containing, as they do, enormous quantities of coal dust, show that, however imperfect these methods may be they have at least held back the dust contained within them.

Very respectfully yours,

JOHN C. TRAUTWINE, Jr.
Chief of Bureau.

REPORT OF VISIT OF JUNE 22–25, 1896.

Leaving the Reading Terminal, Philadelphia, at 4:05 P. M., on Monday, June 22, in company with Mr. J. W. Catharine, Assistant City Solicitor; my Asistant, Mr. Amasa Ely, and Captain A. C. Huckey, who has spent most of his life in the Upper Schuylkill region, and who volunteered to act as guide, we went by the Little Schuylkill directly to Tamaqua, arriving there at 7:10 P. M.

The Little Schuylkill enters the main stream at Port Clinton, which is now the head of navigation and which occupies the gap where the Schuylkill River issues from the Blue Mountains. Just below this point is the Blue Mountain dam, or dam No. 16, now the uppermost dam of the system. It was evidently very much shoaled by coal dust. Captain Huckey states that when, as a boy, he was familiar with this dam, it had a general depth of 25 feet, and that it was always kept thoroughly dredged by the Navigation Company before the lease to the Philadelphia and Reading Railroad Company. Since that lease, however, and especially since the extensive fouling of the river by coal dust, the company does not undertake to do more than keep a channel open through the pool.

Ascending the Little Schuylkill from Port Clinton to Tamaqua, we found its water very black throughout.

A mile above Port Clinton is the site of the Milldale dam, the breaking of which, in 1888, gave rise to the appearance of coal dust in the Schuylkill water at Philadelphia, as mentioned in the report of my predecessor, Mr. Ogden, for that year. A mile further up is the flouring mill at Molino, which has suffered much damage by reason of the filling of its dam and mill-race with coal dust. The bed and banks of the stream throughout are largely composed of coal dust.

The first washery we passed was that of Beard & Shindel, at Reynolds, about ten miles above Port Clinton. It was idle when we saw it and it has been so for some time, but it is intended to re-commence operations there.

Extensive piles of culm occupy both banks of the Little Schuylkill.

In the evening we examined the Little Schuylkill and Panther Creek in the vicinity of Tamaqua.

We found the water of Panther Creek very much blackened by the operations of the coal breakers of the Lehigh Coal and Navigation Company, in the Panther Creek Valley, but the water of the Little Schuylkill proper above the mouth of Panther Creek has, until within a very few weeks, been quite clear. Now, however, it is beginning to be fouled by the operations of the breaker at Old Silver Brook, at the very head of the stream, seven miles above Tamaqua.

This breaker has been washing its coal for some years, but it is only recently that the coal dust has made its appearance as far down as Tamaqua, after filling up dams on the stream, as mentioned more particularly below.

We also called on Mr. Schick, one of the owners of the flouring mill at Molino, already mentioned. From Mr. Schick we learned that the culm fills their dam and their mill-race, the latter 500 feet long.

In former years it was sufficient to wash the mill-race once in six months, whereas now it requires washing every two or three days. The washing is accomplished by opening the waste weir at the lower end of the race and partly

raising the head gate, thus creating a scouring action in the race. They also found their turbines and other machinery in process of destruction by the mechanical action of the coal dust and the chemical action of the acids contained in the mine water, which the operation of washing carries into the stream. They are claiming damages, and owners of the breakers seem willing to grant them, as they do not dispute their share of the nuisance.

On Tuesday morning, June 23, we proceeded in an open carriage up the Panther Creek Valley as far as breaker No. 5, which is just beyond Lansford, in Carbon County, a distance of about six miles.

The Greenwood breaker, about one and a half miles from Tamaqua, on the north side of the valley, belonging to the Lehigh Coal and Navigation Company and leased to Garber, was idle.

The next breaker reached, No. 11, was also idle, but we were shown through it, in order to gain a general idea as to the processes employed.

At breaker No. 10 we examined the culm deposits and tasted the water issuing from the mines before it reached Panther Creek and before it was polluted by coal dust. We found it very strongly astringent, quite sufficiently so to account for its popular name of "alum water."

At breaker No. 12 we noticed a new channel extending from the washery and discharging directly into Panther Creek.

At breaker No. 8, above Coaldale, four and a half miles from Tamaqua, there is no washery; the breaker being what is called a "dry breaker."

At breaker No. 9 a trough for the conveyance of water charged with coal dust leads directly from the breaker into the creek, and a new trough, exactly similar, has just been constructed on the other side of the breaker.

Opposite Lansford, five miles above Tamaqua, the Nesquehoning tunnel, built 1869-70, carries the Tamaqua Branch of the Central Railroad of New Jersey through the Nesquehoning Mountain to Hauto, in the valley of the Nesquehoning, a tributary of the Lehigh.

At breaker No. 5, above Lansford, we examined the surroundings with considerable care. Here, as at other breakers, the water carrying the coal dust in suspension is led from the breaker through wooden troughs, and discharged upon the ground at their ends. The troughs are extended from time to time, and thus a considerable area is covered with coal dust to a depth of several feet.

At breaker No. 5 this trough had reached a length of several hundred yards, and we saw, in places, evidences that the coal dust in it had accumulated sufficiently to necessitate its being shoveled out and piled up alongside of the flume. Below the lower end of the flume the black water discharges upon the surface of the dirt pile and flows over it for one or two hundred yards further. We found, in many places, a hard crust formed under this stream upon the top of the soft dust, no doubt owing to the action of chemicals in the mine water used in the breaker for washing the coal.

Near the lower end of the dirt pile a very feeble dam, or rather fence of boards, had been built, but this had been entirely wrecked, and a new dam, of similarly defective construction, had been built about two hundred feet further down; but this, also, had become broken, so that the black water discharged freely through it.

Returning to Tamaqua by the same route, we learned that the town of Lansford is supplied with water from streams on the south slope of Broad Mountain, a mile or two to the north; the pipes passing through the Nesquehoning tunnel, already mentioned. The water is furnished through street hydrants. This water is supplied, also, to the collieries and the breakers for use in boilers and for washing.

As the mine water injures the boilers and machinery it is used as little as possible.

We were informed that all of the coal treated in the breakers of the Panther Creek Valley is subsequently sent to a breaker at Hauto, in the Nesquehoning Valley, for further treatment.

Returning to Tamaqua, we talked with Mr. Spiese, an intelligent merchant of that place, who confirmed the accounts of pollution from the Old Silver Brook breaker, at the head of the Little Schuylkill, belonging to the Silver Brook Coal Company. Mr. Spiese says that Mr. Harry A. Welde, who is interested with the DuPonts, of Wilmington, Del., in the gun-powder business, has five or six dams in the upper Little Schuylkill, between Tamaqua and Mintzers, and that these have all been filled up from the source named. It would seem to be the overflow from these dams which is now fouling the water of the Little Schuylkill at Tamaqua.

We also caled on Mr. Shindle, of Beard & Shindle, the proprietors of the washery which we passed in the train on the Little Schuylkill at Reynolds, five miles below Tamaqua. Mr. Shindle claims that they throw all their dirty water into the excavation made by taking culm out of the pile, and that none of it goes into the stream.

We left Tamaqua at 1:15 P. M. in an open carriage, en route for Pottsville, via the valleys of the Wabash, which enters the Little Schuylkill from the west at Tamaqua, and of the Schuylkill proper.

At Tuscarora, four miles from Tamaqua, we noticed a small washery north of the road and west of the town.

At Middleport, eight miles from Tamaqua, we left the river and the main road and drove northward, returning to the river again at New Philadelphia, at the mouth of Silver Creek, two miles below.

About two miles north of Middleport we passed an abandoned colliery, where a washery, operated by a Mr. Priest, is said to work the culm now produced at the Kaska William colliery.

At Kaska William the mine was open, but the works were not running.

On Silver Creek, half a mile above New Philadelphia, we visited a colliery and breaker, operated, as we understand, by the Philadelphia and Reading Coal and Iron Company. Here, as in most of the modern collieries mining a dirty coal, water is used throughout the cleaning operations. The water, leaving the breaker heavily charged with coal dust, is led by wooden flumes and deposited upon a dump, or dam, about 300 feet square, 13 feet deep at its lower side, and containing about 20,000 cubic yards of material. This was bounded on three of its sides by a weak bank of soft coal dirt provided with three sluices. Water passing through these carries some coal dust with it, and passes into a box by the road-side, in which is the foot-valve of a suction main supplying a pump at the breaker. At the time of our visit the water in the box, which is provided with a waste-valve, was low, so that the foot-valve was dry. In one compartment of the box we found, floating upon the water, a thick mass, evidently composed of grease and coal dust.

On the Schuylkill, below New Philadelphia, we visited a washery formerly owned by Mr. P. J. Kelly, but sold by him to McTurk & Tyler, of 322 Walnut street, and now operated by him for them. We found Mr. Kelly at the washery, which, however, had just stopped for the day when we arrived. Mr. Kelly is now dumping his dirty water upon a bank retained within a substantial dam of slate, and he claims that the water filtering through this dam when the washery is in operation is perfectly clear. As the dirt pile is extended, the dam is correspondingly lengthened. Some dirt has washed into the stream above the south end of the east bank.

Further down the stream, on the same side and at the same works, we found an old dirt bank similarly protected on the stream side by substantial slate banks, but filled to the top and piled up above them.

On the north side of the stream we noticed an older and lower dump, which appears to have been protected on the stream side by banks of coal dust. They showed no signs of having been scored by rain.

Mr. Kelly states that washing on a small scale was in use when he was a boy, say thirty or forty years ago, and Captain Huckey confirms this; but, according to Mr. Kelly, the first washery on the present system was started in Mahanoy Valley about eight years ago.* He visited this at the time and started his present washery about six years ago. He washes from three hundred to three hundred and fifty tons of culm per day, obtaining from fifty to seventy-five per cent. of small merchantable coal.

Mr. Kelly expects to exhaust his present culm pile in three or four years more.

About three years ago he shipped several car loads of the refuse dust to a party in New Jersey, to be made into fuel bricks, but he has had no further orders for it for that purpose.

After spending the night at Pottsville, we drove, on Wednesday morning, through St. Clair, on Mill Creek, to the new breaker of the St. Clair Coal Company, which occupies the former site of the Johns breaker, just above St. Clair, on the left or east bank of Mill Creek. We found in charge Mr. W. W. Patterson, who is interested in the breaker. He expressed himself as in hearty sympathy with any efforts to prevent the pollution of the stream, and as being anxious to do anything in his power to prevent such pollution.

* Mr. Dana C. Barber, in his report of a Sanitary Survey of the Schuylkill Valley, dated February 28, 1885, published in Report of Philadelphia Water Department for 1884, page 249, refers to the processes as having been in use during "the last three years."

The breaker, which was started only a week or two ago, and which is not yet in full operation, takes its water from dams in the hill back of it.

The greater part of the discharge of coal dust water is through two flumes into a pit over an old mine. A drift extends into the hill from this pit, but the principal opening is said to be immediately below. The pile of dust formed here is protected by a dam of slate or cinder.

The water discharged here at any rate disappears from view, as does also a smaller quantity discharged at the foot of the breaker over the railroad track; no better means of disposal having yet been devised for it.

Examining the banks of the creek along the breaker property, we found water issuing at two points. At the upper one there was a small and perfectly clear discharge, which, however, had an astringent, ferruginous taste. This appears about one hundred feet below the breaker. The larger stream, about two hundred feet further down, is much less clear, but still by no means heavily charged.

Leaving Mr. Patterson's breaker, we proceeded up the Valley of Mill Creek to New Castle Station, and then, turning to the left, up a small stream entering Mill Creek at the station.

Just above the station we found what appeared to us the most flagrant case of pollution with which we had met. This was a double washery, consisting of two portions, one on each side of the stream, and belonging, as nearly as we could learn from a man who seemed to be interested, to a concern calling itself the Broad Mountain Coal Company.

The culm piles from which these washeries are supplied lie along the creek for some distance up, and the culm is brought from them to the washeries in troughs by water taken from the stream still higher up. These troughs are led through and across the culm piles, and men are stationed there shoveling into them the culm, which is then brought

down into the washery by a stream of water constantly flowing.

We found several large streams of very black water flowing from both branches of the washery directly into the stream. The proprietor claimed that the dirt goes into an old working further up the road, but upon examining this working we found it dry and nothing going into it, and, in view of its considerable elevation above the washeries, it is difficult to see how it could serve any important purpose in this respect.

About half a mile above the washery just described we passed the nearly new breaker of the Roberts Coal Company, on the hill-side, on the north of the same valley.

Here we found the dirt discharged into a dam similar to that at Silver Creek breaker; that is, the bank was built of soft culm and provided with several sluices. One of these sluices we found discharging tolerably clear water, while the other, at the same time, was discharging quite blackish water.

About a quarter of a mile southwest of New Castle, on the headwaters of Butcher Creek, which flows into the west branch of the Schuylkill just above Mine Hill Gap, we found a colliery on the right hand side of the road, operated by three brothers named Davis. One portion of their operations consists of a surface stripping of the mammoth vein. From this comes a considerable quantity of surface dirt, which mixes with the culm, giving it a brownish appearance. Water is taken from Butcher Creek and from an old working. The dirty water is discharged into a gravel dam, several hundred yards below the breakers. A little of the water which filters through the soil under this dam comes out quite clear, but the main body passes off by an overflow weir at one end of the dam, and is heavily charged.

Owing to the heavy rain, which delayed our movements, we were obliged to abandon our purpose of visiting the

operations at Mackeysburg, in the Hechscherville Valley, and turned southward through Mine Hill Gap to Minersville, passing the large Oak Hill breaker at the foot of the hill on the right side of the stream in the Gap.

In the afternoon we left Minersville and drove up Wolf Creek, a small stream which flows through Minersville and enters into the west branch of the Schuylkill at the lower end of that town.

About one and a half miles north of Minersville, on the left, or east, bank of Wolf Creek, we found the small colliery and breaker of the Little Diamond Coal Company, in charge of Mr. Simons, who showed us over the works. Here the discharge is into a dam built partly of gravel and partly of slate, and drained by a small trough. At the time of our visit the works were not in operation, and the trough from the dam was not discharging, but its appearance indicated that the water in it had run pretty black.

Alongside of Mr. Simon's breaker, and just above it, we found the washery of the Stoddard Coal Company, and were shown over the works by Mr. Hollenbeck, one of the company.

This is the largest operation of the kind that we saw, with the largest dirt bank and the most complete arrangement for taking care of the discharge.

The culm is brought from a very large culm heap on the opposite side of Wolf Creek, by means of belt conveyors running along the heap. The link belt is armed with iron blades nearly fitting the conveyor trough, into which the culm is shoveled down short steep iron troughs laid upon the surface of the culm heaps.

Water for the washery, already heavily charged with coal dust by operations further up stream, is taken from Wolf creek, and some clear water is pumped from an abandoned working.

The waste water from the washery, heavily charged with

coal dust, is led by a trough from the upper part of the washery to the top of a very large dump, which is enclosed by high banks of slate. The water, filtering through these banks at numerous places along the base into Wolf creek, is generally heavily charged, but one or two small leakages were quite clear.

The increase in the height of the dump has carried it above the level at which the discharge could be properly handled by gravity, and has necessitated the erection, within the last six or eight months, of a conveyor similar to that bringing culm from the bank. It is about two hundred feet long, with a lift of about twenty-five feet, and is placed on top of the heap immediately opposite the washery. The water discharged from the washery by the trough enters the conveyor trough and is lifted, with the dirt, to the top of the conveyor, and then discharged through short troughs upon the surface of the pile.

We then drove, via the valley of the West Branch of the Schuylkill, to Schuylkill Haven, on the main stream, just below the Junction, and walked to the large coal storage plant of the Philadelphia and Reading Coal and Iron Company, about two miles below, and on the right or south bank of the river. Here there are enormous coal bins built upon the hill-side at a considerable elevation above the railroad, and in connection with these there is a large "wet" breaker.

The wash from this breaker is emptied into large dams built of soft culm and provided with sluices.

We found two openings through the uppermost dam, and the waste from them seemed to proceed into other dams constructed at lower levels and adjoining the upper one.

Time did not permit us to make investigation of these lower dams or to satisfy ourselves as to the extent to which they retained the dust discharged into them.

REPORTS OF SUPPLEMENTARY VISITS.

Wednesday, July 15, 1896.

Left Minersville at 8 A. M. and drove through Mine Hill Gap, leaving Oak Hill colliery on the left.

Drove westward up the Heckersville valley through Coal Castle to Heckersville. Crossed valley to Howell & Courtney's colliery on south side. Breaker has been in operation about a year. It is "half dry," using water only in lower portion of the breaker, and chiefly on chestnut and smaller sizes of coal; sometimes on stove, if slaty. Superintendent Smith, who has been in charge but a few weeks, showed me over the ground below the breaker. He has just introduced, in the breaker, a washing device for retaining the coarse stuff from the dust.

The water used in the breaker is stored in wooden tanks on the side of the hill behind the breaker.

The dust is deposited in a long and narrow valley and is held back by a short dam built of culm, with one sluice. At the time of my visit, 9 A. M., the sluice was dry, the breaker having been in operation only two hours.

The jigs are washed every few hours, and this adds more dirt to the discharge.

Superintendent Smith says that at Maltby colliery, Forty Fort, near Wilkesbarre, and at Eckley B. Coxe's breaker, settling tanks are used for the deposit of the dust by the water, and that in the Wyoming region the culm can be used entire (with the dust) for firing with McClave and other blowers. He claims that in that region the particles of dust are cubical, and that the high pitch of the strata in the Schuylkill region causes the dust to become more finely ground, and thus renders it unfit for use under boilers and more difficult of removal by sedimentation.

Thomaston Colliery, of Philadelphia Coal and Iron Company, on south side of valley. Very large dam, built of culm, with sluices. Discharge quite black. A large pumping station is maintained about half a mile below the breaker for the purpose of raising water from the mine and discharging it into the west branch of the Schuylkill.

Mackeysburg, Glen Carbon Station, Richardson Colliery, Philadelphia and Reading Coal and Iron Company, on north side of valley, just above Mackeysburg. Large dam, built of slate from old washery, now abandoned. The water can be heard filtering through the slate. It comes out more or less black according to rate of filtration.

The stream of black water flowing to the dam was about three feet wide and two inches deep. Velocity about one foot per second. This would give a discharge of half cubic foot per second.

Glendower Colliery, near head of valley. Discharges into a dam. Owing to rain, did not stop.

Left Heckersville valley and drove over the hill to Minersville, stopping at Lytle Colliery on branch of Pennsylvania Railroad. Gentleman in charge tells me that there is a small washery there, for preparing coal for the furnaces, and that the jigs in the breaker are washed. Owing to rain, did not examine dam.

In the afternoon visited York Farm Colliery of Lehigh Valley Coal Company, about one and a half miles west of Pottsville. The discharge is on the west, or lower, side of the breaker, and forms the main body of a small stream flowing westward into the west branch of the Schuylkill. The water is received in two settling pools, one immediately below the other, and both about half a mile below the breaker. These are formed by dams of gravel taken from the banks of the stream, and the discharge in each case is over a weir.

The water, which is very black as it comes from the breaker, is greatly improved by its passage through the two setting pools, but still issues from the second one slightly discolored by fine dust.

Saturday, August 15, 1896.

Glendower Colliery.

Visited Glendower Colliery, Philadelphia and Reading Coal and Iron Company, near head of Heckscherville valley, and examined dams for retention of coal dust. Found two very extensive dams, separated by the west branch of the Schuylkill, which is bridged by a trough. The water is led from the breaker to the dams in wooden troughs lined with sheet iron. When the dam has filled up, it has been cut through at the lower end and the water allowed to flow through the opening into a lower dam formed further down stream.

The sides of the dams are protected by strips of sheet iron tied together with loops of wire, and, in the newer portions, provided with flares at intervals of about 15 feet. These flares are small plates of sheet iron extending out into the dam and pointing obliquely down stream. They are supported by culm piled behind them.

The ends of the dams are far less thoroughly protected, apparently in order to allow the water to flow off.

The outer slopes of the fine culm banks enclosing the dam were badly gullied by rain.

The north dam has, at its eastern end, an outlet through a series of small dams to a meadow, through which flows the west branch. The meadow is covered several feet deep with coal dust, which is gullied by the stream flowing from the north dam. The stream must be much polluted when the breaker is running. Found new sheet iron piled on the ground near lower end of main north dam, evidently with a view of closing it.

Ascertained location of Lytle Colliery, at head of a stream feeding the west west branch.

Visited Pine Hill and new colliery at the extreme head of Wolf creek, about half a mile above the Diamond and Stoddard operations visited with Mr. Catherine.

The water, with coal dust, is carried from the breaker to the dam through a wooden trough lined with sheet iron. The iron was very rusty and showed no indications of coal dust or of recent use. The trough passes through a culm bank and the stream flows down the eastern side of the bank into a small dam which appears to have no outlet.

A small overflow from a bend in the trough at top of bank flows down the western side of bank and around it into Wolf creek.

Noticed troughs leading steeply from old culm banks to dam of breaker.

Trolley to Pottsville. Drove to Schuylkill river and down its left bank to Schuylkill Haven.

The large bend in the river here was utilized by the Navigation Company for the construction of a waste weir and channel, the latter reaching the river just below dam No. 7, close to the railroad bridge.

The meadow through which this channel flows and the flat lands along the river below it are covered with coal dust. Walked to Mine Hill Junction via railroad, and back by road and highway bridge.

APPENDIX N.

CONCLUSIONS REACHED RESPECTING SAND FILTRATION IN PHILADELPHIA.

By Allen Hazen, C. E., in a report to the Womans' Health Protective Association of Philadelphia.

Population and Quantity of Water to be Provided.

The population of Philadelphia in 1880 was 847,170. In 1890 it had increased to 1,046,946. Assuming that the increase from 1890 to 1900 is at the same rate as for the ten years before 1890, the population in 1900 will be 1,294,000. For the purpose of estimating the quantity of water required I assume that the population will be 1,300,000, and that of this number 800,000 will be resident in the low district; 260,000 will be resident in the district supplied from the Queen Lane Reservoir; 100,000 in the Roxborough district, and that 140,000 people will occupy the Belmont district west of the Schuylkill River.

I have further assumed that the average consumption of water for all seasons of the year will have been reduced by the introduction of meters to 100 gallons per capita, but that at times of maximum consumption as much as 150 gallons per capita daily may be required, making a total filtering capacity required of 195,000,000 gallons. This quantity of water is much less than that now being used, but I beleve it is ample for all purposes with a reasonable system for the sale of water.

Estimates of Cost.

The following estimate of cost of works required to filter the quantity of water mentioned in connection with the various pumping stations has been made up from approximate data, and while not exact, the figures are upon ample

basis, and will be sufficiently close to the truth for your purpose. The estimates are as follows, by pumping stations:

Belmont pumping station, 7 acres of filters; capacity, average, 14,000,000; maximum, 21,000,000 gallons daily.		
Land now owned by the city.		
Receiving basin	$35,000	
Filters	254,000	
Piping and connections	28,000	
Total		$317,000
Roxborough pumping station, 5 acres of filters; capacity, average, 10,000,000; maximum, 15,000,000 gallons daily.		
40 acres of land	$40,000	
Receiving basin	28,000	
Filters	198,000	
Piping and connections	34,000	
Total		$300,000
Queen Lane pumping station, 13 acres of filters; capacity, average, 26,000,000; maximum, 39,000,000 gallons daily.		
40 acres of land	200,000	
Receiving basin	54,000	
Filters	472,000	
Piping and connections	61,000	
Total		$787,000
Cambria site; Spring Garden pumping station, 30 acres of filters; capacity, average, 60,000,000; maximum, 90,000,000 gallons daily.		
Land now owned by the city.		
Receiving basin	$103,000	
Filters	1,030,000	
Piping and connections	445,000	
Total		$1,578,000
Frankford pumping station, 10 acres of filters; capacity, average, 20,000,000; maximum, 30,000,000 gallons daily.		

20 acres of land	$20,000	
Centrifugal pumps and accessories for lifting water from river to filters	55,000	
Filters	330,000	
Piping and conections	4,000	
Total		409,000
Total cost of filters with a maximum capacity of 195,000,000 gallons daily in connection with existing pumping stations		$3,391,000

In case the city is unwilling to bring itself to a reasonable use of water, and insists on wasting water as at present, the cost will be increased in proportion to the quantity of water required. The land provided for, however, at Roxborough and Queen Lane, is sufficient for the construction of filters with twice the areas of those estimated for, and this item would not, therefore, increase with additional filters on those sites.

The cost of the operation of the filters may be approximately estimated upon a very liberal basis at $3.50 per 1,000,000 gallons of water filtered, or, for the quantity of water estimated for, $166,075, annually. This capitalization at 5 per cent. amounts to $3,321,500.

When additional quantities of water are required, the capacity of filters at the Belmont, Roxborough and Queen Lane stations can be increased in connection with those now estimated for, the areas of land being ample for the requirements for a long period of years. The capacity of the filters on the site of the proposed Cambria reservoir, filtering water from the Spring Garden pumping station, can also be increased if desired, although the area of land available is apparently limited, and might not be sufficient for the ultimate requirements. It will, however, be better in many ways to get additional water for this district from the Delaware, instead of from the Schuylkill. Additional

filters can be placed on the Delaware at any point selected as most suitable for this purpose.

As mentioned earlier in this report, investigations have not been made to determine the most advantageous point for taking the Delaware water. In case the water should be taken at a point immediately below Torresdale, works for an additional supply of 100,000,000 gallons daily would cost about $3,000,000, of which $1,100,000 would be required for filters, as much more for force mains from the filters to Market street, connecting at various points with the pipes leading the water to all parts of the city, and $800,000 would be required for pumps, land and various accessories.

The total cost of works for securing water in this way amounts to about $30,000 for every 1,000,000 gallons daily capacity secured, and the works would be of such a nature that any considerable part of them could be installed at nearly the same proportionate cost, and the capacity could be increased as required at the same rate. I do not consider that such a large additional quantity of water will be required in the near future, but the estimate is included that you may know the expense which will be involved in case the city insist upon having so large a quantity of water as 300,000,000 gallons or more per day.

Conclusions.

The City of Philadelphia is now using water in a most wasteful and extravigant manner, and immediate measures should be taken to check such waste, and to reduce the consumption to a reasonable amount.

It is possible to construct sand filters similar to those in use at London, Hamburg and many other European cities, in connection with the existing pumping stations, of sufficient capacity to furnish water for all reasonable requirements, for the present population, and for that which may be expected in the near future.

When larger quantities of water are required, it will be possible to secure them from the Delaware River by means of filtration, and to use the water so obtained in connection with that from the present pumping stations. The quantity of water which can be secured in this way is practically unlimited, at least 1,000,000,000 gallons daily being available.

The cost of installing filters with all necessary accessories to filter an average of 100 gallons of water per day for every inhabitant in the city, and with a maximum capacity of 150 gallons per inhabitant per day, amounting to 195,000,000 gallons daily in all, may be approximately estimated at $3,400,000.


CHESTNUT HILL
RES.
Wissahickon
FILTERING AREA
UPPER ROXBOROUGH RES.
Roxboro
LOWER ROXBOROUGH RES.
ROXBOROUGH PUMPING STA.
Mt. Airy
RES.
Mt. Pleasant
GERMANTOWN
City Schuylkill Line
W. Manayunk
MANAYUNK
River
FILTERING AREA
RES.
QUEEN LANE PUMPING STA.
Cynwyd
Falls of Schuylkill
Wayne Jc.
FILTERING AREA
Germantown Jc.
RES.
CITY LINE
FILTERING AREA
BELMONT RES.
PUMPING STA.
EAST PARK RES.
SPRING GARDEN PUMPING STA.
RES.
RES.
PUMPING STA.
FAIRMOUNT RES.
PHILADELPHIA
CITY LINE
Darby
Cobbs Cr.
Schuylkill River
Paschallville
Ashbourne
Cheltenham
Oak Lane
Lawndale
FRANKFORD RES.
Rockledge
Bustleton
Pennypack Cr.
CITY LINE
Torresdale
FILTERING AREA
Holmesburg
Wissinoming
Tacony
FILTERING AREA
FRANKFORD PUMPING STA.
FRANKFORD
Frankford Cr.
Bridesburg
Coopersville
Palmyra
DELAWARE RIVER
CAMDEN
GLOUCESTER
MAP OF
PHILADELPHIA
SHOWING
PRESENT INTAKES, PUMPING STATIONS AND RESERVOIRS
TOGETHER WITH
PROPOSED FILTERS
AND CONNECTIONS.
● Pumping Station. X High service pumping station.
NOYES & HAZEN,
CONSULTING ENGINEERS,
BOSTON, MASS.
AUG. 1896.
SCALE OF MILES
0 1 2 3 4 5
BRADLEY & POATES ENG'RS N.Y.