

ON THE PRESENT CONDITION OF THE PHILADELPHIA WATER SUPPLY. THIRD MONTHLY REPORT.

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[*Read at the Stated Meeting of the Chemical Section, June 18, 1889.*]

In my last report presented to the Section, a month ago, I recommended that the Kensington pumping station be dismantled. I did not, however, deal with the Kensington supply as fully as I now propose to do, as there appeared to be a reasonable hope that this station would only be resorted to in the immediate future in the event of an unexpected break-down occurring at one or other of the stations on the Schuylkill.

This hope, which was based upon statements emanating from the Department of Public Works, has, however, been shattered during the past month, and the importance of the subject is so great that I feel I cannot do better than devote this report entirely to its consideration.

I wish it, at the outset, to be distinctly understood that whatever is said in this report refers exclusively to the water drawn from the Delaware at the Kensington station, and does not have any bearing whatever upon the city supply as a whole. While I shall presently speak strongly against the water pumps at the Kensington Works, the experience of the past month has strengthened the fairly favorable conclusion to which I had previously come and which has been already expressed in my last two reports, regarding the actual quality, aside from muddiness, of the Schuylkill water, which, as is well known, forms the bulk of the city supply.

The Kensington district is at present supplied from the Delaware at Kensington, from the Delaware at Lardner's Point, and from the Schuylkill.

Two thirty-inch mains, the one conveying water from the Wentz Farm reservoir, the other from the Schuylkill, make

connection with the Lehigh basin, which supplies the district. The Kensington pump also discharges into the Lehigh basin.

In spite of all efforts which can be made by the Water Department, under existing circumstances, the water carried through the two mains just referred to, from the Schuylkill and from the Wentz Farm basin, is not sufficient for the requirements of the neighborhood, and consequently the level in the Lehigh basin gradually sinks, pressure diminishes, and finally complaint of short supply reaches the Department. Nothing remains but to start up the pump at Kensington, and to continue drawing water from the Delaware until the reservoir is again filled. I thoroughly believe that the necessity of abandoning the Kensington station is fully realized by the Chief Engineer of the Water Department, but he is powerless to cause this to be done until some adequate provision is made for meeting the requirements of the district.

The bulk of the water drawn at the Kensington Works is supplied to the sixteenth, seventeenth, eighteenth, nineteenth and thirty-first wards. This district, as is well known, is the unhealthiest portion of the city. That the water is in a great measure responsible, there can be no doubt; to say that it is entirely responsible, might possibly be stating the case too strongly.

It is proposed to carry a forty-eight-inch main from the Schuylkill, in place of the thirty-inch main now existing, but this cannot be done without money, and until the sum necessary for this purpose is appropriated, pumping from the Delaware at Kensington must continue to a greater or less extent.

For years past the money which has been placed at the disposal of the Department has been very far short of that required for its imperative needs, and this state of affairs promises to continue unless some action is taken by the general public in asserting its rights and insisting that they shall be respected.

Whatever difference of opinion may exist regarding the wholesomeness of the Schuylkill, there is absolutely none

possible regarding that of the Delaware at Kensington, and it cannot be too strongly insisted that this foul, sewage-polluted water shall be no longer used for city supply, even though its poisonous and filthy character is partially or entirely disguised by admixture with large volumes of water from the Schuylkill and from Lardner's Point.

It is simply impossible for the sewage discharged into the Delaware, in the neighborhood of the Kensington Works, to be in any degree purified before it is taken up by the pump and distributed to the helpless population of the sixteenth, seventeenth, eighteenth, nineteenth and thirty-first wards. What wonder, then, that the Kensington district is a very hot-bed of disease in this city?

For nearly thirty years, this water from the Delaware at Kensington has been repeatedly condemned as *unfit for use* by Health Boards, by the engineers of the Water Department, by the experts who have examined into the matter, by every one, in fact, whose scientific knowledge has been sufficient to enable a clear estimate to be formed of the danger of supplying this sewage-saturated water to the community. Common sense rebels against it, the records of the Health Office silently protest against it, and yet for thirty years this pumping from the Delaware at Kensington, from a station which ought never to have been established, has been continued.

For a great number of years it has been the purpose of the various administrations of the city to abandon the Kensington Works, and it may be well to inquire how it happens that in spite of such good intentions these works still exist. The recommendations suggested by the various engineers of the Water Department, if carried out promptly at the time they were made, unquestionably would have enabled the Kensington station to fall into disuse, but unfortunately they were allowed to remain so long unacted upon, that when finally put into effect, instead of being able to supplant the Delaware supply for which they were originally devised, they were only able to meet the additional requirements of the district, due to its growth in the meantime.

It has been argued that the quantity of water pumped at Kensington is insignificantly small compared with the total supply of the city. So much the better; but instead of being a good reason for the water to be tolerated, it makes substitution of better water all the easier, and therefore all the more to be insisted upon.

Let me now refer to a few extracts from the reports of the Board of Health. The first is taken from the report for the year 1862, p. 13 :

"One of the most serious and aggravated nuisances which has attracted the attention of the Board was the water supplied by the Kensington Works. After a careful investigation, based upon personal observation, as well as the experience of several physicians practising, and the analysis of a practical chemist, the Board, in May last, declared the water therefrom furnished to be a nuisance, prejudicial to public health, and so notified Councils.  
\* \* \* *We are of the opinion that the only permanent remedy will be the total abandonment of the Kensington Works.*"

In the report of the Board of Health for 1866, p. 10, occurs the following :

*"All things considered [the water] is a sanitary evil of so dangerous a nature to the health of the inhabitants of those wards through which it is distributed, as to demand at the hands of Councils its immediate disuse."* (The Chief Engineer, after an allusion to the alterations since made, says : *"I regard it as certain that the supplying of pure, or in any considerable degree suitable, water, for domestic purposes, from the river Delaware at the location of the Kensington Water Works, is impossible."*)

"Notwithstanding the improvement in the induction passage from the river to the pumps there has been no improvement in the water itself, nor can there ever be whilst the present supply of Kensington water is derived from the river Delaware at the present location. It will be evident to every disinterested visitor to the Kensington Water Works that a supply of pure water is impossible. The sewers opening into the river Delaware discharge their contents at a rate of an average of about 13,000,000 gallons daily, which necessarily includes every description of

impure and refuse matter from the city, and of late years this impurity is much increased by the construction and connection of numerous water-closets with the sewers, from both public and private dwellings. A further deterioration necessarily occurs from the emptying of Gunner's Run and Cohocksink Creek into the Delaware, together with the large amount of human and other offal deposited in the river at Richmond. \* \* \*

"The action of the tides, the movements of steamboats and the general traffic on the river, keep in suspense and carry a large portion of the impurities from the sewers from Gunner's Run and the Cohocksink Creek far beyond the present mouth of the induction tube at the end of the wharf. \* \* \* When we know from our bills of weekly mortality that out of 277 deaths from *cholera Asiatica*, 132 (or 47 per cent.) have occurred in those wards supplied with the Kensington Delaware water, we think we shall be borne out in the opinion that the prevalence of the disease in those districts is not only occasioned by the use of the water as a prominent cause, but that it is so deteriorated in quality as to make it unfit for domestic purposes, dangerous to health and life, and therefore your committee would declare it to be a nuisance prejudicial to health, and would offer the following:

"*Resolved*, That the Kensington water supply as taken from the Delaware is a nuisance prejudicial to public health, and that Councils be urged by this Board to discontinue the supply at the earliest practicable moment, as the only remedy for the removal of the nuisance and the protection of the health of the district supplied therewith."

If this was the condition of affairs nearly twenty-five years ago, with how much more force do these arguments apply at the present time, when the amount of the sewage flowing into the river Delaware in the neighborhood of the Kensington pumping station has been ever on the increase.

The following extract is taken from the report for 1871, p. 28:

"The immense quantity of filth of every description deposited in the river from the common sewers, estimated

at over 13,000,000 gallons daily, and decomposing organic matter always floating about the wharves, which is carried up and down the river front by the tidal currents, and constantly agitated by the general traffic upon the river, must of necessity have a deleterious effect upon the water, even at a distance from the shore. \* \* \* *In the opinion of this Board, water taken from the Delaware River at any point along the city front is totally unfit for domestic use."*

Again, in the report of the Board of Health to the Mayor, for 1882, p. 13 :

"The water pumped at the Kensington Works is unfit for domestic use, and this station should be abandoned."  
\* \* \*

"This recommendation has frequently been made before, but it has never been heeded. It would appear reasonable to infer that the high death rate in the wards supplied with this water has some connection with the fact above stated."

From the report of Chief Engineer, Philadelphia Water Department, for 1883, p. 45 :

"The Delaware, along the city front, is the recipient sooner or later, of the sewage refuse and street washings of a city area occupied by a population probably exceeding 800,000. These waste matters are borne up and down by the tides and usually pass and repass the city several times before taking their final departure. Under these circumstances, whatever may be the volume of the stream, it is by necessity polluted and is not suitable for immediate and habitual daily use.

*"In especial is the vicinity of the Kensington station marked by an accumulation of the foulest materials.*

"Its central position insures its getting the full benefit of the city's sewage, and in addition the Aramingo Canal—an open sewer of large dimensions and choked with filth—discharges in its immediate vicinity. The water taken thence is utterly unfit for human consumption."

These extracts might be indefinitely multiplied, chemical analyses might be quoted, health statistics dwelt upon—but to what purpose? The evidence I have already

presented seems to me so overwhelming that it would gain nothing in force by such additional arguments.

If the arguments against the Kensington station carried only one-tenth of the weight of those actually existing, there would still be sufficient reason to require its immediate removal.

The existence of the Kensington station through the past thirty years has been a sufficient disgrace to the city. Let it be tolerated no longer. Let public opinion express itself strongly, unmistakably. Let the newspapers of this city unceasingly agitate the matter. Let the learned and other societies engage in the contest. Let individual influence be exercised. The Kensington pumping station will then exist only as a memory of the past, to be long remembered for the desolation it has wrought in many families, but not to be feared for that which it also threatens, as at the present time and in the future.

Let us not be satisfied with any half measures, for so long as the Kensington pump remains it will be liable to be put into operation at any time. The station must be completely dismantled and pumping rendered absolutely impossible in the future.

Finally, let me ask you gentlemen, who represent the most prominent of the chemists of this city, and who by your attainments and knowledge are especially qualified to give judgment on this most important subject, unanimously to recommend to the INSTITUTE the passage of the following resolution:

“That the FRANKLIN INSTITUTE most strongly condemns the use of the Delaware water at Kensington for city supply and that it urges Councils to take immediate steps to render possible the abandonment of the Kensington pumping station.”

By passing this resolution without a dissenting vote, I feel that you will confer a great benefit on the city and add to the good work for which the FRANKLIN INSTITUTE has been noted in the past.

## ABSTRACTS.

**ALLOTROPIC FORMS OF SILVER.** By M. CAREY LEA.—In the *American Journal of Science* for June, 1889, Mr. M. Carey Lea has a paper on "Allotropic Forms of Silver." His experiments show that metallic silver may exist in a perfectly soluble form, dissolving easily and abundantly in water. Starting from this, it may show all degrees of solubility down to absolute insolubility, still, however, existing in an allotropic form and quite distinct from normal or ordinary silver. The solutions formed are as perfect as those of any other soluble substance.

There are three modifications of this allotropic form :

*A. The Soluble Form.*—A solution of ferrous citrate (or of a mixture of ferrous sulphate and sodic citrate) is added to a solution of silver nitrate, the mixture well stirred and allowed to stand for ten or fifteen minutes. The lilac-blue precipitate is then washed on a filter with a five per cent. or ten per cent. solution of nitrate, citrate or sulphate of ammonia or of soda, in any of which salts it is perfectly insoluble. The color changes on washing to a deep blue. To remove the iron as far as possible, repeated solution in water and re-precipitation by ammonic nitrate is necessary, the ammonia salt being finally displaced by washing with ninety-five per cent. alcohol. The aqueous solution of this allotropic form of silver is blood-red. Optical examination proved it to be a true solution, and not a mere suspension of a finely-divided precipitate. "The inference, therefore, seems to be very strong that there exists an allotropic form of silver, freely soluble in water. This is a property so exceptional in a metal that I have admitted it with much hesitation. The principal arguments are as follows :

"The contents of silver in the various products was very carefully, and, I believe I may say, quite accurately determined; it was extremely high, always above ninety-seven per cent. As already remarked, this virtually excludes the presence of all other elements, except hydrogen and possibly oxygen. These elements were carefully searched for, but their presence could not be detected. To suppose that we had to do with a mixture in which some compound of silver was mixed with metallic silver was not possible, for, as the whole was soluble, we should still have to admit the solubility of silver.

"We have, consequently, to deal with a substance containing over ninety-seven per cent. of silver, and neither hydrogen nor oxygen in combination with it—the remaining two or three per cent. fully accounted for by ferric oxide and citric acid, determined as present as accidental impurity; the substance itself readily amalgamating with mercury by simple friction, nevertheless abundantly soluble in water. If I had been able to find any other explanation for these facts, without admitting the solubility of silver, I should have adopted it. But none presented itself.

"Whether, in solution, it exists as a hydrate—that is, in more intimate combination with one or more equivalents of water—cannot be said with entire certainty; but the easy amalgamation with mercury seems hardly to favor that view."



*B. The Insoluble Form.*—The first and soluble modification of the allotropic form of silver was produced, as shown above, by precipitating by an alkaline nitrate, citrate or sulphate. The second and insoluble form is produced by precipitating by magnesium, cupric, ferrous or nickel sulphate, or by potassium bichromate or ferrocyanide, or by barium nitrate, or even by silver nitrate. If any one of these salts is employed in extremely dilute solutions as the precipitant, the resulting precipitate is insoluble in water. If it is treated with a concentrated solution of any of the above salts, it becomes, strange to say, once more soluble in water.

This insoluble form is best seen when applied as a thin film to paper by a brush, enough water being added to give it a paste-like consistency. This film is of a greenish color, blue in certain lights, yellow in others; the yellow being the more pronounced in proportion as the washing is thorough. On drying, the lustre is remarkable, a perfect mirror being obtained. This insoluble form, after drying at 100°C., contained 97.96 per cent. silver. "The remaining 2.04 per cent. consisted of ferric oxide and citric acid."

*C. The gold-yellow and copper-colored silver* is produced by the reduction of silver tartrate by ferrous tartrate. The resulting precipitate is first glittering red, then changes to black, and on the filter has a beautiful bronze appearance. The silver nitrate is entirely converted into this allotropic form, which is insoluble in water, and dries to lumps exactly resembling highly-polished gold. A paste of it extended over glazed paper, dries with the splendid lustre of gold leaf. The percentage of silver present = 98.75. Occasionally, a spontaneous reversion to normal silver occurs, the latter being extremely beautiful and resembling the finest frosted jeweler's silver.

All of the above allotropic forms have the following properties in common:

(1) *That of drying with their particles in optical contact* and consequently forming films and mirrors as above described.

(2) *The halogen reaction.* When any of the films on paper are dipped in a solution of sodium hypochlorite or ferric chloride, or of iodine dissolved in potassium iodide, magnificent intense shades with metallic reflections are produced. They often remind one of the color of a peacock's tail and are caused by interference. This characteristic forms one of the principal reactions for distinguishing allotropic silver from ordinary silver.

(3) The stronger acids, even when much diluted, instantly convert the allotropic form of silver into normal gray silver, without the slightest evolution of gas.

(4) All of these allotropic forms are easily reduced to an impalpable powder. In addition to these four points, Mr. Lea states that all of his products readily form an amalgam with mercury.

Mr. Lea has been at work upon this subject for over three years. He expects to have a second paper in the July number of the *American Journal of Science*. The properties of these allotropic forms of silver discovered by him are certainly extraordinary. Indeed, any one of the properties of these products is remarkable. It is remarkable that silver can be obtained in a form having all the color and brilliancy of gold. It is remarkable that while having thus the lustre of a metal and also the metallic property of amalga-

ming with mercury, it still is friable and easily reduced to powder. But most remarkable of all is the fact that it is freely and abundantly soluble in water. Certainly this property is unique. In the entire list of metals there is none that possesses anything like it.

Mr. Lea's investigations have opened a most interesting field of research, that will probably produce results of the highest importance. P.

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## GIFTS TO THE LIBRARY OF THE FRANKLIN INSTITUTE.

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