

THE CROTON WATER ANALYSIS.

We publish below the official reports of Professors Torrey and Chilton, appointed by the Croton Aqueduct Board to make a chemical examination of the water of the Croton lake. These documents are extremely satisfactory, and at once dispelled all the doubts and misgivings by which the minds of our more nervous citizens had been for some time agitated.

Of the important questions settled by these reports, two or three deserve special notice. *First*—The cause of the musty odor and unpleasant taste, so universally complained of, has been discovered. The foreign substances are proved to be easily separable from the limpid fluid, leaving it clear, sweet, and wholesome. It has been placed beyond doubt that the unpleasant smell and taste, together with the suspended matter producing them, could be easily removed by the simple process of filtration, and by immersing in a gauze bag a small quantity of animal carbon, or fresh-burned vegetable charcoal. *Secondly*—The temporary nature of these minute floating particles is also fully established, both by the evidence of the scientific gentlemen already named, and by the fact that for several weeks past the Croton water has been entirely free from all offensive qualities. The diminutive microscopic plants whose volatile odorous juices caused so much alarm, have probably, in small quantities, vegetated for years with the other aquatic plants of the Croton lake, without being noticed, or communicating any appreciable flavor of an offensive nature. But the past summer appears to have been unusually favorable to the growth and multiplication of this little alga. For several years, perhaps, this aquatic vegetable may not be again noticed; should it however appear, and cause a repetition of the annoyances of the past summer, the plant is so short-lived that a few weeks at most will terminate the trouble. *Finally*—The harmless character of the water, when in its worst condition, has been clearly proved. Dr. Chilton states, that he not only drank freely of it, when its odor and taste were most offensive, but that he separated the suspended matters, and partook of them in a highly concentrated form without receiving harm.

Among the numerous other subjects for congratulation in connection with this report is the fact that the present analysis, when compared with those of 1836, of 1842, and of 1843, proves that at present the Croton water is not only more free from organic and inorganic substances than most of the water supplied to other cities of the old and new world, but that it is purer than ever before.

The following engraving represents a portion of the microscopic plant, by whose unusual multiplication the offensive qualities referred to were communicated to the Croton water.

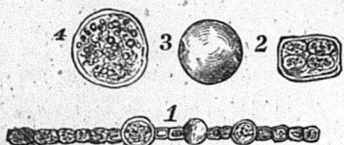


Fig. 1. A portion of the plant 800 times magnified.

Fig. 2. One of cells more highly magnified.

Fig. 3. A larger yellow cell, destitute of granules.

Fig. 4. A spore bearing cell.

Figure 1 represents the thread-like stem of the plant, which is continuous, and never branches off into smaller stems, as is usual with other forms of vegetable life. It is highly magnified, and is easily seen to be composed of a row of contiguous cells, which, on close examination, prove to be of three distinct kinds. Figure 2 represents one of the smallest and most numerous of these three classes of cells, as it appears when subjected to a superior magnifying power. Figure 3 represents a larger and more spherical cell, produced probably by the expansion and development of the former class of cells, and assuming as it ripens to maturity a yellowish hue. It contains no granules, and is filled with a fluid of a peculiar nature, whose functions are not at present ascertained. Figure 4 represents a larger spherical cell, which is usually three times the size of the undeveloped ones marked No. 2. It is filled with minute green germs, or seeds, and probably future investigations may prove that both these classes of spherical cells are connected with the functions of propagation, and are related to each other in a manner somewhat analogous to that of the two classes of flowers appearing in the blossoms of fruit-bearing trees, and so familiar to us in other sections of the vegetable creation.

OFFICIAL.

CROTON AQUEDUCT DEPARTMENT,
New York, August 27, 1859.

The unpleasant taste of the Croton water in the early part of the month, induced the Croton Aqueduct Board to call upon Messrs. Torrey and Chilton, to make a thorough chemical examination.

The reports of those gentlemen are herewith submitted to the public, and it is confidently believed will prove satisfactory to the community as they have been to this Board. The Board would take this opportunity of saying, that from the first appearance of the objectionable taste in the water, every available means has been employed to discover the cause and counteract its effect; and are happy to add that, in a few days, the entire renewal of the water in the pipes and in the Reservoirs, will do away with the last trace of anything objectionable in its taste.

MYNDERT VAN SCHAICK, } Croton
THOMAS B. TAPPEN, } Aqueduct
A. W. CRAVEN, } Board.

New York, August 25, 1859.

To Myndert Van Schaick, Thomas B. Tappen, and A. W. Craven, Esqs., Croton Aqueduct Board.

GENTLEMEN.—At your request, and in company with Dr. Chilton, I visited Croton Lake on the 18th instant for the purpose of ascertaining, if possible, the cause of the disagreeable quality observed in the water distributed through the city, and which had been the subject of serious and general complaint for a week or two previous. On driving down the hill that leads to the dam, and before reaching the lake, we noticed the same musty odor that characterized the water of the hydrants in the city. Mr. Adamson, the gatekeeper, afforded us every facility in prosecuting our researches, and piloted us to various places on the lake. He brought to our

notice a bright green substance that had appeared within the last twenty-four hours in the water near the dam. This material had been driven, by a favorable wind, to the outlet of the lake, where it accumulated so as to form a considerable stratum in quiet recesses near the shore. The water at the time was very low, only a small portion flowing over the dam. A quantity of the water, quite thick with the green material, had been reserved for our examination, and we collected some of it ourselves from the surface of the lake. We soon became convinced that this unusual ingredient was the cause of the peculiar taste and odor of the water. After examining the character of the larger aquatic plants that grew abundantly in the western portion of the lake, and taking new samples of the water from various places, we returned to the city, and I commenced my examination immediately, before any obvious change had taken place in the properties of the water. On placing a portion of it under a microscope, it was found to be loaded with little straight filaments (see fig. 1) which were composed of oblong roundish cells, in a single row like a string of beads (see fig. 2); and in no case did I find the threads to be branching. Most of the cells were about one-third longer than broad, and were filled with a bright green substance, composed of irregular grains. This matter was proved to be chlorophyll, or the green coloring substance of leaves. Interposed, here and there, in the bead-like filaments were two other kinds of cells; the one perfectly spherical, three times the size of the oblong ones, and filled with green spores or seeds, by which the plant is reproduced (see fig. 4); the other also spherical, but much smaller, and containing a yellowish fluid, but no green grains (see fig. 3). The function of the latter is unknown to me.

There were only a few other kinds of microscopic plants in the water, nearly all of which belong to a particular tribe, called by botanists *Desmidiaceae*. In ordinary seasons these constitute the chief vegetable forms existing in the Croton. The number of living animalculæ was also unusually small. In repeated instances on concentrating the water of the city hydrants, at the time that it exhibited the offensive properties complained of, I found its characters precisely those of the water taken at the dam. The day after collecting the sample of bright green water at the lake, I submitted it again to the microscope, and was surprised to find that all the beaded filaments had disappeared; but there were floating in the liquid, in a separate state, the large spherical green cells, and the smaller yellowish ones. I had noticed, in my first examination, several of the filaments break up by the successive bursting of the little cells. Without doubt, the myriads of little plants contained in my sample had disappeared in the same way. I have since repeatedly seen the filaments break up in water taken from the hydrants. They undergo dissolution much more quickly when they are accumulated by the filter, or when they are confined in a bottle. After the rupture of the cells the water retains its green color for some time, but it finally becomes bleached from the decomposition of the chlorophyll. The bright green water from the Croton Dam became quite viscid in less than twenty-four hours, and the following day it was somewhat putrid and emitted a little ammonia, but not the least trace of sulphuretted hydrogen. Most of the spherical cells just noticed remained entire, but the green ones had evidently matured their spores or seeds.

Before the green water had decomposed, I evaporated a portion to dryness, with great care, so as to avoid scorching it. Sulphuric ether agitated with the residue became of a lively grass-green tint, but without materially diminishing the color of the mass. The solution, after spontaneous evaporation of the ether, left a thick brownish-green matter, which was resolvable in ether and in alcohol, but not in water. It was doubtless one of the coloring bodies of the chlorophyll. A portion of the green water was then boiled for sometime. It lost its color and odor, and deposited brownish flakes on cooling. The water that distilled over contained the odorous principle in a concentrated form.

From this examination, and from the researches of Dr. Chilton, I think we are warranted in concluding, that the recent offensive condition of the Croton water was owing to a rapid and abundant growth of a microscopic conferva-like plant, which abounds in a volatile, odorous principle, soluble to some extent in water. We were extremely fortunate in making our visit to the Lake at just the time when a favorable wind drove the little plant (floating by adhering bubbles of oxygen gas) to the outlet; thus bringing within the space of a cubic inch as many of the filaments as could be separated by filtration from a hoghead of the water a short distance above the dam.

I have not yet satisfied myself as to the origin of those little filaments; whether they are the entire plant, or once constituted part of a more complex alga. They are more minute than in any true conferva known to me, being only 2,500th to 2,000th of an inch in diameter, and from 50th to 20th of an inch long. I strongly suspect that they are derived from a species of the genus *Nostoc* of botanists. This genus usually consists of a globular or oblong vesicle, from the size of a duck shot to the bigness of a plum, and filled with mucus which is loaded with minute bead-like filaments. When the little bladders burst, the contents escape, the mucus dissolves in the water, and the filaments are set free. Sometimes the waters of small lakes are filled with these small bladders of *Nostoc*. Since examining the water I have had no opportunity of revisiting the lake to verify my conjecture.

The question naturally arises why this plant should have made its appearance in such quantities, and not have been noticed before. We can only reply that the case is not a singular one. Even in the higher order of plants it is a common circumstance for a particular species to abound at one time and then almost disappear for years; and in the lower vegetable tribes, especially those which inhabit the water, is this strikingly the case. The present summer has been unusually favorable to vegetation of all kinds, but what are the circumstances which have so remarkably multiplied this little alga I have not yet determined. It is a plant of short duration, and should it reappear another season, the probability is that it will not annoy us long. Very likely more or less of it occurs every summer, but this is the first time that it has been offensively brought to our notice. Even when it was most abundant in the Croton, I do not believe that it communicated any unwholesome quality to the water. Its odor and taste were certainly unpleasant. While the unpleasant quality of the water continues, the ordinary filter will remove all the suspended matter, and a little fresh-burned vegetable charcoal, or animal carbon, will take away the disagreeable smell and taste. A good method of using the charcoal is to heat some small pieces red-hot, and, after quenching, inclose them in a little bag of gauze, and suspend them in the water. The charcoal should be removed or returned every day or two.

I am, gentlemen, very respectfully your obedient servant,

JOHN TORREY.

New York, August 25, 1859.

To Myndert Van Schaick, Thomas B. Tappen, and A. W. Craven, Esqs., Croton Aqueduct Board.

GENTLEMEN.—In compliance with the request received from your Honorable Board, that I would make a chemical investigation and analysis of the Croton water, for the special purpose of ascertaining the cause of its peculiar unpleasant condition, I beg leave to offer the following report as the result of my investigation:

On the 12th of August instant, I received from Mr. A. W. Craven, Chief Engineer of the Works, three demi-johns of the water, numbered and labeled as follows:

No. 1. Water from the mouth of the Aqueduct, at the Receiving Reservoir.

No. 2. From the east side of the gate-house, southeast corner of Receiving Reservoir, South Basin.

No. 3. Water from Forty-second street Reservoir.

On emptying the water from each of the demi-johns into separate large glass jars, it presented the same general appearance in all. The color, when viewed thus in bulk, by reflected light, was of a faint brownish hue, but by transmitted light it had a shade of green. It was nearly transparent, but upon close inspection, some minute particles were observed suspended throughout the mass. The taste and odor of each was the same as that of the water drawn from the hydrants in the city, and in these particulars closely resembled the water of ponds and marshes abounding in vegetable matter. After remaining at rest for a few hours, a deposit of light flocculent matter was observed at the bottom of each of the jars containing the water. Portions of this matter were removed and examined with a microscope, and in each case numerous minute aquatic plants and siliceous remains of *Brittle-worts* (*Desmidae*), with a few living animalcules, were easily detected. A similar sediment was obtained from a new filter attached to the hydrant in my laboratory, by allowing the water to pass through it for a short time. In this concentrated form it was of a decidedly green color. By the application of nitrate of silver to each of the samples of water, they were found to change color quickly, under the influence of solar light, to a deep claret color. The change of color being greater than I had observed by similar treatment of Croton water on former occasions, indicated that it contained an unusual amount of vegetable matter. One gallon (231 cubic inches, 58,327 grains) of the water No. 1, was carefully evaporated in a porcelain dish to dryness; and the dry residuum, which was of a brown color, was found to weigh 3.68 grains. This was heated in a platinum capsule until the organic matter was burnt off. During the combustion it emitted the odor of burning vegetable matter, mixed with a small quantity of animal substance. It was again weighed, and found to have lost 0.92 of a grain. The solid contents, therefore, of one gallon of water No. 1 consisted of

Inorganic (mineral) matters	Grains.	2.76
Organic (chiefly vegetable) matters	0.92	
Total	3.68	
One gallon of water No. 2, similarly treated, gave		
Inorganic matters	Grains.	2.769
Organic matters	0.930	
Total	3.699	
One gallon of water No. 3, treated in the same way, gave		
Inorganic matters	Grains.	2.765
Organic matters	0.940	
Total	3.705	

A qualitative analysis of the inorganic matters showed the presence of lime, magnesia, sulphuric acid, chlorine, soda and a trace of potassa. The organic matter was mainly composed of extremely minute aquatic plants, of which an account will be given by Dr. Torrey in his report; but I detected in it also crenic acid, in combination with alkaline bases.

To determine the relative proportions of the several constituents of the water, I made a quantitative analysis of three gallons of the water No. 3. The results thus obtained, when reduced by calculation, gave the following as contained in one gallon:

Chloride of sodium	Grains.	0.4040
Chloride of calcium	0.1036	
Chloride of magnesium	0.1466	
Sulphate of lime	0.3536	
Carbonate of lime	0.8366	
Carbonate of magnesia	0.3900	
Carbonate of soda, and a trace of carbonate of potassa	0.2700	
Silica, alumina, and a trace of iron	0.1698	
Total	2.6742	
Organic matters	0.9158	
Total grains	3.5900	

While the preceding investigation was in progress, I was requested, on the 16th instant, to visit the Croton Lake, in company with the President and Mr. J. C. Winder, Assistant Engineer. We traversed the entire length of the lake, a distance of five miles, taking samples of water from different parts of it. The first sample was procured from that part of the dam where the water first enters the aqueduct. The next about one-fourth of a mile distant. The next sample about a mile further on. The fourth from the vicinity of Pine's Bridge. The fifth from Kisco Creek, where it mingles with the water of the lake. The last sample was taken from the head of the lake.

A physical examination, made at the time of taking the samples, revealed nothing unusual or different from what I had observed in the water obtained from the reservoirs in the city. The odor and taste were similar, and the same kind of minute floating particles were observed in each, when examined with the aid of a magnifier. The extraneous particles were most abundant in the water from the dam. They were found to be less apparent as we approached the head of the lake, where the water was clear and transparent.

On the following day I again visited the lake, in company with Prof. Torrey, who, through some misunderstanding, did not accompany us on the first excursion. Upon arriving at the lake, we learned that Mr. Adamson, the keeper of the dam and gate, had observed since the preceding day, an unusual quantity of a light green matter floating on the water near the dam. Upon the slightest agitation of the water this green substance was diffused so as to appear lost, but with care he had procured a pailful of it, which he had preserved for our inspection. Some of the same materials we procured ourselves from the surface of the lake, and we took home with us samples for chemical and microscopic examination. Before leaving the spot we had a strong conviction that to this substance might be attributed all the unusual qualities lately observed in the Croton water throughout the city. It had precisely the same taste and odor, but in a very concentrated degree. Of its vegetable nature we entertain no doubt.

A chemical examination of the green matter gave the following results: A portion of it, mingled with water, was gently heated and finally boiled. Upon the first application of a moderate heat, the color quickly changed from a green to a light buff color. When near the boiling point, the whole was converted into a thin mucous substance, and by continuing the heat the odorous matter nearly all disappeared. Some of the green matter, mixed with water, was submitted to distillation, when the odorous principle passed over in union with watery vapor, and condensed in the receiver as a colorless transparent liquid, possessing the characteristic flavor of the original substance. A portion of the

same green material was agitated with pure sulphuric ether. After subsidence, the ether, which rose to the surface, was separated and allowed to evaporate. A minute quantity of an oily substance, slightly tinged with green, was thus obtained. The coloring matter was probably due to chlorophyll, the green coloring-matter of plants. When examined with a microscope of high power, the green substance was seen to consist of some minute aquatic plant, a detailed description of which is given by Dr. Torrey. There was also observed among it a few of the living animalcules, such as the microscope usually reveals in unfiltered water from fresh-water ponds. It may be worthy of remark that, so far as I have observed, the apparent number of these living forms is much less in the Croton water now than I have noticed in former examinations.

It is quite evident, that the flavor of the Croton water, so much complained of during the past week or two, is now rapidly disappearing, and that the water has nearly regained its normal condition. I believe the unusual little plant which we have found in it, and which gave it the peculiar flavor complained of, to be of a perfectly harmless character, and consequently that the wholesomeness of the water has not been impaired by it in the least degree. I have drank freely of it during the time when it was in its worst condition, and have partaken of the green matter which we procured from the lake, in its concentrated state, and also after it had been converted into a jelly by heat, without experiencing any ill effects whatever from it. Filtration of the water through the porous filters, now so much in use, was found to separate effectually all the minute floating particles from it, and thus rendered it more palatable.

Upon comparing the present analysis with the results that I obtained in the year 1836, and again in 1842, as well as with the analysis by Prof. B. Silliman, Jr., in 1845, I find that the Croton water at the present day is purer, or, in other words, contains a smaller proportion of inorganic and other constituents, than has been found in it since the liberality and wise forethought of our rulers caused the introduction of this source of countless blessings to our great city.

Respectfully, your obedient servant,

JAMES R. CHILTON.

THE PIONEER OF GAS-LIGHTING IN AMERICA.

In the September number of the AMERICAN GAS-LIGHT JOURNAL, the name of DAVID MELVILLE, was mentioned in connection with the earliest attempts to introduce gas-lighting into this country. Several private papers of this gentleman have been submitted to us, recording some interesting facts, of which, together with other evidence that our researches have brought to light, we propose to give a brief sketch, for the benefit of such of our readers as may be interested in the history of gas-lighting in the United States.

Captain Melville, whose portrait we present herewith, resided at Newport, R. I., and seems to have been a man of much research, and of a sagacious and inventive genius, and undaunted energy. How much of his first patented invention he borrowed from Europe, does not appear; but, there is evidence that in 1811, and probably earlier, he was engaged in those experiments which enabled him at last to perfect his gas-apparatus, for which the patent is dated 18th March, 1813. A portable gas-apparatus was also patented by him on the 23d of September, 1815, as will be seen from the specification at the close of this article. In 1816 and 1817, he was employed in some experiments for furnishing light-houses with the gas-apparatus. Failing in this project, he some years later obtained a patent, which he sold to the United States Government, for increasing, by a simple and scientific contrivance, the intensity of the light of the ordinary oil-lamps used in light-houses; and he, also, while prosecuting these experiments, discovered a valuable and effective method for preventing the frost-coating of light-house windows, by which, during severe weather, the lights were often obscured, and many vessels wrecked and lost.

In the beginning of the year 1813, Captain Melville, with a view to obtain funds and other facilities for bringing into public use the gas-apparatus, which he had just completed, formed a copartnership with Captain Winslow Lewis, a constructor of light-houses, doing business in State street, Boston. Arrangements were immediately made for lighting with gas the bath-house at Newport, and several contiguous apartments. By the middle of February, the whole was completed, and the public were invited to examine and see for themselves the perfection and efficiency of the new method of lighting. We insert two of the advertisements on this subject, which were inserted in the *Newport Mercury* of the 20th and the 27th of February, 1813.

ADVERTISEMENT NO. I.

GAS-LIGHTS.

THE PROPRIETORS, to gratify the public curiosity, and to be in some degree remunerated for the very great expense which a long course of experiments have occasioned him, will have the BATHING-HOUSE and the adjoining apartments lighted up with gas, to the exclusion of every other species of artificial light, for public exhibition, on MONDAY and THURSDAY evenings, when a person will attend to give every necessary information. Price of admittance, 25 cents each person. Newport, February 19th, 1813.

ADVERTISEMENT NO. II.

"Let there be Light."

THE SUBSCRIBER, having received from the President of the United States, Letters Patent for an improvement in the GAS LAMP for lighting manufactories, mines, mills, streets, theatres, light-houses, and other buildings with Hydrogen Gas, or inflammable air, produced by a chemical process on Pit-Coal, in a much more agreeable, and less expensive manner than has hitherto been done by any other method; and having it now in operation in the Bathing-House in this town, every room of which, with the apartments connected with it, are brilliantly illuminated with gas light, to the exclusion of every other species of artificial means; he most respectfully invites gentlemen concerned in manufactories, &c., to call and view it in operation, that they may be able to judge of the utility and advantages of this improvement. Contracts will be entered into for the furnishing and putting up the apparatus in manufactories, &c., in the course of the ensuing summer, on terms highly advantageous to the proprietors. The gas apparatus is very simple in its construction, and so easy in its management, that any person of ordinary faculties may be taught in one day to manage every part of it effectually, and the trouble will be found infinitely less than that of trimming and tending lamps, to afford the same number of flames.

The gas-lights are in no way offensive, and very agreeable to the eye; and will be found extensively useful in every situation where much light is required, most especially in the growing manufactories of our country, inasmuch as they are less