grouped spherically. Owing to the fineness of the tablets and the capillary attraction, it is difficult to remove the impure mother-liquor sufficiently from the crystals by means of a centrifugal machine, and even with a hydraulic press high purity cannot be obtained, together with a large yield. It is different with the crystals of anhydrous grape sugar. They are of a prismatic shape, and form loose aggregations from which the syrup can be easily removed by centrifugal force, and which lend themselves to a treatment of draining and washing very similar to that of cane sugar. Under these circumstances it is possible to produce a grape sugar which compares in purity with block and granulated cane sugar. A number of applications for such an article readily suggest themselves. The confectioner, the druggist, the manufacturer of condensed milk may use it. In the preparation of certain wines it can safely take the place of cane sugar; but its principal use ought to be in the kitchen for all those preparations where utmost sweetness is not sought for. It is not so well suited for sweetening tea or coffee, though it does not quite so unfavorably compare with cane sugar as the books will have it. To obtain a moderate sweetness, equal to that produced by a given amount of cane sugar, it is not necessary to take 2½ or 3 times as much as cane sugar, but only about 1⅔ times the quantity; at least I have found it so, and some of my friends also.

V. THE WATER SUPPLY OF THE CITY OF NEW YORK.

BY E. WALLER, PH. D.

I desire, in the first place, to present the results of complete analyses of the Croton water made at different times. The various denominations of salts quoted have been given in order to literally quote the different analysts. For the three first, double columns are given, representing the results in grains per English (Imperial) gallon of 70,000 grains, and also in grains per United States gallon of 58,318 grains, the first columns in each case being the form in which the analysts have recorded their results, to judge from the context. In Nos. 4 and 5, the magnesium and calcium bicarbonate have been calculated back to mono-carbonates, and the results given in brackets. Another table of the same results, calculated to parts per 100,000, is appended.

There is probably less difference in the results than the figures would seem to indicate, the mode of stating the results in the earlier analyses rather suggesting different methods of conducting the examination, and calculating the results to those at present in use.

Next, permit me to call your attention to a chart showing graphically the variations found in the constitution of the Croton water by Dr. C. F. Chandler during the Summer months of 1867 and 1868, representing some fifty examinations, and my own results, made in a similar manner every week, from the latter part of 1872 to the middle of 1879, representing about 350 examinations. The average results may be thus stated :

Average of results of tests made on Croton water (Parts per 100,000) :

		Mineral matter.	Org. and volatile.	Total solids.	Hardness.	Ox'n absor'bed from Permanganate.
Summer of	1867	6.72	1.12	7.84	4.32	0.181
"	1868	5.66	1.97	7.63		0.168
Last 2 mos.	1872	7.48	0.44	7.92	3.553	0.131
Year	1873	6.23	1.59	7.82	3.395	0.135
"	1874	5.83	1.76	7.59	3.332	0.166
"	1875	5.656	1.835	7.491	3.293	0.211
"	1876	5.416	1.682	7.098	3.159	0.185
"	1877	5.603	1.823	7.426	3.260	0.253
"	1878	5.299	1.904	7.203	2.846	0.183
First 5 mos.	1879	5.424	0.912	6.336	2.811	0.072
Average from Nov. 1872, to May, 1879, inclusive		5.702	1.678	7.380	3.210	0.180

The "Total solids" were determined by weighing the residue obtained by evaporating a measured quantity ; the "Organic and Volatile" by igniting this residue, moistening with carbonic acid water, drying and weighing again ; "Hardness" by standard soap solution as usual, the results being expressed in the equivalent of calcium carbonate, while the "Permanganate" test was that of Miller. (J., Lond. Chem. Soc., 1865, p. 117 ; see also R. Angus Smith, Watts' Dictionary, v. 1029 ; Wauklyn's Water Anal., 1st Ed., 1868, p. 42. &c. and others), acidifying with H_2SO_4, adding standardized solution of permanganate, until the color held for half an hour at the ordinary temperature of the laboratory.

In addition to these, several other examinations made at irregular intervals, and at other times than those specified above might be given, but as they present no marked deviations, I will not occupy your time with them.

As a sample of similar determinations made on samples of the Croton, taken from different parts of the city at the same time, I would present the results obtained in April of last year, when the odors in the water caused suspicion that it contained some compounds dangerous to health.

No.	Locality.	Mineral matter.	Organic & Vol.	Total Solids.	Oxygen absorbed from Permanganate.
1	West 33d St.	6.6	2.2	8.8	0.064
2	East 34th St.	6.0	1.5	7.5	0.060 F
5	West 131st St.	4.4	1.3	5.7	0.064 F
8	East 122d St.	5.7	trace	5.7	0.062

The samples marked F were clarified by subsidence or filtration before examination, as they contained varying amounts of muddy sediment, and were therefore not fair samples of the water as ordinarily used. It may be mentioned that about a pint of No. 5 on standing half an hour in a cylinder, some 2½ inches in diameter, deposited a sediment ⅜ of an inch in depth. When this sediment was distributed as evenly as possible through the water and a portion was examined, the results were

No.	Mineral.	Org. and Vol.	Total.	Oxygen from Permanganate.
2	75.7	21	96.70	0.366
5	69.2	15.1	84.30	0.455

A portion of the sediment was examined separately. Shaken with ether it afforded as soluble in that menstruum, a minute proportion of vegetable wax having a slight greenish-brown tinge, probably from the presence of chlorophyll.

A small amount was obtained for analysis. The results were

Loss on ignition.	23.31		
Silica	43.61 to 51.00%		
Lime	0.63	$=CaCo_3$	1.12%
Magnesia	3.16	$=MgCo_3$	6.64

Ferric and Aluminic oxides 20.92

As to other determinations on the Croton Water, the following results are offered.

Parts per 100,000.

Date.	Free Ammonia.	Albummoid Ammonia.	Remarks.
August, 1874.	0.00095	0.0145	average of 6
December, 1877.	0.0010	0.0102	" of 2
Nov. 16th, 1878.	0.0015	0.0130	
July 11th, 1879.	0.0008	0.008	
April 4th, 1881.	0.0020	0.0110	
" 22d, "	0.0016	0.0117	average of 10
" " "		0.019 to 0.031	Total NH_3 on very turbid samples.
May 16th, 1881.	0.001	0.007	
Nov. 8th, 1881.	0.002	0 012	

	Nitrogen in Nitrates
July 29th, 1881.	0.0198
Nov. 8th, "	0.0181

The results obtained on free and albuminoid ammonia do not indicate any material alteration in the proportions of those constituents yielding nitrogen in those forms since the examinations began to be made. The investigation of last April shows that the quality of the water does not vary very much in different parts of the city at the same time, unless the sediment is mixed in, when the amount of nitrogen obtainable as ammonia by distillation may reach nearly thrice the amount obtainable from the sample when fairly clear.

The amounts of nitrogen in nitrates so far as they go give no indications of sewage contamination in the water.

About the end of last year a paper by Prof. Leeds on "Relative purity of city waters in the United States," was published in the *Chemical News* (XLIV p. 265), in which the Croton water was condemned as contaminated.

The analytical results were given as follows:—

Croton, June 23d, 1881.		(Results in parts per 100,000)	
Free Ammonia	0.0027	Chlorine	0.350
Albuminoid "	0.027	Hardness	3.30
Oxygen required	0.81	Total Solids	11.80
Nitrites	none	Mineral Matter	5.00
Nitrates	0.8325	Organic & Vol.	6.80

These results I strenuously object to as misleading.

The term "nitrates" is indefinite, and when so many chemists calculate their results to "nitrogen in nitrates," &c. a false impression is readily created by the above statement in that regard. The "oxygen required," I have learned was obtained by Kubel's method —by the action of potassium permanganate on the water strongly acidified with sulphuric acid at the boiling temperature. Inasmuch as most chemists (at least in English speaking countries), use the permanganate test at ordinary temperatures, such a statement as the above, without specifying the method used, is calculated to convey a false impression of the quality of the water. Moreover the test performed in that way is open to serious objections.

Under those circumstances the chlorine in the water would affect the results, and Prof Leeds himself has shown us that the reagents used invariably contain impurities which would affect the test to the prejudice of the water tested, the permanganate containing chlorine compounds, and the sulphuric acid (which is used in considerable amount) containing lower oxides of nitrogen and sulphur, so that where a line is drawn on comparatively small amounts of oxygen absorbed from permanganate, the impurities in the reagents would make a great difference in the conclusions to be drawn.

Prof. Leeds' results on Total Solids and Free and Albuminoid ammonia are very high, indeed higher than any results I have obtained during the past fourteen years, except when—as last spring—the samples of water were so charged with sediment as to render them by no means fair samples of the Croton Water as ordinarily obtainable. The conclusion would seem to be that his sample was turbid with sediment.

With regard to other determinations they either agree with the preceding examinations, or the methods employed were different from those of which I made use, and therefore preclude a comparison between them.

In commenting on the results, Prof. Leeds remarks: "New York and all the places mentioned lower on the list receive their water from contaminated sources. The feeders which empty into Croton Lake, the principal reservoir of the New York water, pass through a settled country, with numerous tanneries, factories, &c., along their banks. Analyses of the Croton water, made at different times during the past five years, have shown that it is to be classed among contaminated water supplies." A quotation of this statement was sent to Mr. Isaac Newton, Chief Engineer of the Croton Aqueduct Department. His reply was briefly to the effect that he had comparatively recently examined the Croton water-shed, and that Prof. Leeds' assertion with regard to it was altogether erroneous.

From other sources, I have been able to ascertain, *first*, that with regard to the population of the water-shed: for its area of 339 square miles the population is from 17 to 20,000, or about one man to every ten acres. Permit me to quote the table given by Mr. D. M. Greene in the 23d annual report of Water Commissioners of Troy for 1877, p. 120.

Population of water sheds for city supplies :

City.		Population per square mile.
Rochester, N. Y.		36
New York, N. Y.		65
Albany, N. Y.		77
Poughkeepsie, N. Y.		86
Schnectady, Cohoes, and West Troy, N. Y.	Supply from Mohawk River.	103
Brooklyn, N. Y.		119
Boston, Mass.,		229
London, England,		270

Second.—As to industries in the Croton water-shed. But few tanneries now exist in that region for the simple reason that the most of the trees yielding the necessary bark have been cut down, and tanning is no longer profitable in that section. As regards other industries the region contains but few factories of any kind, and those are on a small scale.

To sum up, I desire to express a most emphatic dissent from Prof. Leeds' conclusions for the following reasons:

1. The proportion of chlorides existing in the water has not increased of late years so far as the records extend, and hence no indications of contamination by sewage or manufacturers can be asserted to exist.

2. The amounts of oxygen absorbed by permanguate test for a number of years, (serving to compare the water with itself at different times) show no changes in the quality of the Croton water. The same may be said fo· the results on Free and Alluminoid Ammonia and Organic and Volatile matter.

3. The Croton water-shed is not crowded either with population or with manufacturers as Prof Leeds seems to imagine.

4. The health of the community is not, and has never been, such as to indicate the presence of any contamination in the water supply.

COMPLETE ANALYSES OF CROTON WATER.

RESULTS IN GRAINS PER GALLON.

Number	1	1	2	2	3	3	4	5	6	7
Analyst	Professor J. C. Booth.		Dr. J. R. Chilton.				C.F.Chandler.		E. Waller.	
Date	1843.		1843.		August, 1859.		Sum'er 1869.	May, 1872.	May, 1879.	Nov. 1881.
Gallon used	Eng.	U. S.	Eng.	U. S.	Eng.	U. S.*				
Sodium chloride	....	....	0.44	0.367	4.404	0.336	0.402	0.284	0 205	0.205
Calcium sulphate	....	...	......	.....	0.353	0.294	0.158	0.024	0.723	......
Alkaline chlorides	0,193	0.161	......	.....	......	......	......	......	......	......
Potassium sulphate	....	......	......	......	......	.. ...	0.179	0.205	0.188	0 201
Sodium sulphate	.....	......	......	......	......	......	0.260	0.024	0 200	0.216
Akaline carbonates	0.828	0.690	0.90	......	0.270	0:225	......	......	......	0.054
Magnesium chloride	.....	....	0.84	0.750	0.147	0.122	......	......	......	......
Calcium chloride	.	....			0.104	0.087	... ...	......	......	......
Magnesium carbonate	0.939	0.782	1.52	0.700	0.390	0.325	(1.101)	(0.770)	0.918	0.685
Calcium carbonate	2.293	1.910	......	1.266	0.836	0.696	(1.648)	(1.439)	1.650	1.319
Magnesium bicarbonate	.. .	....	......	... ..	... .	......	1.913	1 338	......	......
Calcium bicarbonate	.....	....	......	......	.....	......	2.670	2.331	......	......
Ferric & aluminic oxides	0.110	0.092	......	......	......	......	trace	0.058	0.175	0.045
Silica	0.359	0.299	0.46	0.383	0.170	0.142	0.621	0.222	0.274	0.210
Organic and volatile	0.276	0.240	......	......	0.916	0.763	0 670	0.874	0.560	0.233
Total solids	.....	....	......	......	3.590	2.990	6.873	5,360	......	... ..
Solids by evaporation	4.998	4.174	4.16	3.466	3.705	3.087	4.780	3.849	4.893	3.168
Chlorine	.....	... ...	......	... ..	......	0.296	0.243	0.172	0.124	0.124

ABOVE RESULTS GIVEN IN PARTS PER HUNDRED THOUSAND.

Number	1	2	3	4	5	6	7
Analyst	Booth.	Chilton.		Chandler.		Waller.	
Date	1843.	1843.	1859.	1869.	1872.	1879.	1881.
Sodium Chloride	......	0.629	0.577	0.690	0 487	0.351	0.351
Calcium sulphate	.... ..	......	0.504	0.272	0.041	1.239	.....
Alkaline chlorides	0.276	....	......	......	.. ....	......	......
Potassium sulphate	....	....	.....	0.309	0.351	0 322	0 345
Sodium sulphate	.. ...	. ....	......	0.449	0.041	0.343	0.371
Alkaline carbonates	1.183	... ..	0.386	... .	...	... ..	0.092
Magnesium chloride	......	1.286	0.210	....	....	......	......
Calcium chloride	......	....	0.149	....	....	......	......
Magnesium carbonate	1.341	1.200	0.537	(1.888)	(1.320)	1.575	1.174
Calcium carbonate	3.276	2.171	0.194	(2.826)	(2.467)	2.830	2.262
Magnesium bicarbonate	....	....	......	3.280	2.294	......	......
Calcium bicarbonate	....	....	......	4.578	3.996	......	.....
Ferric and aluminic oxides	0.157	....	0.243	trace.	0.100	0.300	0 078
Silica	0 513	0.657					
Organic and volatile	0.394	......	..	1.060	0.380	0.470	3.300
	....	... ...	1.309	1.150	1.500	0.930	0.400
Total	....	......	5.129	11.788	9.190	......	......
Solids by evaporation	7.140	5.943	5.293	8.200	6.000	8.390	5.432
Chlorine	......	....	0.508	0.416	0.294	0.213	0.213

Nos. 1 and 2. Illustrations of the Croton Aqueduct. F. B. Tower. N. Y., 1843, p. 135,
No. 3. Report of Water Commissioners of Albany for 1865, p. 50.
Nos. 4 and 5. Report of Board of Health for 1871, New York, p. 371.
No. 6. Report on Croton Water, New York, 1881, p. 45.
* U. S. gallon of 231 cubic inches (58,318 grains).