In another place right across the whole face of the lake stretched half a dozen islands, affording no foothold for man or beast, surrounded by stagnant green water filled with every conceivable vegetable rottenness.

The sewers from farm houses, cottages of laborers and factories were noticed to draindirectly in the water supply; in fact the source of water supply of New York city was found to be a common drain for about 300 cattle yards, dwelling-houses, factories, pig-sties, slaughter-houses, and other sources of impurities, every one of which are distinctly shown on the maps we present, the exact location being indicated by a black spot. Space will not allow us to give futher evidence on this point which it is in our power to offer, but we present a cut of one of these sources of pollution, showing the direct drainage into the Croton water.

Of the danger of drinking such water full of the vilest contaminations we will not dwell, each reader can take his own course, but those who are prudent will both boil and filter it before using for drinking purposes. Individuals and journals still claim that the source of the supply is free from contaminations, and the water pure and fit for drinking purposes; to be consistent they have to say that the water is wholesome.

Professor Leeds of the Stevens Institute recently showed that the Croton water contained more organic volatile mattert han the water supply of Newark, which is taken direct from the Passaic with all the sewage of Paterson and other towns. He found the organic matter in 100,000 parts in New York water to be 6.50, Newark 6.00, Hoboken 4.50. At the February meeting of the American Chemical Society (see page of this number), Dr. E. Waller, of the New York Board of Health, endeavored to deny this startling statement, by producing analyses of his own, showing quite different results. We understand that at the March meeting of the same Society, Professor Leeds asserted to the satisfaction of the Society that Dr. Waller's methods were bad and had led him to error, while the integrity of his own analysis was established.

We consider the method of storing the water supply of a city in shallow, marshy lakes, in fever and malarious districts, to be wrong in principle, and that a radical change in the management of the water supply of New York City, rather than an expensive extension of it, to be the most prudent course to adopt at the present moment.

ELECTRIC CONDUCTION AND DISCHARGE.

By F. E. Upton.

The question of the nature and the vehicle of the electrical discharge is an important one, and its determination will contribute greatly to the solution of many interesting problems in cosmical physics. It is desired in this article to call attention to some recent advances that have been made in this direction.

The view that the phenomenon is one of pure conduction, though it has received the attention of eminent physicists, can be said to be no longer entertained.

When a conductor is made to connect two poles or electrodes which are at a different potential, it is well known that the greater the cross section of the conductor, or in other words, the more of the conducting material is laid bare by a cross section, the *less* resistance will be offered to the union of the electricities of the two terminals, and the greater will be the ensuing current, with a given E. M. F.

Now, in the discharge, the contrary is observed directly. This characteristic of conduction is absent when the discharge takes place; in a tube containing air, the greater the pressure (above a certain inferior limit), or the more of the conducting material there is laid bare by a cross section, the *greater* will be the resistance to the passage of the spark, and the nearer together the terminals will have to be brought to effect a spark with a given difference of potential. Sir Wm. Snow Harris, in 1834, made an attempt to grasp at the law governing the relation of the length of spark to pressure; and he then stated that the length of spark is in the simple inverse ratio of the pressure. Gordon, in 1878, made a series of experiments to test this law, (Elec. and Mag. II. 55-62). He found that from a pressure of about eleven inches to that of the atmosphere, Harris's law held approximately good.

Representing resistance by r, and matter laid bare by cross section by s, in the case of conductor $r = \frac{1}{s}$; in the case of discharge 92 of $r=s$, approximately. Thus there is in question two entirely different order of phenomena.

Another distinctive characteristic of conduction will be recognized in the fact that whenever there is any conductor at all, however small and however long it may be, connecting two poles, some degree of current will flow, as long as there is any difference of potential. With discharge, however, a certain lower limit of distance apart of poles, and of interposed matter, is requisite for any current at all, and when that limit is reached the spark passes, instantaneously, and the discharge commences.

Whether the current passes by conduction or discharge, heat is equally developed; in the conductor in the one case, and in the interposed matter in the other. This common development of heat does not in any way assimilate the two phenomena. The condition of affairs in the two cases will perhaps become obvious if recourse is had to the corresponding hydraulic analogy.

Imagine a pond of water held in place by a dam, with a pipe leading from the bottom of the dam, for the purpose of drawing water from the pond. The smaller that pipe is in section, the smaller will be the current of water flowing through it under a given head, and a certain amount of heat will be developed by friction of the water against the interior of the pipe; moreover some degree of current will flow as long as the pipe has any size of cross section at all. That corresponds to conduction. Now let the pipe be imagined closed to the exit of water; as long as the dam is sufficient, no current at all will flow; but suppose the dam be diminished in thickness gradually and constantly, a point will be eventually reached when it will no longer suffice to hold back the water, which will break through the impediment; the friction of the water against the fragments of the dam, and of those fragments against each other will develop heat as in the first case. That corresponds to the discharge.

By this analogy the difference between conduction and discharge is clearly apparent. A conductor between two points at a different potential never offers any *resistance* to the passage of the current, strictly speaking. Instead of saying that a slender wire offers more resistance than a thick one, it would give a better understanding of the matter to say of the latter that it offered a freer passage to the current than the former. In the case of discharge, on the contrary, the matter interposed between the points acts always as a bar, or resistance to be overcome, and the more there is of it the more resistance. It is never an aid or way.

Mr. E. Goldstein, in the *Annalen der Physik*, describes an ingenious experiment bearing upon this point, which, if not conclusive, is entitled to some consideration. In a discharge tube which was filled with dry nitrogen, he placed a little sodium, which could be vaporized by heating. The positive light had a purplish red color, but in the vicinity of the sodium it was of a golden yellow. By careful heating and manipulation, the upper half of the tube could be kept red and the lower half yellow. Now the tube was brought over and near, in a horizontal and equatorial position, to a powerful magnet. The discharge light was repelled as a slender thread to the opposite (upper) side of the tube; but it was a pure eddish thread, and showed no trace of sodium yellow.

So the sodium was not displaced or repelled under the influence of the magnet, as it would have been had it been a *conductor* of electricity.

There has been considered the possibility that metallic particles thrown off from the electrodes might be the conductors of the current. To determine if this were the case, Mr. Goldstein made use of a tube with platinum electrodes, in which the light from the kathode was deflected by a second kathode. The light alone underwent this deflection, while the minute particles torn off from the platinum, which lodged on the opposite wall of the tube and formed a sort of mirror there, went exactly to the same point after the deflection of the light, as before. There was thus no connection between the light of discharge and the abraded metallic particles.

But the most elegant demonstration in this matter has been furnished by the experiments of De La Rue and Müller: they arranged that the discharge of 2,400 chloride of silver cells should pass through a circuit consisting of a vacuum tube and a large variable resistance, R—; now with different resistances R_1, R_2, the resistance of the vacuum tube formed a varying fraction of the whole resistance; and, according to Ohm's law for the fall of potential along a conductor, the fall of potential along the vacuum tube should have been variable, had its function been that of a conductor. It was found in fact, however, that the fall of potential along the tube remained constant, no matter what resistance was introduced in the remaining part of the circuit between the poles of the battery, showing that the discharge was not a case of true conduction, but that even at the lowest pressure it was disruptive.

THE AMERICAN CHEMICAL SOCIETY.

The February meeting of the American Chemical Society was held on Friday evening, the 3d inst.

Dr. Orazio Lugo was elected a regular member.

The first paper of the evening was "On Crystallized Anhydrous Grape Sugar," by Dr. Arno Behr.

It was customary in the preparation of the anhydrous grape sugar to crystallize it out from an alcoholic solution, particularly from that of methylic alcohol, but Dr. Behr was lead to believe it possible that a simpler method could be devised. After some experimenting, he found that it could be obtained from the ordinary hydrated solution. A solution with 12 to 15 per cent of water gave the best results. In the description of its properties, Dr. Behr stated that when dried in a current of dry air, the crystallized sugar would not retain more than two or three per cent moisture, its reaction was neutral, its melting point is between 141° and 145° C. When tested by the polariscope it showed birotation. Dr. Behr then briefly referred to its economic uses, how by its cheapness it would be largely used by the confectioner, the druggist, and by those who manufacture wines. He also stated that as regards its sweetening qualities, instead of requiring twice as much or more to make it equal to cane sugar, he had found that one and two-thirds as much was sufficient. Mr. Nelson H. Darton followed with a short paper "On the Precipitation of Tannic Acid as Tannate of Copper." This paper was a supplementary description of Mr. Darton's method, already read before the Society. It consists in the precipitation of tannic acid by the ammonia sulphate of copper. The precipitate was tested for ammonia with negative results, and therefore it was contended by Mr. Darton that the precipitate was composed of copper tannate and not the double salt as has been elsewhere claimed.

The final paper of the evening was by Dr. E. Waller, of the School of Mines, Chemist to the New York Board of Health. Its title was "On the Water Supply of New York City. The object of this paper was to contradict certain statements made by Prof. Leeds in his recent paper read before the Society and also published in the *Chemical News*. Dr. Waller produced the analysis made by Dr. Booth in 1843, then by Dr. Chilton running between the years 1843 and 1859, Dr. Chandler's results from analysis in 1869-72, and finally his own, which have been regularly reported since 1872. These latter were represented by means of curved lines on diagrams which showed exactly the amount of each constituent for any time during the past nine years. These we may condense and show by the following table:

	PARTS IN 100,000.		
	Maximum.	Minimum.	Average.
Mineral matter	8.44	3.20	5,702
Org. and vol. matter	4.40	1.67	0.04
Total solids	11.07	4.80	7.38
Hardness	5.40	1.88	3.21
Oxygen by permanganate method.	0.383	0.047	0.180

The results ohtained by Prof. Leeds in comparison with those showed from the above table were in several instances quite different. Thus, Prof. Leeds finds the total solids to be higher than any result obtained by the New York Board of Health during the past fourteen years. In other determinations similar discrepances were shown by Dr. Waller. The statement that the Croton water was contaminated by tanneries and other factories was objected to as incorrect, the tanning having long since ceased on account of the scarcity of trees. A statement from the Chief Engineer of the Water Department was read, in which he claimed that the water shed of the Croton River was the cleanest of any from which the supply of drinking water was obtained, either in this country or abroad. The population of the country through which the Croton flows does not exceed 20,000 inhabitants, or about one person to every ten acres. In comparison with other cities, the number of inhabitants to the square mile residing along the water shed of Croton, was stated to be extremely small, thus:

	Population to the Square Mile
London	270
Boston	229
Brooklyn	119
Schnectady, Cohoes, West Troy, (Drawing their supply from the Mohawk River.)	103
New York	65
Rochester	36
Albany	77
Poughkeepsie, supply from Hudson River	86

By arguments such as the above, Dr. Waller maintained that the conclusions reached by Professor Leeds were erroneous. In the discussion that followed certain of Dr. Waller's modes of analysis were criticized by Dr. Endemann, but his remarks were merely on a side issue, and had no bearing on the results. M. B.

To the Editor of "SCIENCE."

DEAR SIR:—I am sorry to find that I have been misled as to one important fact stated in my paper upon Standard Time which appeared in "SCIENCE" for January 21st. The Signal Service has not applied for an appropriation of $25,000 for the purpose indicated in the paper, but a bill introduced in the house by Mr. King of Louisiana, asks this amount to enable the *Naval Observatory* to establish and drop time-balls at the principal ports of entry; and this was confounded with the Signal Service bill in the mind of my informant.

I supposed I had good authority for what I wrote, but as the result shows I ought to have looked into the matter more closely before trusting the statement to type. I regret exceedingly to have aided in giving currency to an erroneous statement.

C. A. YOUNG.

PRINCETON.