NOTE ON THE ACTION OF WATERS UPON LEAD PIPE.

By E. Waller, Ph.D.

About nine months ago, a couple of samples of water were sent to me from the mountain region of Kentucky. They were stated to be from creeks in that region, and the intention was to utilize one or both of them for domestic purposes. The results of the analysis were as follows in parts per 100,000 :

	I.	II.
Appearance: Faintly turbid, brownish.		
Odor when heated to 100° F	none.	none.
Chlorine in chlorides	0.0311	0.0560
Phosphates and nitrates	none.	none.
Nitrogen in nitrates	0.0165	0.0247
Free ammonia	0.0004	trace.
Albuminoid ammonia	0.0046	0.0016
Hardness temporary	0.950	0.750
" permanent	1.40	1.300
Organic and volatile (loss on ignition)	1.300	1.400
Total solids	3.400	2.900

	I. Salts.	II. Salts.
$NaCl$	0.051	0.092
K_2SO_4	0.284	0.263
Na_2SO_4	0.157	0.093
Na_2CO_3	0.032	0.017
$CaCO_3$	0.556	0.404
$MgCO_3$	0.501	0.346
Fe_2O_3 and Al_2O_3	0.107	0.180
SiO_2	0.912	0.957
Organic (by difference)	0.800	0.548
Total	3.400	2.900

The results, as may be perceived, are such as to allay any suspicions of organic pollution, indeed the accounts given me of the surroundings were such as would lead to a conclusion as to their safety in that regard, irrespective of the analysis.

Since, however, the water was to be used in several houses, in some or all of which leaden pipes might be used as service pipes, I made, as I frequently do, a test as to the action of these waters upon lead. Pieces of ordinary lead pipe which had been used for service pipe were filed and scraped perfectly bright and clean, and then placed in stoppered bottles, each having a capacity of about 300 c. c. The bottles were then filled with the waters and labelled.

As a comparison test, a piece of the lead pipe, cleaned in the same manner, was placed in a bottle, and Croton water run in in the same way. All three bottles were thus stoppered and set aside. After standing for about 20 hours, all three bottles showed a slight separation of white granular material which was proved by tests to contain lead. The bright surface of the pieces of lead pipe, had also become dull, indicating some action. The waters, however, on filtering showed no decided reaction for lead in solution. The action of the Croton water was appriciably less than either of the others. The water and sediment was poured off, and after two or three rinsings with fresh lots of the respective samples to remove all perceptible sediment, fresh portions of the waters were run in upon the lead, and they were again put by, as before, at the ordinary temperature of the laboratory, for 24 hours. At the end of that time practically no separation of lead scales had occurred with the Croton water, a little had shown itself with No. I. and much more with No. II. The operation of rinsing off and refilling with water was repeated and at the end of the next 24 hours, the Croton water showed no sediment, No. I. showed hardly any, while No. II. showed about the same amount as before. They were then allowed to stand, without further changing of the water, and they have been allowed to stand thus ever since.

The results I have brought to show you as they may be interesting. The lead in the Croton water has become blacker with time, and had developed in one or two spots, some white crusts which seem to be moderately hard, and firmly adherent. Practically no sediment has formed. In the No. I. water the lead has a more whitish appearance, and some particles of the lead compound have become detached forming some sediment. But, in the case of No. II. the scales, of white lead compound appear to have become detached almost as fast as formed, and the action seems to be going on indefinitely, for, as may be seen, it nearly conceals the piece of lead, being nearly half an inch in depth, and has when shaken the pearly crystalline appearance such as are often obtained by pouring solutions of bismuth salts into a large bulk of water.

Whatever may be the impurities in the lead, the pieces must be very nearly of the same character in all, for they were cut from the same piece of pipe.

The action appeared to be quite rapid at first, and has become slower as time has gone on, but for a long time the increase in the amount of separated lead salt was quite perceptible from week to week, and even now can be perceived by inspection at longer intervals.

The action corresponds almost exactly to the description given by Professor Frederick Penny of the action of Loch Katrine water upon lead *in open vessels*. Water No. I. in the closed bottle acts in very much the same manner as the Loch Katrine water in closed vessels, described by Professor Penny.* The analysis of the Loch Katrine water given in his report, shows about the same proportion of solids, though the salts are different in their respective amounts. His figures are given in grains per gallon, presumably the imperial gallon of 70,000 grains. On that assumption, I have calculated the proportions per 100,000, for comparison with the figures already given.

LOCH KATRINE WATER. (Analysis by Prof. Penny).

	"Grains per gallon."	Parts per 100,000.
Organic matter	0.900	1.285
$Ca\ SO_4$	0.381	0.544
$Ca\ Cl_2$	0.144	0.206
Alkaline chlorides	0.433	0.619
$Mg\ CO_3$	0.216	0.309
$Si\ O_2$ and phosphates	0.170	0.243
$Fe_2\ O_3$	traces	traces
Total	2.244	3.206

Hardness, 0.8°

*Reports and opinions on the use of lead pipe for service pipe. J. P. Kirkwood, New York, 1859. Page 212.