

mittee has, however, secured as much information as possible both from men of practical experience and those who have approached the subject from a scientific standpoint.

Many towns continue to use for service pipes the material which has always been used since the works were installed, although in many cases much trouble has been experienced. There are, however, about one hundred places where changes are reported to have been made for various reasons. A study of these changes and the reasons given therefor is very interesting.

The table below gives the changes which have been made and materials used before and after the change.

Changes Made in Material Used

From	Wrought Iron or Steel	Enamelled	Galvanized	To	Lead	Lead Lined	Cement Lined	Totals
Wrought iron or steel	..	..	11	4	3	4	22	
Enamelled iron	..	..	10	1	1	1	13	
Galvanized	..	1	..	7	7	2	17	
Lead	..	..	4	..	..	2	6	
Lead-lined	1	..	5	..	..	2	8	
Cement-lined	..	..	16	6	5	..	27	
Totals	1	1	46	18	16	11	93	

The disfavor with which plain iron and steel are regarded is shown by the fact that 22 places have changed from those materials to some other, while only one place has reported as having taken up their use. Galvanized pipe, on the other hand, has lost only 17 while gaining 46. Lead and lead-lined pipes have gained 18 and 16 places respectively and lost 6 and 8. Changes to cement-lined pipes have occurred in 11 places, and changes from cement-lined pipes to some other material have occurred in 27 places.

A comparison of the number of places now using the different materials with the number of places where this material has been abandoned shows that 63 per cent. of those formerly using plain iron or steel pipes have changed to some other material. Eight per cent. have changed from galvanized iron; 19 per cent. from lead or lead-lined; and 42 per cent. from cement-lined.

Of those places where changes have been made from galvanized pipe to some other material, 13 are supplied from surface sources, 1 with ground water, and 3 with filtered water. Of the places changing from lead or lead-lined pipe to some other material, 5 are supplied from surface sources, 13 from ground water sources, and 4 from filtered sources. Of the places abandoning cement-lined pipes for other material, 18 are supplied with surface water, 7 with ground water, and 1 with filtered water.

A large proportion of the places where the works have been in operation for a sufficient time report trouble with service pipes no matter what the material used, except in the case of cement-lined pipes. With cement-lined pipes, 54 per cent. of the places reporting report little or no trouble. With galvanized pipe, 36 per cent. of the places report little or no trouble, and with lead pipe 10 per cent. so report.

The trouble with iron and steel pipes, both plain and galvanized, appear to be through the entire length of the pipe. The trouble with lead pipes appears largely at the

corporation cock. The trouble with cement-lined pipes is very largely corrosion of the outside of the pipe just inside the cellar walls, with some trouble at the lead gooseneck.

Life of Service Pipe

The data in regard to length of life of a service pipe and the period that elapses before it begins to give trouble are very unsatisfactory. The averages of the figures given in the returns are as follow:

	Years before Trouble Begins	Life of Pipe (Years)
Plain iron or steel	12	16
Galvanized	15	20
Lead	10	35
Lead-lined	10	23
Cement-lined	14	28

The main sources of trouble from corrosion are largely inside the pipes, due to the action of the water. In certain soils, however, there is a rapid corrosion of the pipes on the outside, and, if the inside is protected, as in the case of cement-lined pipes, this is the main source of trouble. Pipes laid in salt marsh or in cinder-fill are certain to be acted upon rapidly. Pipes in clay are much more subject to corrosion on the outside than those in sand or gravel. One of the common places where trouble occurs is at the corporation cock, or, where a gooseneck is used, at the junction of the gooseneck with the service pipe. Some of the troubles at the corporation cock are due to the tuberculation of the inside of the main pipe, which tends to cover the end of the corporation cock. This can be overcome in a large measure by inserting the corporation cock well beyond the inside of the main.

The following table gives the location of the principal troubles with different kinds of services as reported to the committee:

Where Trouble Occurs

	Plain Iron or Steel	Galvanized	Lead	Lead Lined	Cement Lined
Throughout entire length	10	49	17	8	2
Couplings and fittings	4	24	7	6	10
Cellar wall	3	8	5	6	13
Corporation or gooseneck	7	20	14	6	14
Curb cock	3	8	6	2	4

Conclusions

Service connections may, and frequently do, give more trouble than any other part of a waterworks system, causing the deterioration of an otherwise good water and constituting an unduly large proportion of the maintenance expense. The preservation of the purity of the water is obviously the most important requisite, and only those materials should be used which will not impair in any way the quality of the water.

The cost of the installation of services is so small in comparison with the total cost of the system, and the expenses for repairs and renewals are so large, that only the most durable materials should be used.

There are very few, if any, places where it is advisable to use uncoated wrought iron or steel in service-pipe construction. The metal will corrode more or less rapidly, according to the character of the water, clogging the pipes, giving trouble in the houses from rusty water, and eventually requiring renewal of the service.