that river water, no matter how impure, may be brought into a condition of absolute safety bacteriologically and of great relative purity chemically by means of lime.

As regards the cost of the chemical, Dr. Houston explains that best Buxton lime calculated as CaO could be delivered at Sunbury Works at 21s. per ton. Enough to treat 1,000,000 gallons—*i.e.*, 1,972 lb.—would cost 18.48s. If 67 per cent. of the water were limed and 33 per cent. of stored Staines reservoir water used for neutralization the cost would be 12.38s., or, say, 12s. 6d. per million gallons. Sixty-seven per cent. of the total volume would then contain no excremental bacteria and the whole of the water would be softened to the extent of about 16 parts per 100,000 c.c.

THE COST OF RAILWAY TIES.

One of the formulas submitted by the tie committee of the American Railway Engineering Association last March gives the annual cost of maintaining a tie as follows:—

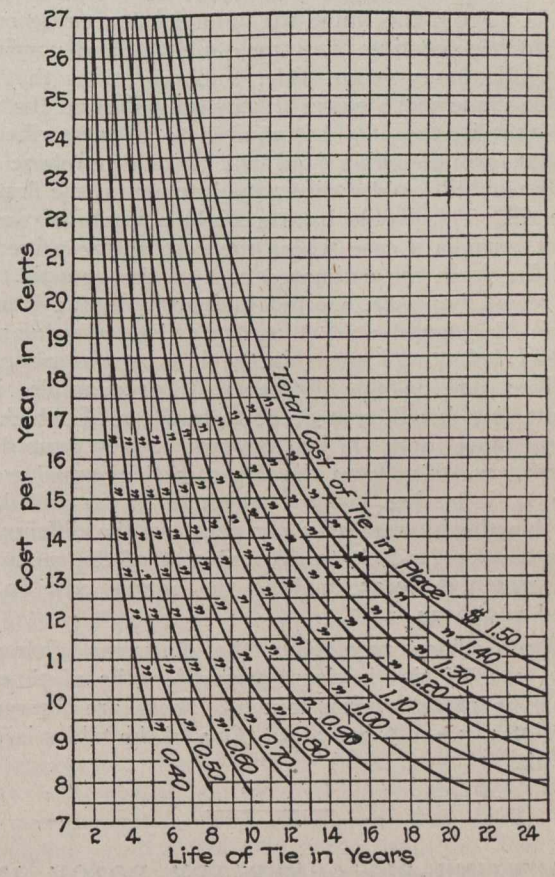
$$I + A = \frac{CR(1+R)^n}{(1+R)^n - 1} = \frac{C(1+R)^n}{\frac{(1+R)^n - 1}{R}}$$

or

$$I + A = \frac{\text{Amount of } C \text{ after } n \text{ years}}{\text{Amount of \$1 annuity for } n \text{ years}}$$

C = Final cost of tie in place;
R = Rate of interest;
I = Interest = CR;
n = Life of ties in years;
A = Annual contribution to sinking fund, which at compound interest will provide for renewal at end of life of tie.

Mr. J. G. Sullivan, chief engineer of western lines of the Canadian Pacific Railway, has had three diagrams



Cost per Tie per Year—for Ties Varying in Total Cost and in Length of Life, With Money at 5 per cent. Interest.

prepared to better facilitate the use of this complex appearing formula. The diagrams are for the use of the

Annual Cost of Ties Lasting Various Lengths of Time, Costing in Place Various Sums, Money Figured at 5% Interest.

Life in years.	Cost in Place.											
	$0.40	$0.50	$0.60	$0.70	$0.80	$0.90	$1.00	$1.10	$1.20	$1.30	$1.40	$1.50
1	0.420	0.525	0.630	....	....	....	....	....	....	....	....	....
2	.215	.269	.322	0.376	0.430	0.484	0.538	....	....	....	....	....
3	.147	.184	.221	.257	.294	.331	.368	0.405	0.442	....	....	....
4	.113	.141	.169	.198	.226	.254	.282	.310	.338	0.367	0.396	0.423
5	.092	.115	.139	.162	.185	.208	.230	.254	.278	.301	.324	.345
6	....	.098	.118	.138	.157	.177	.196	.216	.236	.256	.276	.294
7	....	.086	.104	.121	.138	.155	.172	.190	.208	.225	.242	.258
8	....	.078	.093	.109	.124	.139	.156	.171	.186	.202	.218	.234
9	....	....	.084	.098	.112	.126	.141	.155	.168	.182	.196	.210
10	....	....	.077	.091	.104	.117	.129	.142	.154	.168	.182	.195
11	....	....	....	.084	.096	.108	.120	.132	.144	.156	.168	.180
12	....	....	....	.079	.090	.102	.113	.124	.136	.147	.158	.169
13	....	....	....	....	.085	.096	.107	.117	.128	.138	.149	.160
14	....	....	....	....	....	.090	.101	.111	.121	.131	.141	.151
15	....	....	....	....	....	.087	.096	.106	.116	.125	.135	.144
16	....	....	....	....	....	.083	.092	.101	.111	.120	.129	.138
17	....	....	....	....	....	....	.089	.098	.107	.115	.124	.133
18	....	....	....	....	....	....	.086	.094	.103	.111	.120	.129
19	....	....	....	....	....	....	.083	.091	.099	.108	.116	.124
20	....	....	....	....	....	....	.080	.088	.096	.105	.112	.120
21	....	....	....	....	....	....	.078	.086	.094	.101	.109	.117
22	....	....	....	....	....	....	....	.084	.091	.099	.106	.114
23	....	....	....	....	....	....	....	.082	.089	.096	.104	.111
24	....	....	....	....	....	....	....	.080	.087	.094	.102	.109
25	....	....	....	....	....	....	....	.078	.085	.092	.100	.107