

plants for the preservative treatment of their supplies of ties and other timbers. Still more railroads buy large supplies of chemically preserved ties and timbers from the 61 private corporations who make a business of supplying them.

It is necessary that some means of lengthening the life of cross-ties be soon adopted in Canada.

The supply of timber in Canada is not so large as is commonly supposed. There is a great waste of timber in the manufacture and in the use of ties. About one-eighth of the ties in all the tracks of Canada must be replaced each year because of decay. The average length of life of ties of the important woods as reported by the steam roads is: cedar 9 years; tamarack, 8 years; hemlock, 7 years; Douglas fir, 7 years; jack pine, 6 years; spruce, 6 years. It is the experience of the railroads of Europe and of many in the United States that if cross-ties of any of the above or even less durable species are thoroughly impregnated with some preservative such as creosote, carbolineum, crude petroleum or zinc chloride, materials which prevent or delay decay in timber, a much greater length of satisfactory service is assured. At the 10th Annual Convention of the Maintenance of Way Association a committee reported that when ties were thoroughly treated with creosote they gave a service of 15½ to 19 years; when treated with zinc chloride they lasted 10 to 14 years and when treated with zinc-creosote they gave a life of 12 to 18 years. If protected from mechanical abrasion by tie plates the life is in some instances still longer.

The general introduction of some preservative treatment would greatly lessen the annual demand upon the forest. There are, not including yards and sidings, about 28,300 miles of railway with about 85,000,000 ties in operation or under construction in Canada. Under present conditions one-eighth of the ties, 10,625,000 must be renewed every year. Were the preservative treatment of ties general and an average life of 16 years secured the annual renewals would only be one-half as great, one-sixteenth of the total, and there would be a saving each year of 5,300,000 ties. Supposing it were thoroughly protected from fire and under better forest management than can be expected in Canada, before many years it would take from 2,000,000 to 5,000,000 acres of our northern forest belt to produce 5,300,000 cedar, jack pine and tamarack ties annually. For this reason alone it is important that the government, by experiment and demonstration, encourage the use of timber preservatives.

There would be great economy for the railroads in the use of chemically preserved ties. Allowing that the average length of life of untreated ties of different species is, as was stated above, adding to the cost given in Table I 20 cents for the expense (labour and freight) of placing the tie in the track, it is seen that cedar ties give 9 years service for 65 cents, tamarack 8 years for 59 cents, hemlock 7 years for 53 cents, Douglas fir 7 years for 54 cents, jack pine 6 years for 50 cents and spruce 6 years for 45 cents. The annual charge for these ties may be computed from the

formula 
$$A = E \left( \frac{\left(1 + \frac{P}{100}\right)^n \times P}{\left(1 + \frac{P}{100}\right)^n - 1} \right)$$
 in which A is the annual charge, E, is the

initial expenditure (in this case the cost of the tie in the track) P is the rate of interest and N is the number of years service per tie. Where the rate of interest is 4 per cent the annual charges for untreated ties of the most important Canadian species are:—spruce 8.59 cents, cedar 8.74 cents, tamarack 8.76 cents, hemlock 8.83 cents, Douglas fir 9.00 cents and jack pine 9.54 cents.

Spruce and cedar are soft-fibred woods and when used for cross-ties are so easily cut by the creeping and pounding action of the rails that by the time they are decayed they are also worn out. Preservative treatment would enable these species to resist decay for 15 years or more, but spruce and cedar ties would only last this time under heavy service if protected from mechanical wear by tie-plates. The other common Canadian species of tie timbers, tamarack, hemlock, Douglas fir and jack pine might not require tie-plates, but even if they did, there would still be economy in giving them preservative treatment; though these woods are not so easily treated as poplar