

stickiness and make them easier to handle, just in the same way as an asphalt road is sanded. Timber for building, where neat joints and carpentry are required, would probably be better treated with some pigment mixed with oil or varnish, but for rough work the asphalt or mineral tar seem to be all-sufficient and very inexpensive. The estimated cost of the drying process is 7c to 8c; of the protective coating 3c or 4c a tie. Taking the higher figures and adding a margin, it would appear that 15c will cover the total cost.

Increases Supply of Tie Timber.—The prospect which is opened up by this process is something more than merely getting the equivalent of the process-creosoted tie at a less cost. It is, besides, the potentiality of using for ties, timbers which are now useless for the purpose, or nearly so. The northern birch, for instance, is a strong, reliable wood, used by the Indians for every purpose requiring a hard wood, but unavailable for ties or bridge timber on account of its superabundant sap and its consequent tendency to rot rapidly. The poplar and the balsam are others for which there is at present practically no demand. These timbers are particularly interesting to us just now, on account of the recent opening up by the railways of thousands of square miles of northern forests, of which, with spruce and jack pine, these are the main constituents. The use of these woods for commercial purposes means not only millions of dollars to the railways in reduced cost of ties and in freight, but more millions to the people of Canada who have been burning up and wasting this forest growth as something not only worthless, but as actually impeding settlement.

Conserve the Northern Forests.—It is quite conceivable—I think we may say probable—that the settler in New Ontario, or Northern Saskatchewan, or Alberta, will find it profitable to conserve the forest on a considerable portion of his land, cutting from year to year only the mature timber, so as to encourage the young growth. Aside from the question of ties and pulp wood, what a large potential value there is in poplar, balsam and spruce! In Winnipeg's early days, poplar lumber was the principal material in house building, and there was no fault to be found with it, except its shrinkage, which drying would have prevented.

Balsam is to this day the principal cut of the little country mills in northern Nova Scotia for home use, and is an excellent material for inside carpentry. Spruce is the finest material for spars, probably, of any known; and only its perishability prevents it from making a cleaner, straighter, and stronger telegraph pole than the crooked, twisted cedars we are using. Birch is already coming to its own in the manufacture of furniture. Our northern settler has been in the habit of burning up most of these timbers as almost worthless, in order to grow potatoes in their stead. A century ago the settlers in Southwestern Ontario thought much the same about the white pine and the black walnut, and some of the wealthiest residents in that portion of the country today are those whose fathers, either by accident or design, left some of the original forest standing.

The foregoing portion of this paper was written two years ago, and there is practically no change in it except in respect to one or two details, as a result of more testing which has been carried on, and as to the figures of costs which would be considerably higher than those quoted.

A number of ties have been put in the Canadian Northern track, and while the times have been somewhat too strenuous of late for experimenting, and changes in staff have led to the neglect of the examination of these from time to time, some of them have been taken up and tested for absorption of moisture and for signs of rot.

I have one sample of a tie dug up only a few days ago which had been under the track in the Trenton yard for over three years; and I have also another sample of a birch tie, which has never been under the track at all, but which shows how absolutely perfect the drying part of the process is and what available timber birch is, though absolutely a worthless timber if it is used in outside work without seasoning, and the reason is unquestionably the amount of sap which it contains. If this is dried out and the wood sterilized, it is as strong and lasting as most other hardwoods, and better than some. It is incidentally the only hardwood in Northern Ontario and Quebec.

As a result of our experiments with these ties, we concluded that they were in the right direction in the main, but that the asphaltic waterproofings were imperfect. They melted and ran under a strong hot sun; and when abraded, as was inevitable in the case of ties, the waterproofing was gone. Some of the more tarry products which penetrated the grain of the wood were much better, and we believe them to be very good indeed.

Except for the expense, creosoting after the seasoning process has been carried out would be perfect; but I for one am extremely doubtful of the efficacy of creosoting for an unseasoned stick of timber. It always seems to me like putting a coat of paint or varnish on green wood. This merely closes up the outside pores of the wood and prevents the evaporation and oxidation of the juices and saps of the interior.

I have already alluded to the care which the Germans take with their drying and seasoning, but we are too impatient in this country to wait for this and we give at most 8 or 9 months, which is not enough. Most people probably have seen standing timber after a bush fire. For a year or so the seasoning goes on all right, and then the borers get to work. They bore through the hard seasoned outside shell, so as to get at the juices of the interior; which shows that the juices are there, although the stick has been seasoned under almost ideal conditions standing straight on end, and nearly always with the bark on to shed rain and snow.

Creosoting, I understand, costs now some 40 cents per tie; so that the treated tie costs us considerably over \$1.00 and is heavier and harder to handle than the untreated tie. One of the advantages claimed for the seasoning is that it very greatly reduces the weight instead of increasing it, and that as a result we have less to pay for transportation and for trackwork. The seasoning can be accomplished in a month or less (the time varies with the character of the timber), so that even if we resort to creosoting we save time and interest on money invested in green ties, and we save room in our piling yard and drying sheds.

I have dealt in the above practically altogether with ties, because it is one problem which is bothering us railway men a great deal. Even before the war and the recent enormous advance in prices, we had become so impressed with the growing scarcity and increasing cost of timber ties that we had been making

all kinds of experiments with metal and concrete ties—not in order to cheapen the first cost, but to lengthen the life of the tie and so make it annual cost less.

If we go into concrete at all, it has always seemed to me that we should alter our whole system of support to a longitudinal instead of a transverse bearing, and this again would alter the most economical form of rail to be used. Possibly we might, with a long stringer of concrete giving us the necessary stiffness and rigidity, dispense with enough steel to pay for part of the increased price to the bearing; but imagine what we should get in the way of drainage and precautions against frost heaving in our climate! I have seen reinforced concrete ties doing very excellent work in the tropics, but our frost conditions alter the whole aspect of the matter. Shimming upon the top of a concrete tie would be a very different matter from drawing the spikes out of a wooden tie and putting longer ones in; or, as we have to do sometimes, putting a complete new tie on top of the old one.

I am afraid that for many years to come we must continue to use wooden ties, at any rate on all but the most perfect and most heavily congested parts of our railways; and this being the case, and the supply diminishing while the demand increases, it behooves us to make them as long-lived as possible.

There are, besides the item of ties, a great many other utilities about a railway which we have hitherto been accustomed to build of wood, but for which latterly we have been substituting structures of steel, concrete and other materials; and the reasons for the substitution have been the same—increased life and lower maintenance charges, and also, in the case of timber trestles, water tanks and buildings, danger from fire.

On our own Canadian Northern at any rate we have had numerous cases of bridge decks catching fire, and in many cases the fires have spread from the decks to the body of the structure; but in how many cases have we found that the commencement of the fire was where some little punkiness and rot had started, and that a smouldering fire had been fanned by a strong wind into a blaze! Ballast decks have been introduced to obviate these fires, but they don't seem to have come into general use; and the tie, aside from fire risk, certainly does not last so long as if freely ventilated. Prevent the rot and I think you will find that the risk of fire is greatly diminished. Season the timber thoroughly, and apply a fireproofing coating of tar and sand, similar to what we have put on our building roofs at times, and the risk will disappear almost entirely. In this case, the question of abrasion, of the rubbing off of the protective coating, does not come in at all; but the protective coating, whatever it may be, should not be put on unseasoned timber.

We all know of old bridges and other structures which have been protected from the weather and have stood up for a generation or more, and been replaced only because too small or too weak for modern loads; and in many cases where wooden bridges have been replaced by steel and concrete, it is somewhat questionable whether the change was economical in the fullest sense of the word, and whether it would not have been better policy, as an intermediate step, to take more care in preserving the timber and to put concrete abutments and piers under it.

One of the main reasons for much of