DEPARTMENT OF THE INTERIOR, CANADA
Hon. Frank Oliver, Minister; W. W. Cory, Deputy Minister.
FORESTRY BRANCH—BULLETIN No. 14
R. H. Campbell, Superintendent of Forestry

FOREST PRODUCTS OF CANADA

1909

CROSS TIES PURCHASED

COMPILED BY
H. R. MacMILLAN, B.S.A., M.F.

OTTAWA
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CROSS TIES PURCHSAED IN 1909

The data upon which this report is based were furnished by the steam and electric railways of Canada. The value given for the ties is the cost at the point of purchase.

There were 14,178,241 cross-ties, costing $5,210,490, purchased in 1909 by the steam and electric roads of Canada. This was an increase of 199,825, 1·4 per cent over the purchases recorded for 1908. Owing to a decrease of one cent in the average price paid per tie $71,195 more was paid for the ties used in 1908 than for those used in 1909.

The number of ties of each kind of wood purchased in 1908 and 1909 with their total and average cost, and the per cent each species forms of the total is given in Table I.

TABLE 1.

THE NUMBER AND COST OF CROSS-TIES of different species used in 1908 and 1909, with average cost per tie of each species and per cent each species forms of the total.

Kind of Wood.	1908.				1909.			
	Number.	Cost	Av. Cost Each.	Per cent Distribution.	Number.	Cost.	Av. Cost Each.	Per cent Distribution.
		$	cts.			$	cts.	
Cedar	5,452,665	2,030,139	37	39	(3) 4,131,380	1,859,121	45	29·1
Jack pine	(1) 1,391,700	469,013	34	9·9	3,404,501	1,021,350	30	24·1
Tamarack	2,178,942	768,566	35	15·6	(4) 2,811,820	1,096,610	39	19·7
Hemlock	2,194,319	810,031	37	15·7	1,850,056	610,512	33	13·1
Spruce	1,314,394	452,103	34	9·4	891,573	222,893	25	6·3
Douglas fir	.....	.....	.....	.....	653,403	225,258	34	4·6
(2) White pine	.....	.....	.....	.....	92,633	27,519	29	0·7
Chestnut	.....	.....	.....	.....	84,669	49,809	59	0·6
Oak	.....	.....	.....	.....	34,389	21,292	62	0·2
Cypress	.....	.....	.....	.....	8,362	3,010	36	(6)
(2) Red pine	.....	.....	.....	...	1,661	316	19	(6)
(2) Southern pine	.....	.....	.....	.....	332	223	67	(6)
Unspecified	1,446,396	751,833	52	10·4	(5) 213,462	72,577	34	1·6
Total	13,978,416	5,281,685	38	100	14,178,241	5,210,490	37	100

(1) Includes all pines used in 1908. (2) Included under jack pine for 1908. (3) Includes 10,500 Western cedar ties, cost $2,958. (4) Includes 713,261 Western larch ties, cost $249,296. (5) Includes 18,150 creosoted ties, cost $16,335. (6) Less than one-tenth of one per cent.

More woods are reported as used in 1909 than in 1908. This is partly explained by a lack of care in reporting the minor species in 1908 and partly by the growing scarcity of the woods commonly used for cross-ties in Canada and a consequent growth in the use of new or imported species.

Though not as many cedar ties were purchased in 1909 as in 1908 cedar is still the chief species used in Canada. In 1909 it furnished over one-quarter, 28·9 per cent of the ties purchased by Canadian roads. Nearly all the cedar used is eastern cedar (*Thuya occidentalis*); only 10,500 or 0·2 per cent of the cedar ties purchased were western cedar. Western cedar is too soft for satisfactory use as cross-ties.

Jackpine is the second in importance in cross-tie production; in 1909 it supplied about one-quarter or 24·2 per cent of the ties used in Canada. Though the figures for 1908 were only approximate it is evident that there was a much larger proportion of jackpine used for ties in 1909 than in 1908. In 1908 jackpine (including other pines) furnished only one-tenth of the ties used, in 1909 one-quarter of the ties used were jackpine.

Tamarack occupied the same relative position as a tie producer, third, in both 1908 and 1909. There was a slight increase in 1909, when one-fifth of the ties were of tamarack as compared with 1908 when the proportion was only one-sixth. About one-quarter of the tamarack ties used, 713,261 or 25·4 per cent, were of western Larch (*Larix occidentalis*). The remainder were the eastern larch or tamarack (*Larix laricina*).

Hemlock is extensively used for ties in Canada. Over one-eighth, 13·1 per cent, of the ties purchased in 1909 were hemlock.

The four species above noted, cedar, jackpine, tamarack and hemlock, furnished six-sevenths, or 86·2 per cent, of the ties used in Canada. Nearly all the remainder, 10·8 per cent of the total, is made up of spruce and Douglas fir.

Several species, white pine, chestnut, oak, cypress, red pine and southern pine (yellow or hard pine, probably loblolly) are used to a small extent for ties. The chestnut, nearly all the oak, the cypress and the southern pine are imported. The use of oak is usually confined to switch-ties.

The average price of ties in 1909 was 37 cents each as compared with 38 cents in 1908. Of the important woods cedar cost the most, 45 cents per tie, and spruce the least, 25 cents per tie. The prices of the other important woods are tamarack 39 cents, hemlock 33 cents and jackpine 30 cents. The woods used to a smaller extent vary greatly in price—from southern pine at 67 cents to red pine at 19 cents. The best value of all, without a doubt, is cypress at 36 cents.

The reports received for 1909 do not all indicate what proportion of the ties used were hewn or sawn; 52·5 per cent of the ties used in 1908 were sawn, the remainder hewn. The data received for 1909 would indicate that about two-thirds of the ties purchased in 1909 were hewn.

Steam railways used 99·2 per cent of the ties purchased in 1909. They used 98·3 per cent of the ties purchased in 1908.

TABLE 2.

THE NUMBER AND COST OF CROSS-TIES of different species used for Steam Railways in 1908 and 1909, with average cost per tie of each species and per cent each species forms of the total.

Kind of Wood.	1908.				1909.			
	Number.	Cost.	Av. Cost Each.	Per cent Distribution.	Number.	Cost.	Av. Cost Each.	Per cent Distribution.
		$	cts.			$	cts.	
Cedar	5,298,746	1,970,562	37	38·6	(3) 4,079,414	1,838,609	45	28·9
Jack pine	(1) 1,390,978	468,742	34	10·1	3,404,501	1,021,350	30	24·2
Tamarack	2,136,647	750,948	35	15·5	(4) 2,803,820	1,092,130	39	20·
Hemlock	2,159,587	798,249	37	15·6	1,844,762	608,830	33	13·1
Spruce	1,305,803	449,340	34	9·5	889,659	222,373	25	6·3
Douglas fir	.....	.....	...	.....	626,946	211,864	34	4·5
(2) White pine	.....	.....	.....	.....	92,483	27,303	30	0·7
Chestnut	.....	.....	.....	.....	84,669	49,809	59	0·6
Oak	.....	.....	.....	.....	21,207	13,199	62	0·2
Cypress	.....	.....	.....	.....	8,362	3,010	36	(6)
(2) Red pine	.....	.....	.....	.....	1,661	316	19	(6)
(2) Southern pine	.....	.....	.....	.....	332	223	67	(6)
Unspecified	1,446,396	751,833	52	10·7	(5) 213,296	72,502	34	1·5
Total	13,738,157	5,189,674	38	100	14,071,112	5,159,518	37	100

(1) Includes all pines used in 1908. (2) Included under jack pine for 1908. (3) Includes 10,500 Western cedar ties, cost $2,958. (4) Includes 713,261 Western larch ties, cost $249,296. (5) Includes 18,150 creosoted ties, cost $16,335. (6) Less than one-tenth of one per cent.

Table 2 shows the number, cost and other details of the ties of each kind of wood purchased by the steam railways in 1908 and 1909; the same data for the electric railways is given in Table 3.

TABLE 3.

NUMBER AND COST OF CROSS-TIES purchased by Electric Railways in 1908 and 1909 by species with average cost of each and per cent each forms of the total.

Kind of Wood.	1908.				1909.			
	Number.	Cost.	Av. Cost Each.	Per cent Distribution.	Number.	Cost.	Av. Cost Each.	Per cent Distribution.
		$	cts.			$	cts	
Cedar	153,919	59,577	39	64·1	51,966	20,512	39	48·6
Douglas fir	.....	.....	.....	.....	26,457	15,394	58	24·7
Oak	.....	.....	.....	.....	13,182	8,093	61	12·3
Tamarack	42,295	17,618	42	17·6	8,000	4,480	56	7·5
Hemlock	34,732	11,782	34	14·4	5,294	1,682	32	4·9
Spruce	8,591	2,763	32	3·6	1,914	520	28	1·8
White pine	(1) 722	271	38	0·3	150	216	1·44	0·1
Unspecified	.....	.....	.....	.....	166	75	45	0·1
Total	240,259	92,011	38	100	107,129	50,972	47	100

(1) The species of pine used in 1908 was not reported.

The steam railways using nearly all the ties, take them in about the same proportion and at the same prices as they are quoted in Table 1. The electric railways depended upon cedar for nearly half their supply, next in importance was Douglas fir, furnishing one-quarter of the total, and oak was third with one-eighth. Other woods used in smaller quantities were tamarack, spruce, hemlock and white pine. The electric railways, most of them at a distance from the jackpine regions, reported the use of no jackpine, the wood which furnished one-quarter of the ties used for the steam railways. No chestnut, cypress, southern pine or red pine were used by the electric roads.

Though one-half the ties used by the electric railways were cedar, for which only 39 cents was paid, as compared with the 45 cents paid for cedar by the steam roads, the average cost of all ties bought by the electric roads was 47 cents as against an average cost of 37 cents for the steam railways. The reason of this higher average was that the electric railways bought very few ties for less than 39 cents and paid 61 cents for oak, 58 cents for Douglas fir and 56 cents for tamarack. A few white pine ties were bought at $1.44.

There is a great difference between the conditions governing the supply of crossties in Canada and in the United States.

Just about eight times as many ties are used annually in the United States as in Canada; about four-fifths of them are hewn and about 95 per cent of them are used by the steam roads.

Ties cost more in the United States than in Canada and are of better quality. The price paid for ties in the United States in 1908 was 50 cents each and in Canada was 38 cents each. But the Canadian ties were over one-half of short-lived species, hemlock, tamarack, jackpine and spruce, while 86·6 per cent of the United States ties were of such durable woods as the oaks, southern pines, cedar, chestnut, Douglas fir and cypress. Over 48,000,000 or 42·8 per cent of the ties used in the United States in 1908 were oak, yet, with a far larger supply of durable woods than exists in Canada, the railways of the United States, largely educated by government demonstrations, have generally adopted the preservative treatment of ties. Over one-fifth of the ties purchased by United States railways in 1908 were chemically treated before being laid in the track. Altogether 23,776,060 ties were so treated in one year. In the beginning of 1910 sixteen of the large railways in the United States had erected 23

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-eight 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 $A = E\left\{\frac{\left(1+\frac{P}{100}\right)^n \times \frac{P}{100}}{\left(1+\frac{P}{100}\right)^n - 1}\right\}$ 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 porous

woods they can be thoroughly impregnated with creosote and furnished with suitable tie-plates for 25 to 35 cents per tie and when treated will last 15 years or more in the track.

If 30 cents is allowed as the cost of creosoting ties and equipping them with tie-plates so that they will last 15 years, the annual charge with an interest rate of 4 per cent is for spruce 6·74 cents, jack pine 7·19 cents, hemlock 7·47 cents, Douglas fir 7·55 cents, tamarack 8·00 cents and cedar 8·54 cents. This is a saving of 2·35 cents per year on every jack pine tie, 1·85 cents on spruce, 1·45 cents on Douglas fir, 1·36 cents on hemlock, 0·76 cents on tamarack and 0·20 cents on cedar.

For every mile of track preservative treatment would bring about an annual saving in maintenance charges, of $70.50 where jack pine ties are used, $55.50 on spruce ties, $43.50 on Douglas fir ties, $40.80 on hemlock ties, $21.80 on tamarack ties and $6.00 on cedar ties.

This reduction in regular yearly maintenance expenses represents the earnings at 4 per cent on $1,762.50 per mile of track where jack pine ties are used, $1,387.50 for spruce, $1,087.50 for Douglas fir, $1,020.00 for hemlock, $545.00 for tamarack and $150.00 for cedar.

These figures are conservative. The economics possible to the large railway organizations of Canada would probably enable them to bring the price of treating ties and furnishing them with tie-plates, down to less than 30 cents each. On the other hand it is likely that well treated ties will give efficient service for more than 15 years. Mr. W. F. Sherfesee, in Bulletin 78 of the United States Forest Service estimates that thoroughly creosoted ties will last, on the average, 17 years in the United States, where, on the whole, the climate is more conducive to decay than it is in Canada. Creosoted jack pine ties lasting 16 years would bear an annual charge of 6·86 cents; if they lasted 17 years, which might reasonably be expected, the annual charge would be 6·58 cents. Compared with the present method of using raw or untreated ties the cost of maintaining the road would be $79.50, or $88.80 less per year if treated ties were used giving a service of 16 or 17 years each; at 4 per cent the capital invested in maintaining the road would be $1,987.50 or $2,220.80 less per mile than it is now.

For convenience in making comparisons a summary of these figures is given in Table 4.

TABLE 4.

A Comparison of the service and cost (1) of Treated and Untreated Ties of common Canadian woods, showing the economy in using Treated Ties.

Kind of Wood.	Untreated Ties.			Treated Ties.					
	Cost of each tie in track. (2)	Life in years average.	Annual charge per tie.	Cost of each tie in track (3)	Life in years estimated (4)	Annual charge per tie.	Annual saving per tie.	Annual saving per mile of track	Saving in capital cost of mile of track at 4 p.c
	cts.		cts.	cts.		cts.	cts.	$ cts	$ cts.
Spruce.....	45	6	8·59	75	15	6·74	1·85	55 50	1,387 50
Jack pine...	50	6	9·54	80	15	7·19	2·35	70 50	1,762 50
Hemlock.. .	53	7	8·83	83	15	7·47	1·36	40 80	1,020 00
Douglas fir..	54	7	9·00	84	15	7·55	1·45	43 50	1,087 50
Tamarack...	59	8	8·76	89	15	8·00	·76	21 80	545 00
Cedar	65	9	8·74	95	15	8·54	·20	6 00	150 00

(1) All costs figured at 4 per cent interest.
(2) 20 cents is added to the purchase price of the tie to allow for labour and transportation cost of placing it in the track.
(3) 30 cents added to cost of tie in track for preservative treatment and tie-plates.
(4) Well treated ties are likely to last more than 15 years.

Financial inducements such as these should commend to the leading Canadian railways the preservative treatment of ties. No doubt the general adoption of the policy would be hastened if the government undertook to co-operate with the railways and demonstrate that the preservative treatment of timber is true economy from all standpoints.

Preservative treatment would encourage the use for ties of timber now wasted. It would give value to timber now considered almost or quite valueless. There are comparatively large areas of fire-killed timber standing in different regions in Canada. This timber is well seasoned, light and strong, and may be cheaply handled. It is checked and cannot be used for lumber. It lacks only durability to make it very suitable for cross-ties. It is so well seasoned that preservative treatment is as a rule easy and efficient. The adoption of preservative treatment would prevent the now common waste of large quantities of this material and would turn it into first class ties. It is now believed in Canada that unless fire-killed timber is taken out within one, two or three years after the fire it is lost. So long as it is sound it will make good ties if it is given a preservative treatment. Preserved ties made of Engelmann spruce and lodgepole pine killed 50 years ago are giving satisfactory service in the Western United States.

The introduction of the chemical preservation of wood would make available, for use as cross-ties, woods which cannot be used now because of their lack of durability. Such species when thoroughly treated resist decay as long as do the most durable Canadian woods. Species which are of small value now, but which would give adequate service as tie timbers, if chemically treated, are poplar, cottonwood, birch, red maple and beech. Poplar and birch especially are widely distributed throughout Canada, grow rapidly and reproduce well, commonly coming up densely over large areas after fires and lumbering operations. These timbers, among the fastest to grow and the readiest to reproduce in Canada, have a very poor market at present. To prove them available for tie timbers would be doubly beneficial; it would solve the problem of marketing them and provide for the use of the railways, to replace the more naturally valuable species, already disappearing, a large supply of timber hitherto unappreciated.

Every means should be taken to encourage the use of inferior species of timber for cross-ties. Cedar, tamarack, Douglas fir and oak are woods of such high technical value that they are to some extent wasted when used for cross-ties. Cedar, tamarack, and oak are becoming scarce in Canada and being of slow growth cannot be quickly replaced; the use of these timbers, together with that of Douglas fir, should be restricted to those situations in which they have no substitutes.

The wisest use of the forests of Canada will demand that the chief tie timbers of the future will be the cheap, fast-growing species, together with what dead timber can be utilized. These are the two with which, of the timbers now used, preservative treatment effects the greatest economies, jack pine and spruce, and the others, poplar and birch, which can be used only after preservative treatment.