

Macmillan

DEPARTMENT OF THE INTERIOR, CANADA

Hon. FRANK OLIVER, Minister ; W. W. COY, Deputy Minister

FORESTRY BRANCH—BULLETIN No. 9.

R. H. CAMPBELL, Superintendent of Forestry

FOREST FIRES IN CANADA

BY

H. R. MACMILLAN AND G. A. GUTCHES

OTTAWA
GOVERNMENT PRINTING BUREAU
1910

607 207
DEPARTMENT OF THE INTERIOR, CANADA

Hon. FRANK OLIVER, Minister; W. W. COYNE, Deputy Minister

FORESTRY BRANCH—BULLETIN No. 9.

R. H. CAMPBELL, Superintendent of Forestry

FOREST FIRES IN CANADA

BY

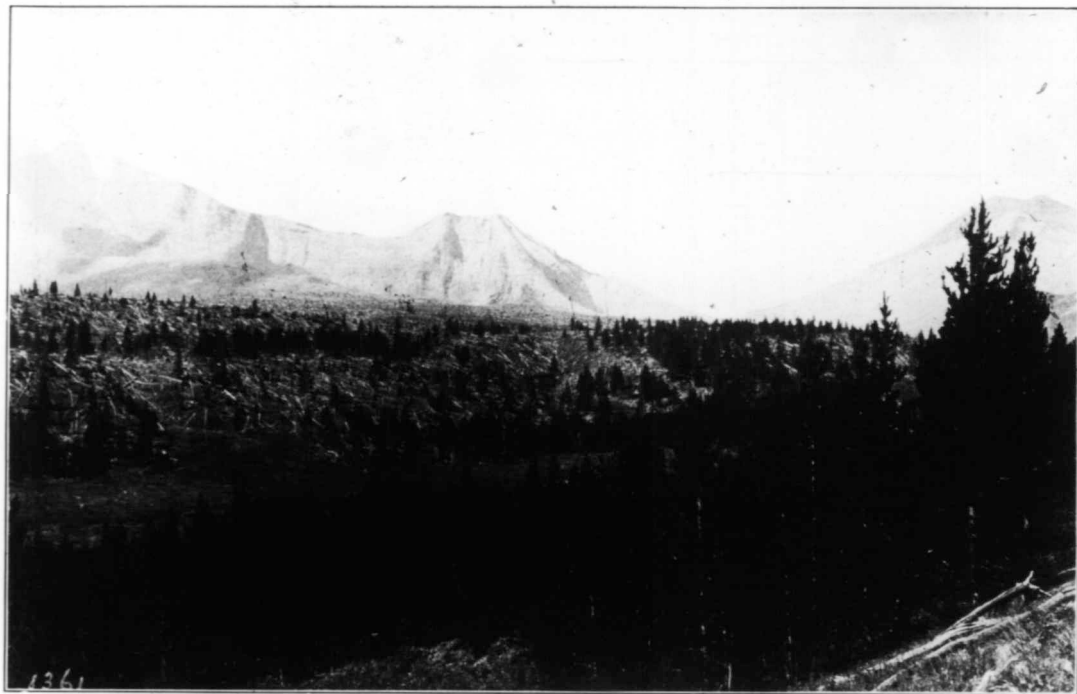
H. R. MACMILLAN AND G. A. GUTCHES

OTTAWA
GOVERNMENT PRINTING BUREAU
1910

m430 886

CONTENTS.

	Page.
Condition at Time of Settlement.....	5
Classification of Lands in Canada.....	5
Barren Lands.....	5
Semi-treeless Lands.....	5
Inland Lakes and Area above Timber line.....	5
Prairie Lands.....	6
Forest.....	6
Destruction of the Forest.....	6
Nova Scotia.....	8
New Brunswick.....	8
Ontario.....	8
Manitoba, &c.....	9
British Columbia.....	13
Effects of Forest Fires.....	15
Destruction of Timber.....	15
Effect on Soil.....	16
Effect on Subsequent Growth.....	17
Effect on Waterflow.....	19
Causes of Forest Fires.....	24
Railways.....	25
Settlers Clearing Land.....	26
Cut-over Land; the Danger and its Remedy.....	27
In Spruce Slash.....	27
In Douglas Fir Slash.....	27
In White Pine Slash.....	29
Other Causes of Fire.....	29
Forest Fires in 1909.....	30
British Columbia.....	30
Dominion Lands (Manitoba, &c.).....	31
Ontario.....	32
Quebec.....	33
New Brunswick.....	33
Nova Scotia.....	34
Conclusions.....	35
Summary of Forest Fire Loss in 1909.....	36
Appendix: Advice to Settlers, &c.....	37



Ten miles of mountain side along the northwest branch of Oldman River, covered with fallen timber as the result of fire.

FOREST FIRES IN CANADA.

A REVIEW OF THE SITUATION AND A STATEMENT OF FIRES OCCURRING IN 1909.

The loss which Canada has suffered from forest fires during the last century is beyond comprehension. The actual extent of the waste is hard to ascertain, but the data given below will show in a general manner the degree to which the wealth of the country has suffered through the burning of timber.

Condition at time of Settlement.

The first settlers in Canada found a country densely covered with a magnificent forest growth, and as they travelled through the vast wilderness they felt that the whole country was as heavily wooded as the eastern provinces, which they then knew, and that such great forests could never be exhausted. It is little wonder that the Canadian people, whose forefathers lived and died fighting the forest and the enemies it sheltered, and whose every generation has known the slow agony of clearing the land of encumbering timber, it is little wonder that such a people are slow to realize that the forest, so long an enemy, now needs protection, and that the timber resources of the country, so long overwhelming, are now so comparatively small that they will be, unless carefully and wisely handled, inadequate for the future demands of the country.

Two causes have brought about this change in the public attitude towards the timberlands: first, the discovery that Canada was never so heavily timbered as is generally supposed; and secondly, the unfortunate fact that of the timber which originally covered the land, *far more than half has been destroyed by fire.*

Classification of Lands in Canada.

As regards forest cover Canada is broadly divided into the following five distinct classes of land:—

BARREN LANDS.

The barren lands cover an area of approximately 600,000 square miles of the northern part of the Dominion, and are treeless because of the Arctic climate.

SEMI-TREELESS LANDS.

South of the barren lands lies an area of about 700,000 square miles which is only sparsely wooded. In this country forest is found only along the watercourses. As a source of timber for commercial use in regions now uninhabited, this forest is of little or no value. It is, however, of the utmost importance to the travellers and fur traders who frequent the region, and is necessary for the protection of the game which is here the support of life and the basis of trade. When the mineral and agricultural possibilities of this country are developed, these scattered areas of timber will be invaluable.

INLAND LAKES AND AREA ABOVE TIMBER LINE.

The lake area is scattered throughout Canada, but enters most largely into the composition of the country in the forest belt stretching from northern Quebec to the Mackenzie valley. The area above timberline is located in Alberta, British Columbia and Yukon Territory. The total area occupied by mountains above timberline and inland lakes is approximately 300,000 square miles.

PRAIRIE LANDS.

In the southern portions of the provinces of Manitoba, Saskatchewan and Alberta and in the Peace River Valley, is a prairie country which is absolutely treeless save for small clumps of timber in the larger watercourses and a few isolated areas of timber on outstanding hills. The lack of forest growth on the prairies is believed by some scientists to be largely due to the influence of the fires which have regularly swept over the country annually and semi-annually. The prairie area of Canada is about 200,000 square miles.

FOREST.

Practically the whole remainder of the country was covered with timber when the earliest settlers landed at Quebec in 1608. From the maritime provinces westward to southeastern Manitoba was an unrivalled stand of pine. In southern Quebec and southern Ontario were large bodies of valuable hardwoods, the only hardwood forest Canada possessed. From Nova Scotia to the Yukon stretched the great spruce belt of America—hundreds of thousands of square miles of pulpwood and saw timber, broken in its continuity only by reservoirs, driveable streams and water-powers. From the east slope of the Rocky mountains to the Pacific coast and Vancouver island stretched in a solid body a pure coniferous forest containing the largest trees and the greatest amount of timber per acre of any of Canada's timber lands.

This vast forest covered an area of about 1,900,000 square miles. Supposing the whole area averaged only 3,000 board feet per acre (a smaller average than is common on any district yet lumbered), we find that Canada originally possessed 3,648 billion* board-feet of good saw timber.

The early forest was also the home and support of the immense fur trade, and the fur traders, who were also the explorers, report that, in their travels, extending even to the Arctic and the Pacific, they found nothing but green timber. In his long journey from Montreal to the mouth of the Mackenzie river, and again to the Pacific ocean, Sir Alexander Mackenzie, while faithfully noting the condition of the country through which he travelled, mentions only thirteen places where the forest had been destroyed by fire. The past one hundred years, with settlement, railway construction and increased travel, has brought about such a change that any one following Mackenzie's route across the continent could hardly lose sight of the vast brûlés since created.

Destruction of the Forest.

It was necessary for the first settlers to clear the land for farm purposes. In many cases there was no market for the timber and it was burned. According to the Dominion Census of 1901 there were 98,804 square miles of occupied land in Canada at that date. This has since been increased to approximately 110,000 square miles. Of this total 18,000 square miles is located in the prairie, thus leaving 92,000 square miles of land within the forested area, which have been cleared for settlement. Although 25,000 square miles of this is reported as still wooded, in order to be conservative we shall not consider it as an addition to the forested area.

Since the first settlement 300 years ago, lumbering operations have been conducted, growing in importance yearly, until now the production of timber has become one of the chief industries of the country. The production of sawn lumber in 1908 was 3,351,176,000 feet board measure, valued at \$54,338,036 at the mill. Adding the other raw products—shingles, lath, cross-ties, poles and pulpwood—the output was approximately five billion board feet. This means that with an average cut of 10,000 board feet per acre, 500,000 acres of prime timber were cleared in 1908.

* A billion is here understood to be one thousand million.

The total area cut over by lumbermen in the past, outside of the area cleared for settlement, can only be approximated. If it is granted that the lumbermen have cut over 100,000 square miles of land, exclusive of lands occupied for agriculture or settlement, it would mean a total cut in the past 300 years of 192,000,000,000 board feet, at the low average yield of 3,000 board feet per acre. This, in addition to the large quantity which has been cut from the 92,000 square miles of cleared farming lands, is certainly as much lumber as has been produced in Canada. Therefore, it may be assumed that lumbermen in Canada have not actually cut more than 100,000 square miles of green timber, if indeed they have cut as much, when allowance is made for the area covered by fires which have caused their operations to be scattered.

The original timbered area, omitting semi-treeless land, was approximately 1,900,000 square miles. Of this we have shown 98,000 square miles to have been cleared for settlement and 100,000 square miles to have been cut over by lumbermen, leaving a timbered area yet untouched of 1,702,000 square miles. Assuming the average of 3,000 feet per acre there should yet remain 3,279 billion board feet of timber in Canada at a very conservative estimate. On the contrary the highest estimate which has been made, that given by the Chairman of the Conservation Commission, the Honourable Clifford Sifton, places the amount of saw-timber and pulpwood in Canada at 494,600 million feet and 1,100 million cords respectively, distributed as follows:—

	Lumber	Pulpwood.
Prince Edward Island..	600 million ft.	
Nova Scotia.	12,000 "	
New Brunswick..	22,000 "	
Quebec..	75,000 "	500 million cords.
Ontario..	35,000 "	300 "
Dominion lands..	150,000 "	(not estimated).
British Columbia..	200,000 "	300 million cords.
Totals..	494,600 "	1,100 "

There is no basis in making a national estimate for distinguishing between lumber and pulpwood under present conditions of manufacture, let alone whatever new condition may be imposed in the future by new inventions in paper-making and scarcity of timber. Timber which is now used in Ontario and Quebec for pulp is used in the mills operating on Dominion lands for lumber. The greater part of the timber on Dominion lands—spruce, balsam, poplar and jackpine—would be classed as pulpwood if it were estimated in Ontario or Quebec. Therefore it seems sensible to convert the whole estimate into board feet. If this is done at the rather high rate of 500 board feet to a cord of pulpwood, and if the estimate of 200 billion feet for Dominion lands is accepted, it is found that there are standing in Canada only 1,094 billion feet of lumber, including the very low grades.* The difference between this and the quantity which should yet remain is 2,185 billion feet. This quantity has been destroyed by forest fires. It is a quantity so large as to be beyond comprehension; it is 437 times as much as is yearly cut in Canada; it is 49 times as much as the combined yearly cut of the North American Continent, north of Mexico. It means that for every foot of timber that has ever been cut in Canada by lumbermen at least seven feet have been destroyed by fire. If the stumpage value is placed at the low sum of fifty cents per thousand feet (the smallest royalty collected by any Canadian government), the loss to the public treasury has been \$1,042,500,000. The actual money loss to the country has been many times greater, as several dollars are expended in logging, manufacturing and shipping every thousand feet of lumber.

The foregoing figures are enormous, but, stupendous as they are, are within the bounds of actual fact. It is probable that even a larger proportion of the virgin timber of Canada has been destroyed by fire. One prominent lumberman of the

* Mr. Ellwood Wilson, forester for the Laurentide Paper Company, reports that his pulpwood averages 444 board feet, Quebec rule, per cord

Ottawa valley, Senator W. C. Edwards, is authority for the statement that in that district, where lumber is more valuable and has been better guarded than anywhere else in Canada, 20 feet have been burned for every one cut by the lumbermen.

To show how widespread has been the destruction, how impossible it is to travel in any district in Canada without being impressed by the wide barrens created by forest fires, the following extracts are given from different journals of Canadian exploration:—

NOVA SCOTIA.

Survey in Richmond, Inverness, Guysboro' and Antigonish counties, 1879-80:

'Most of this district has suffered from forest fires which have destroyed the timber and given rise to barrens or a second growth.'

NEW BRUNSWICK.

Report Canadian Geological Survey, Robert Chalmers, 1884:

'The forests in New Brunswick and, indeed, throughout the Canadian maritime provinces are undergoing rapid destruction. When the Loyalists landed at the mouth of St. John river, May 18, 1783, the New Brunswick forest stood almost undisturbed in its pristine grandeur; now the original growth has been largely cut away, pine first, deals next.'

When the Intercolonial was constructed it passed through virgin forests for 200 miles of the 222 between Moncton and Bathurst. At present this forest is practically gone. After every dry season there is a fire and no one seems to care about its origin or extinction unless personally affected. Since the great Miramichi fire of October 7, 1825, forest conflagrations have been a constant and an almost annual occurrence. Along the southwest Miramichi river and its tributaries a large portion of the district has been overrun by fires. Large portions of the country lying between southwest Miramichi and Salmon river and the head of the Richibucto river have likewise been devastated in this way.

The eastern portion of New Brunswick, Robert Chalmers, 1885:

'This area has been almost wholly denuded of its forest by fires.'

Survey along proposed route of the National Transcontinental in New Brunswick, A. A. Johnson:

'Forest fires in the past have done incalculable damage and over large areas the only evidence of the former growth is to be found in the charred remains of the great pines and spruces with which the country must have formerly been covered.'

ONTARIO.

North shore of Lake Superior—Voyages to the Arctic, Alexander Mackenzie, 1788-89:

'The people live chiefly on fish; indeed from what has been said of the country it cannot be expected to abound in animals, as it is totally destitute of that shelter which is so necessary to them. The rocks appear to have been overrun by fire and the stunted timber which once grew there is frequently seen lying along the surface of them.'

Report of Bureau of Mines, 1904, J. M. Bell:

'It is unfortunate that so much of the timber of the north has been destroyed by recent fires. During the dry summer of 1901 a conflagration swept the whole country from the Kabenagami as far east as the Little Abitibi, and another, even more terrific in its fury, devastated the region southeastward from Lake Kesagami almost as far as Grand Lake Victoria on the Upper Ottawa. On the Missinaibi,

from the Skunk islands to the mouth of the Soveska, there is scarcely a green tree standing, the few remaining patches standing out as oases in a desert of blackened rampikes. The burned area extends on the Opasatika from below the foot of Skunk island to the Opasatika canyon; though fortunately more clumps of green have escaped the fire. On the Mattagami there is a clear sweep from the Grand rapids almost all the way to the mouth of the White Spruce river, which joins the Kapuskasing about 30 miles above its confluence with the Mattagami. In 1901, before the fire had passed over the country, I journeyed down the Kapuskasing and Mattagami, and made frequent observations on the magnificent forest which then extended along both these rivers and which stretched away in virgin fertility from the river banks. This summer an Indian from the White Spruce told me of the terrible destruction which the fire had wrought. The force of the fire had somewhat abated by the time the Abitibi was reached, and, though great stretches of the country, from New Post northward have been deprived of timber, there is still much fine forest along the lower reaches of the river. I do not know exactly how far west the fire spread, but in our trip up the Wabiskagami our course lay for thirty miles in a more or less westerly direction, and for that distance we passed through a wilderness of blackened tree trunks.

'The loss from these forest fires is enormous. When it is realized that this one fire devastated an area of at least 3,000 square miles and destroyed as well hundreds of moose, bear, caribou, and innumerable small animals, it will be realized in a slight degree how great has been the destruction. Let one travel for miles, be it overland or by water, through these blackened deserts without hearing or seeing a living thing, let him listen in midsummer to the sighing of the wind through these leafless rampikes and he will realize the sadness of the Indian lament that he must now leave his hunting grounds and go elsewhere, far to the eastward or westward, to seek new spots where the game yet lives. I was in the country during that terrible fire of 1901 and I shall always remember the days we passed in semi-darkness, hourly expecting to have to take to the water to save our lives. Fortunately we were beyond its path to the east, but other members of my party were not so fortunate, losing all their clothes and equipment, and one old Indian died from the effects. It has been said that most of these fires have been started by lightning. Some may have been, but most of them are ignited, not by the Indians, although they are unfortunately far too careless, but by occasional white tourists who find their way down the various rivers every year to the Bay, and who do not realize the awful danger of a fire once started in the great spruce forests of the north.'

Cobalt district and northward—Geological Survey, 1906, Robert Bell:

'The trees are mostly of small size and belong to second growth after forest fires.'

MANITOBA, SASKATCHEWAN, ALBERTA AND NORTHWEST TERRITORIES.

Fort Garry to Rocky Mountain House (1,056 miles), Geological Survey, 1873-74, Alfred Selwyn:

'The drying up of the country has been ascribed to many causes, but is generally supposed to be connected with the gradual destruction of the forest over large areas by fire. Whatever the effect may be of these destructive conflagrations, in reference to the water supply of the regions, there is no doubt that at different times almost every square mile of the country between the Red river and the Rocky mountains has been subject to them, and that hundreds of miles of forest have been converted into wide and almost treeless expanses of prairie.'

Norway House to York Factory and northwest to Churchill river—Geological Survey, 1879, Robert Bell:

'Up to 1878 the great region covered by this report has been annually devastated by fires ranging over large areas and destroying the timber in different localities from time to time, until perhaps more than one-half of it is already swept away.'

Photo by J. R. DICKSON, Nov., 1909.



A completely burned area, the result of fire in Lake Manitoba West Reserve, Oct., 1907.

Duck mountains—Geological Survey, 1887, J. B. Tyrrell:

'The northern face of the Duck mountains has formerly supported much excellent forest, but most of this area has now been burned over and is being overgrown with poplar.'

Francis lake, Yukon district—Geological Survey, 1887-88, G. M. Dawson:

'Large tracts of country have been burned over many years ago and extensive recent fires have swept the western side of the upper part of the East Arm.'

The following account of a trip made in 1905 by one of the officials of the Geological Survey, from Norway house on Lake Winnipeg northeast to Shamattawa river, a distance of about 450 miles, gives a fair idea of the extent to which the forests have suffered from fire throughout the northern spruce belt:—

Explorations along Hudson Bay Railway covering about 14,000 square miles bounded by 53° 50' and 56° 10' N. Lat., and 99° 15' and 101° 15' W. Long.—Geological Survey, 1906, W. McInnes:

'Forest fires have been widespread and most destructive throughout the whole region, sparing only the very wet muskeg areas, and a few tracts isolated by surrounding water and marsh. In some places in the uplands the charred stumps seem to indicate the passage of two successive fires at intervals of about 40 years.'

Most of the fires seem to have been due to carelessness on the part of native travelers, for violent storms with lightning are not of frequent occurrence, and during the whole summer but one trunk was noticed that had been shattered by lightning.

'The woods from Norway House and on up the Echimamish river were very young, none of the trees appearing to be over 15 years old; in some parts the fires had been quite recent and indeed in several directions we could see heavy clouds of smoke. The season had been very dry and these fires must have created great destruction among the forests.

'The forest in the neighbourhood of the Robertson portage was denser and the trees seemed to be, on an average, from 15 to 30 years' old. The same condition of things was noticed down to Oxford lake. All along the north shore of this lake fires could be seen and about three miles northwest of the Hudson's Bay post a huge fire was raging and continued to burn, it is said, for nearly three weeks.

'From Oxford lake to Mossy portage the forest growth was very young and gave abundant evidence of at least one recent burning * * * * On entering Manitou river three-fourths of the region from the lake to Red Sucker river has been burned over at least once in the last ten years. From the Red Sucker rapids to the Shamattawa rapids occurs some heavy forest growth, young trees 10 to 15 years old and some fine groves of trees about 25 years old * * * * The forest growth is largest and thickest along the courses of the streams and thins out away from the river banks.

'Along the Pickano the country has been burned at least once in the last ten years and in some places there are evidences of previous conflagrations. The conifers therefore have not attained a growth of ten years, while the birches, poplars, &c., average about six years. Of course there are a few isolated places where the forest growth has attained a larger size, and I counted four groves of about 50 trees with ages ranging from 23 to 42 years.

'The country away from the river valley is a vast slightly rolling plain with burnt sticks standing up like hop poles or lying in an indiscriminate tangle on the ground with young forest growth springing up among them.

'The frequent burnings are nearly always due to the carelessness of the Indians. Several times our party has put out fires that started from unextinguished camp fires.

'There is no reason why most of this region could not, if protected from fires, produce larger trees which might be of great value to the country in the future.

'The whole of the above trip lay in the district classed as "densely wooded."

*Region south of Cape Tatman, Hudson's Bay, and east of Shamattawa river—
Geological Survey, 1905, W. S. Dobbs:*

'Mile upon mile, as far as the eye could see, the country was sparsely wooded and constituted a hopeless tangle of fallen and half-fallen trees, relics of the numerous forest fires that have taken place throughout this region.'

Exploration of the proposed Canadian Northern railway between Split lake and Fort Churchill, 1906, O. O'Sullivan:

'From this point (Little Churchill river) northward the country, which has been overrun by a fire that occurred some forty years ago, is now covered with bunches of second growth black spruce, tamarack and white birch.'

Forestry Branch Report, 1906, E. Stewart:

'For forty miles south of where the Lac la Biche river empties into the Mackenzie river the country has suffered very much from fires.'

Forestry Branch Bulletin, 1908, J. R. Dickson:

'Ninety per cent of the Riding Mountain forest reserve (total area, 982,400 acres) has been burned over.'

Forestry Branch Report, 1908, H. R. MacMillan:

Seventy-five per cent of the Beaver hills forest reserve, and recommended inclusion (total area, 108 square miles), has been burned over. Ninety-five per cent of the Pines forest reserve, and recommended inclusion (total area, 145 square miles), has been burned over.

Photo by H. R. MacMILLAN.



Battle in Larch Forest, Reding Mountain Forest Reserve.

One hundred per cent of the Waterton lakes forest reserve, and recommended inclusion (total area, 191½ square miles), has been burned over and all mature timber killed.

Forest fires have repeatedly overrun the Prince Albert forest reserve, and recommended addition, of 214 square miles.

'In the Crownsnest valley, Alberta, out of a total of 212 square miles originally timbered, 179 square miles or 84 per cent have been burned over.

'The resources of the eastern slope of the Rockies as represented by timber have been reduced 75 per cent by forest fires.'

BRITISH COLUMBIA.

Geological Survey, 1876-77, G. M. Dawson:

'Fires have past extensively over the country between Quesnel and Blackwater, destroying the scrub pine and Douglas fir. It is evident that the destruction of the forest has led to the dessication of the soil.'

Photo by J. R. DICKSON, 1909.



Burned-over "bench lands" at mouth of Twenty Mile Creek, near Revelstoke, B.C.

Geological Survey, 1906, W. W. Leach:

'A great part of this district (Telkwa mining district) has been overrun by forest fires.'

Frankland camp, Rossland mining district—Geological Survey, 1906, R. W. Brock:

When the survey was made the country was timbered and the position of geological boundaries had usually to be assumed. Since then the fires have swept over the camp and rocks and ledges are much better exposed.'

The literature of Canadian explorations and surveys is full of such references to forest fires. The foregoing have been selected to show how wide-spread is the damage, and to bring home to those who do not travel extensively in the country what every traveller knows, that it is almost impossible to make a trip without passing through burned timber land or, in many parts of the country, to find a tract of virgin forest which is not insignificant in area, as compared with the brûlés surrounding it.

That the proportion of timber land burned over in recent years is large is shown by the analysis of the reports sent in by fire rangers of the Forestry Branch. These fire rangers patrol the most valuable timber lands in the west. They cover all the

trails and main waterways through the timber belt from Lake Winnipeg to the Athabaska river, the eastern slope of the Rocky mountains and the railway belt in British Columbia. They are practical men, most of them acquainted with their districts for many years and are very unlikely to give exaggerated reports of damage by fire. They were in the spring of 1909 furnished with maps and requested to ascertain during the summer the percentage of their individual districts which had been burned over in the last forty years, as well as the area and quantity of merchantable timber remaining. Intelligent and evidently careful replies were received from 69 rangers, having charge of 203,300 square miles of territory, extending from Lake Winnipeg to the Peace river, covering the east slope of the Rocky mountains and the railway belt in British Columbia.

Photo by J. R. Dickson, Nov., 1909.



Prairie in Lake Manitoba West Reserve, the result of repeated fires. To plant this again to trees would cost from \$5 to \$10 per acre, i.e., \$3,200 to \$6,400 per square mile. \$5,120 per square mile (\$8 per acre is probably a safe average estimate for planting).

The replies are nearly all from rangers whose districts lie beyond the farthest extension of railways in a territory not yet reached by settlement, and to a very small extent by lumbering operations.

The results given below are not encouraging:—

Area reported upon	203,300 square miles.
Area of merchantable timber	34,384 square miles.
Quantity of merchantable timber	115,800,000,000 board feet.
Area of territory burned over within 40 years	54,700 square miles.

The whole territory of 203,300 square miles bears abundant evidence of having been originally heavily forested, excepting for the small proportion occupied by muskegs, lakes and waterways. But within the past one hundred years, fires have wrought such havoc that now only about 17 per cent or 34,484 square miles are reported to be covered with the original stand of merchantable timber. This estimate is as accurate as can be obtained without a detailed survey of the country, for it is made by men, nearly all of whom have resided in the districts several years, and have exceptional

opportunities of learning of all bodies of merchantable timber, most of which have by their unfortunate isolation become conspicuous. It may be added that the term merchantable timber includes, in the railway belt of British Columbia, everything large enough to manufacture, and east of the Rocky mountains all spruce, lodgepole pine and tamarack over about eight inches on the stump, or in some districts six inches, all jackpine large enough for railway ties and all mature sound poplar.

The quantity of timber reported, 115,800 million board feet, or an average of 5,000 feet per acre for the land now heavily timbered is possibly a little low, but it lends colour to the belief that there are not more than 200 billion feet of timber left on all Dominion lands in the west, the destruction by fires has been so great.

The reports indicate that about 54,700 square miles have been burned over within the last 40 years. This is probably far below the actual area. The rangers keep largely to the timbered areas in the performance of their duties, and, having no opportunity of making an estimate of the area burned within the last 40 years (an arbitrary limit set by the Forestry Branch), have confined themselves to reporting the area they know to have been burned over in the last few years.

It is evident from the foregoing that there is abundant authority for the statement that over one-half of Canada's natural timber wealth has been already destroyed by forest fires. How much will ultimately be destroyed in this manner it is impossible to conjecture, as the fires are still burning every year in a manner unknown to any other country in the world, with the possible exception of the United States.

Effects of Forest Fires.

DESTRUCTION OF TIMBER.

The effects of these annual conflagrations are many and serious. The most obvious is *destruction of timber*.

So many fires occur that are unrecorded that it is impossible to estimate the quantity of timber annually burned. It is a very large quantity, probably as much as is annually cut for use. Canada has no timber to spare. When other nations came to the point where the domestic timber supply could not meet the demand, the development of transportation and the discovery of virgin forests before inaccessible enabled them to import timber in as large quantities as necessary to relieve the demand. It is safe to say that all the areas of useful timbers existing in the world are now discovered and being exploited. The only countries now exporting timber in quantity are Sweden, Norway, Russia, Austria, the United States and Canada; and of these countries all, or nearly all, with the exception of Canada and Russia, are cutting in excess of the yearly growth. There will be no new continent ready to relieve the scarcity in America, as America was in the case of Europe. Where every other nation had a foreign resource to rely upon, Canada will have none. Canada will need none if the forest fires are checked as other nations have checked theirs, and scientific management of forest land is adopted. It is illogical to spend money in reforestation when large areas of virgin forest are still being annually destroyed by fire. It is un-safe and unwise to invest money, public or private, in the improvement of timber lands or in measures leading to the natural or artificial reforestation of timber lands so long as the public sentiment is such that through the carelessness of some individual and the apathy of others, the whole property may be burned over any year. Forest fires are in this way delaying the progress of forestry.

Up to the present time no steps have been taken in public lands in Canada so to manage logging operations as to provide suitable conditions for the natural reproduction of the valuable trees. Nothing has been done to provide for a continual growth of valuable timber on the land cut over. So far everything has been left to chance, to unaided nature, and any one who has seen old logging operations knows that most of

them are barren or covered with comparatively useless trees, such as birch and poplar, and that few of them will soon provide another crop of even small timber. So long as this continues our forests are being treated as a mine, and it is doubly imperative that the fires which are yearly decreasing the contents of this mine be checked and as much as possible of our virgin timber be saved for the lumberman, the manufacturer and the settler.

The following table from Prof. Schlich's Manual of Forestry, giving the average international trade in timber, shows how few are the exporting countries in comparison with those importing all or part of their timber supplies:—

NET WOOD IMPORTS AND WOOD EXPORTS OF FOREST COUNTRIES (AVERAGE DATA, CALCULATED FROM THE RETURNS OF FIVE YEARS).

Country.	Imports.	Exports.	Country.	Imports.	Exports.
	Tons.	Tons.		Tons.	Tons.
Great Britain and Ireland.	99,290,000		Mauritius.	20,000	
Germany.	4,600,000		Servia.	15,000	
France.	1,230,000		Ceylon.	10,000	
Belgium.	1,020,000		Japan.	5,000	
Denmark.	470,000		West India, Mexico, Honduras, &c.		13,000
Italy.	420,000		West Coast of Africa.		28,000
South America.	330,000		India.		55,000
Spain.	210,000		Roumania.		60,000
Egypt.	200,000		United States.		1,020,000
Holland.	180,000		Norway.		1,040,000
Switzerland.	170,000		Dominion of Canada and Newfoundland.		2,144,000
Australasia.	160,000		Austria-Hungary.		3,670,000
Cape of Good Hope.	150,000		Sweden.		4,460,000
Portugal.	60,000		Russia, with Finland.		5,900,000
Natal.	50,000				
Bulgaria.	50,000				
China.	50,000				
Greece.	35,000		Total.	18,725,000	18,390,000

Of the countries exporting now, Sweden, Norway, Austria-Hungary and the United States are cutting more annually than their forests produce, and cannot and will not keep up their exports, at this rate, for many years. Greater demands will then be made on Canadian forests than they can support. Timber now inaccessible and considered valueless will in a few years be eagerly sought, and there will be many bitter reflections as to the prevalence of forest fires in the past.

EFFECT ON SOIL.

The remark is often made that forest fires are useful in helping to clear the land. It is the most expensive method of clearing the land. Conditions are such now that a settler can usually make some use of the timber he clears off his land. At any rate there is nothing gained by burning over land before it is needed by settlers or by burning the timber off land which can never be used for settlement.

Where the soil is a light sand the whole fertility is contained in the upper layers of humus, the product of centuries of decaying vegetable matter. The intense heat created by the burning of the timber consumes this humus and thus destroys the most valuable constituent of the soil. Where the soil is rich this is not the case; the soil may be enriched by the ashes; but where the soil is sandy, as in large areas of the

jackpine land, the ashes even are blown or leached away and nothing left but sterile sand.

Many instances of this are found in 'The Pines' forest reserve. Under clumps of trees which had escaped fire the sandy soil was found to be covered with a layer of decayed and decaying vegetable matter, two to six inches or more in thickness. This soil commonly supported a strong growth of vegetation. On adjoining areas, where the topography and all natural factors remained the same, but where the forest had been utterly destroyed by fire, there was not a trace of humus or decaying vegetable matter. In its place there was the loose sand subsoil, so poor as to be incapable of bringing to its development even the sparse vegetation.

Photo by J. K. DICKSON, 1909.



The fire here had worked into the soil, destroying it. The timber, left without support, soon fell. In the late fires in the Rainy River District, Ont. (July, 1910), green trees, apparently undamaged by fire, were often seen to fall, and, on examination, the soil at the base of the tree was found to be destroyed and the roots burned through, though the bole and the crown of the tree were apparently unharmed. (Lake Manitoba West Forest Reserve.)

Where the soil is thin and overlies rock, as in the mountains and in large areas of the public lands in all the mainland provinces, the results of fire are even more serious. In such situations the products of the rock-weathering and plant-growth of ages has been only a few inches of soil. The first serious forest fire destroys all or the greater part of the soil, leaves the remainder loosened or unprotected, so that it is readily carried away by the rains, and the country is left more barren than it was after the last glacier. The fire destroyed at once the existing forest and any possible prospect of a future forest. There are large areas of territory so ruined in Canada. A notable instance is the territory along the Canadian Pacific railway, north of Lake Superior.

EFFECTS OF FIRES ON SUBSEQUENT GROWTH.

The crop of timber succeeding a forest fire is rarely of as good a quality as that destroyed by the fire. The virgin timber standing on tracts which have been free from fire for long periods is, over the greater part of Canada east of the Rocky mountains,

spruce and pine. When fire destroys spruce and pine timber, one would naturally suppose the next crop would be again spruce and pine. Such is rarely the case. Almost invariably burned-over land, irrespective of what may have grown on it before, produces a dense crop of aspen poplar and white birch or jackpine trees, which have very little commercial value as compared with the spruce and white or red pine which they displace. These trees occupy the ground to the exclusion of more valuable species for long periods after every large fire. If seed trees of the more valuable conifers are present they may again gain possession of the ground, but in the natural course of events

Photo by G. C. PICHE.



Burnt at Lac Clair, P.Q.

hundreds of years are required to establish valuable timber on burned-over land. In fact, excepting the comparatively valueless jackpine, so seldom does one crop of conifers follow another after a fire, that many old lumbermen in the white pine country believe that the soil is incapable of producing two crops of white pine in succession. The real reason is not that the soil cannot bear two crops of pine in succession, but that it seldom gets a chance to do so. Nearly all the clearings in pine timber are made by fire or by lumbering followed by fire. All pine seed-trees and cones are destroyed. Pine seed is not carried very far; it requires about two to five trees to the acre to ensure natural seeding. So there is no chance for fire to get a start. On the other hand, birch and poplar, the usual crop on burned-over land, sprout prolifically from cut or burned stumps and also produce large quantities of seed every year, seed so light that it is carried many miles by the wind. The result is that burned-over land, unless in exceptional cases where the valuable conifers have had exceptional opportunities, produces a crop of comparatively worthless poplar and birch or jackpine. On the east slope of the Rocky mountains the valuable Engelmann spruce is after a fire followed by the less valuable lodgepole pine.

Fire ranger James Clare, for fifteen years a resident of Lac LaRonge, Sask., in reporting on his district, an area of about 70,000 square miles, writes:—'The whole of this country is, or has been, timbered with spruce, poplar, tamarack, jackpine or birch,

the only open country being small stretches of muskeg, generally under water in spring and early summer. Where fires have run there is almost invariably a rapid new growth of poplar and jackpine, the exception to this being on rock formations, where fire has been so fierce and the country so dry at the time that all the moss and other decayed vegetation has been consumed, leaving the 'bare rock.'

Similarly the survey of the Riding Mountain forest reserve showed that two fires twenty years ago, running over a dense spruce forest covering hundreds of square miles, had destroyed every spruce tree, not leaving a single specimen in some townships and resulted in the formation of a forest of pure poplar. A square mile of the spruce forest was worth about \$46,000 when manufactured, and brought the government a royalty of about \$2,000. A square mile of the poplar forest, which it will take sixty years to produce, is worth about \$12,000 when manufactured, and brings the government about \$600.

EFFECT OF THE FOREST FIRES ON WATERFLOW.

Many extravagant statements have been made respecting the interdependence of forests and water. Such statements are hurtful and unnecessary.

There are proofs that the presence of forest growth on the watersheds of streams renders their flow more equable, decreases erosion, lessens the tendency towards destructive floods and thus increases the value of the streams for navigation, water-power or irrigation.

A few instances cited here show that this value for the forests rests upon a sound scientific and practical basis, as well as upon what has been called 'the common knowledge of the people.'

Mr. Cecil B. Smith, formerly chairman of the Timiskaming Railway Commission, states that in southwestern Ontario the Nottawasaga, Saugeen, Maitland, Ausable, Thames, Grand, Credit and Humber rivers all originally possessed valuable water powers, but that when the area was cleared of forest the water-powers were nearly all ruined.

Mr. W. H. Breithaupt, C.E., in a paper read before the Canadian Society of Civil Engineers, deals with the Grand river in Ontario. He states that until 1860, when the headwaters of the river yet remained forested, the flow of water was regular with few or no floods in the spring. Since that time, commencing with the clearing of the townships at the headwaters of the river, the minimum flow has annually decreased. The decrease in the minimum flow from 1890 to 1895 was fully 40 per cent of the minimum flow of 1890.

Mr. C. H. Keefer, C.E., attributes the fact that the flood waters of the Ottawa river reach Ottawa two weeks earlier than formerly to the drainage and clearing of the lower section of the drainage area.

Measurements made by Prof. J. W. Toumey, of Yale Forest School, comparing the flow from four streams, three forested and one non-forested in the San Bernardino mountains, California, are given here, as quoted by Mr. C. H. Keefer, C.E.:-

'In a careful study of the behaviour of the stream-flow in several small catchment areas on the San Bernardino mountains, it has been found that the effect of the forest in decreasing surface flow on small catchment basins is enormous, as shown in the following tables, where three well-timbered areas are compared with a non-timbered one.

The following tables of precipitation and run-off show the run-off during December, 1899, was from 36— to 70— in forested areas, and 312— in non-forested areas:—

PRECIPITATION AND RUN-OFF DURING DECEMBER, 1899.

Condition as to Cover.	Area of Catchment Basin.	Precipitation.	Run-off per sq. mile.	Run-off in percentage of Precipitation.
	Sq. miles.	Inches.	Acre-feet.	Per cent.
Forested	0 70*	19+	36—	3
"	1 05	19+	73+	6
"	1 47	19+	70—	6
Non-forested	0 58	13—	312+	40

At the beginning of this rainy season, in early December, the soil on all four of these basins was very dry as a result of the long dry season. The accumulation of litter, duff, humus and soil in the forest-covered catchment areas absorbed 95 per cent of the unusually large precipitation; on the non-forested area only 60 per cent of the precipitation was absorbed, although the rainfall was much less.

In January, February and March, 1900, the run-off was from 428 to 557 acre-feet per square mile on forested areas and 828 on non-forested areas, and the percentage of run-off to precipitation was from 33 to 43 per cent. on forested areas, and 95 per cent on non-forested areas.

RAINFALL AND RUN-OFF DURING JANUARY, FEBRUARY AND MARCH, 1900.

Condition as to Cover.	Area of Catchment Basin.	Precipitation.	Run-off per sq. mile.	Run-off in percentage of Precipitation.
	Sq. miles.	Inches.	Acre feet.	Per cent.
Forested	0 70	24	452+	35
"	1 05	24	428+	33
"	1 47	24	557+	43
Non-forested	0 53	16	828+	95

The most striking feature of this table as compared with the previous one, is the uniformly large run-off as compared with the rainfall. This clearly shows the enormous amount of water taken up by dry soil, either forested or non-forested, as compared to one already nearly filled to saturation. During the three months here noted on the forested basins about three-eighths of the rainfall appeared in the run-off, while on the non-forested area nineteen-twentieths appeared in the run-off.

The rapidity in decrease in run-off, after the close of the rainy season, was for April, May and June, from 153 acre-feet per square mile to 30 acre-feet per square mile in forested areas, and from 56 to 0 on non-forested areas.

RAPIDITY OF DECREASE IN RUN-OFF AFTER THE CLOSE OF THE RAINY SEASON.

Condition as to Cover.	Area of Catchment Basin.	Precipitation.	April run-off per sq. mile.	May run-off per sq. mile.	June run-off per sq. mile.
	Sq. miles.	Inches.	Acre-ft. ±	Acre-ft.	Acre-ft.
Forested.....	0.70	1.6	153-	66-	25-
".....	1.05	1.6	146-	70+	31-
".....	1.47	1.6	166+	74+	39+
Non-forested.....	0.53	1.	56+	2-	0

'The above table clearly shows the importance of the forest in sustaining the flow of mountain streams. The three forested catchment areas, which during December experienced a run-off of but 5 per cent of the heavy precipitation for that month, and which during January, February and March of the following year had a run-off of approximately 37 per cent of the total precipitation, experienced a well sustained stream-flow three months after the close of the rainy season. The non-forested catchment areas, which during December experienced a run-off of 40 per cent of the rainfall and which during the three following months had a run-off of 90 per cent of the precipitation experienced a run-off in April (per square mile) of less than one-third of the forested catchment areas and in June the flow of the non-forested area had ceased altogether.'

Mr. J. B. Lippincott, supervising engineer of the United States Reclamation Service, gives in an address before the Society of American Foresters another concrete instance of the influence of forest on stream-flow. Two branches of the Yuba river (California) afford an interesting comparison. The north fork has a drainage area of 146 square miles. On September 1, 1903, the stream in that branch of the river was flowing 113 cubic feet per second. The drainage area is well timbered and has not been extensively burnt or cut over. The south fork of the river has 120 square miles of drainage area. Most of it has been cut and burnt over. The normal condition of that branch of the river which is separated from the north fork by an east and west ridge was dry for 120 days out of the year in which observations were made. A number of storage reservoirs have been built in that tributary for mining and power purposes. We have therefore two forks of the same river, draining nearly equal areas, one with a well sustained stream-flow, the other practically dry in the summer. One basin is timbered, the other denuded, and in the denuded area a number of storage reservoirs have been built, possibly to compensate for the destruction of the forests.'

M. Huffel, author of *L'Economie Forestiere*, an eminent European authority, announces that a study of two Swiss streams, one flowing from a valley 91 per cent forested and the other from a valley 18 per cent forested, establishes:—

'First, that at the time of the maximum of high water the channel of the deforested region carries 30 to 50 per cent more water per unit of surface than the wooded region.

'Second, that after prolonged dry periods the springs of the deforested region dry up completely and the bed of the stream is dry, while the stream from the wooded valley is still yielding at least five litres (-175 cubic foot) of water per second.'

The value of the forest in controlling water-flow consists not so much in the trees themselves as in the condition of ground-cover which they create, conditions which are not destroyed by the lumbermen, but are utterly destroyed by forest fires, and which cannot be replaced for many years after a forest fire.

An article, 'La Capacité Rétentionnelle de la Forêt,' published in *La Revue des Eaux et Forêts*, Paris, January 15, 1909, ascribes the influence of the forest on waterflow to the innumerable obstacles, the trunks of the shrubs and trees, the twigs, the dead leaves and the matted network of roots, all of which break up the rainfall and delay the run-off of water. But the greatest influence of all is the great absorption power of the layer of dead leaves, of plant debris and humus which covers the surface of the forest soil, of moss, herbs and bushy plants which grow under the leafy arches of the trees, all of which together form what we call the forest floor, and to which we must attribute the retention of the greater part of the rainfall and of the water formed by the melting of snow. This water, held at the surface, penetrates the soil slowly and unites with the subterranean water which gives birth to springs.

Experiments have been made by government officials in Germany and France to determine the amount of water absorbed and held by the forest floor.

Professor Henry, of the French School of Forestry, found by experiment that a carpet of spruce leaves, taken as they lie and composed of leaves in all stages of decomposition, will absorb on an average over four times its weight in water. Other experiments made in Germany show that the decaying leaves composing the forest floor absorb from two to eight times their weight in water.

Observations made by German forest officials show that of 100 millimetres (about 4 inches) of water falling on forested territory 10½ per cent evaporates, 20 per cent is arrested by the crowns of the trees, 25 per cent is absorbed by the forest floor and 44½ per cent soaks into the upper layers of the soil. On the other hand, when the same quantity of rain falls on open ground, 68½ per cent evaporates and 31½ per cent is held in the soil.

Different experiments carried out by European scientists prove that the moss and humus of the forest soil, independent of the herbs and other vegetation, are capable of retaining a rainfall of from one-half to one inch or more.

Lumbering operations, if they are not followed by fire, do not destroy this absorptive layer of the soil, do not remove all the trees nor the underbrush, as they usually clear only a comparatively small area of the forest regions each year, and so do not greatly affect run-off of streams. Unfortunately, lumbering operations have, up to the present, nearly always been followed by forest fires.

Forest fires, especially in the rocky or mountainous country at the headwaters of the streams kill and consume all vegetation, and destroy all the 'duff' and humus on the ground, leaving absolutely nothing to absorb or retain moisture, while after a lumbering operation there is usually a thick growth of young trees or other vegetation. After a fire there is frequently no soil and consequently no growth whatever. Fires also sweep to the mountain tops and destroy the forest cover on inaccessible slopes where it would never be reached by the lumberman but where it is nevertheless of value in controlling waterflow.

Forest growth on a mountainous or hilly watershed binds the soil together and prevents it from being washed away by the descending waters. Where the forest has been destroyed by fire, as a large proportion of the forest on Canadian mountains has already been destroyed, the little soil accumulated, no longer bound together and held firm by the tree roots, is rapidly carried away with the streams. In this connection, Mr. James Wilson, United States Secretary of Agriculture, says: 'A mountain watershed denuded of the forest, with its surface hardened and baked by exposure, will discharge its fallen rain into the stream so quickly that overwhelming floods will descend in wet seasons. In discharging in this torrential way the water carries away great portions of the land itself. Deep gullies are washed in the fields and soil; sand, gravel and stone are carried down the stream to points where the current slackens. The stone and gravel are likely to be dropped in the upper channel of the stream to be rolled along by subsequent floods, but the sand and silt are carried down to the stillwater of



Tract of country in Northern Ontario, burned over at the time of the great Biscotasing fire. Not only the timber but the soil as well was burned, and the area cannot produce another crop. Scant as it was, the soil consumed was the accumulation of ages.

the first reservoir, where they are deposited. It is this silting up that makes uncertain any reservoir system outside the limits of the forested watershed.

Since the extensive removal of the forest in the upper watershed there has been a vast accumulation of silt, sand and gravel in the upper stream courses. Examples of reservoirs completely filled are already to be seen on almost every stream. Removal of the silt is usually impracticable. If sluiced out of the highest reservoir it gathers in the next below and so on, through whatever system may have been developed. If perchance it should pass the last reservoir, the silt is then free for deposit in the navigable stretches of the stream.

Regardless of whether there are reservoirs the ultimate deposit of the detritus is in the navigable sections whence its removal can be accomplished only by a steam dredge at the expense of the government.

In the degree that the forests are damaged on the high watersheds, then, inevitable damage results to water-powers and navigation through increased extremes of high and low water and through vast deposits of gravel, sand and silt in the stream channels and in any reservoir which may have been constructed.

The above was written of the Appalachian mountains, but it appears equally true of every important watershed in Canada. Especially is it to be considered now, when great navigation works are being projected, wholly dependent upon the water from the eastern slope of the Rocky mountains, when the navigation of the north and south Saskatchewan is being reviewed by public bodies, and when the navigation and water-powers of important eastern rivers are being made the basis of new industries.

Enough has been said to show that the widespread deforestation still continuing in Canada is due to forest fires more than to any other agency, and that this deforestation is destroying timber which will be needed in the development and commerce of the country, is creating barren wastes of large area, is encouraging growth and increasing the proportion of valueless trees in the forest, and is decreasing the value of streams and rivers for all uses, notably irrigation, water-power and navigation.

Causes of Forest Fires.

An analysis of the detailed reports available for the year 1909 shows that the causes of forest fires are uniform throughout the country:—

British Columbia.	Dominion Lands.	New Brunswick.
Total fires	Total fires	Total fires
Cause unknown	Cause unknown	Cause unknown
Railways.....	Campers and travellers.....	Settlers
Settlers.....	Railways	Railways
Campers and travellers	Settlers	Fishermen
Lightning.....	Lightning.....	Smokers
Natural combustion.....	Hunters and trappers.....	Barkpeelers.....
Cut-over land.....	Tramps.....	Dwelling.....
Old fires	Lumbermen.....	
Indians.....	Indians	
Road-building.....	Arson	
Prospectors.....		

The Superintendent of the Forest Protective Service of Quebec, Mr. W. C. J. Hall, reports that the chief causes of forest fires in that province are, in the order of their importance: (1) Railway locomotives, and (2) settlers clearing land.

RAILWAYS.

Railways are a prolific source of danger to forest land, from the time of the first location survey. The most destructive fires usually originate from the construction camps, but fires start every year as long as the road remains in operation and timber remains along the line.

Fires originating from the construction camp and clearing the right-of-way are usually caused by carelessness on the part of workmen and foremen in burning debris, and carelessness or ignorance on the part of freighters and travellers connected with or attracted by the work. Such fires can nearly always be prevented or checked by the maintenance of an efficient patrol along the grade, location line and toll-roads. The law requires a railway building through Dominion lands to pay half of the expenses of such a patrol. The first opportunity to test this arrangement came when the Grand Trunk Pacific was building through the wooded country west of Edmonton. During the two years this work has been progressing, reaching now miles through the timbered country, destructive fires have been wholly prevented, although the right-of-way has been cleared all the way through inflammable timbers and there has been an immense traffic constantly using the trails along the grade and line of location.

The patrol in this construction work is placed in charge of a chief fire ranger who has authority to engage as many rangers as are necessary to patrol the whole line, and who is always on hand to superintend the rangers and see that their work is done in the most effective manner. The cost of thus patrolling 150 miles of the Grand Trunk Pacific in 1909 was \$9,595.56, of which one-half was refunded to the company.

This system would seem the most satisfactory for preventing fires from railway construction. Unfortunately there is in most cases a lack of legislation requiring the railway companies to share in the expense of fire protection. For instance, while the National Transcontinental is building through the valuable spruce forest of northern Ontario it is not in any way required to contribute to the support of a fire protective patrol, and does not do so.* As a rule the cost of preventing fire from railway construction has to be wholly paid by the province. All railway legislation should provide that a part of all the cost of preventing destructive fires from the construction of the road be paid by the company owning the road.

In the past the timber not burned by the construction of the railways was usually burned shortly after the road began to be operated. The locomotives showered sparks and dropped clinkers, some of which remained long enough to start fires. Section gangs burning ties, tramps lighting fires and travellers throwing cigar butts and matches from car windows were all sources of danger. Attempts have been made to remove these causes of fire by legislation. Railways have been required to construct fireguards along the right of way, to carry spark arresters in their locomotives, prevent the escape of fire from the furnace or ash pan, to keep the right of way clear of inflammable material and to employ their section-men for the prevention of fires. Such legislation, wise in theory, has been nearly useless in practice. The railway companies do not always construct or keep in repair their fireguards, they do not furnish their locomotives with spark arresters, or, if they do, they do not keep them in repair, but allow the fireman to punch them full of holes to improve the draught of the engine. The precautions specified in the law are rarely observed.

The laws will not be observed so long as they are not enforced, and they cannot be enforced without adequate machinery. What is needed is a patrol along all railways in operation through timbered land. Such a patrol, kept up by the different public land departments, is now in existence on a few railways. With larger appropriations it could be extended whenever necessary. Certain officers of the patrol should be given authority to examine locomotives at divisional or other convenient points to learn

* Since the above was written an arrangement has (July, 1910) been made between the Transcontinental Railway Commission and the Ontario provincial government by which the former pay one-third of the cost of fire protection along their lines. The other railways refund all expenditure for fire protection along their lines.

if they are properly equipped. The lack of the authority at present prevents fire rangers from knowing whether the companies are complying with the law or not. The chief officers of the patrol should also be given power to enforce provincial legislation. At present the officials in British Columbia cannot force the railway companies to obey the provincial 'Bush Fires Act.'

The railway companies might also be induced to pay for, or help pay for, the cost of such a patrol. In 1909 the province of Ontario spent \$66,712.49 in maintaining a patrol on different railway lines. All of this was refunded by the companies, except that part expended on the National Transcontinental.

SETTLERS CLEARING LAND.

The idea has been developed in this country that whatever has been done in the guise of clearing land for new settlers was, and is, excusable. This idea, together with general carelessness and lack of interest in the public property, has resulted in the destruction of an incalculable amount of timber through fires started from bush-burning and land-clearing.

It has been a general experience in Canada, that if 20 townships or more be covered with timber, and one only of these be fit for agriculture and that one be opened for settlement, the whole twenty timbered townships will be burned over before the first crop is taken off the agricultural township. Such fires, common in every new district, are due to carelessness in burning bush when the weather is dry, and in setting fires without providing for controlling them.

In every province the question of setting out fires is covered and regulated by legislation. Probably the best legislation is that in British Columbia, which requires every settler to secure from the nearest provincial officer written authority before setting out fire. This provision is enforced and ensures that fires are not set out in dangerous seasons and are never set out without proper provisions.

Further legislation is not needed in this respect so much as further public education. So long as the idea is prevalent that fires do good, and that timber is so abundant as to be an incumbrance to the country, fires will prevail unless wholesale police methods are adopted. When the public has been educated to the fact that forest fires are needless and destructive and are the outgrowth of individual carelessness, fires will decrease. Those who cannot be educated in this way will be reached by the enforcing of the law and the collection of fines.

These measures are now being adopted throughout the country. All the public land departments keep posted throughout the country notices calling attention to the provisions of the fire laws. The Quebec Forest Protection Service has issued a booklet for distribution to the lumbermen, citizens and manufacturers calling attention to the serious character of the annual fires and containing information as to how fires may be prevented and checked. The New Brunswick government is preparing a similar pamphlet for distribution to the school children. The Federal Forestry Branch has issued a circular, for distribution to all settlers and residents in the new districts; this is appended to the present bulletin.

If fires in the new settled districts are to be prevented, the departments which have charge of fire protection must be given larger appropriations. One man in a district by keeping the settlers alive to the fire danger, by encouraging them to obey the law, by advising and assisting them in preventing and checking fire, can, in nearly all cases, prevent destructive fires. Such a man costs from \$250 to \$600 a year, according to the wages paid and the length of the season. If he prevents one fire a year he pays for himself many times over in public or private property saved. There is much discussion of what measures to adopt to encourage forestry and the conservation of natural resources. The first practical measure is protection from fire.

CUT-OVER LAND: THE DANGER AND ITS REMEDY.

Very few lumbermen are directly responsible for fires. Fires caused by lumbermen are more common in British Columbia than elsewhere, on account of the logging engines used in that country. These engines burn wood, producing large quantities of sparks. In the past they have been prolific causes of forest fires. At present they are regulated by law and are, as a rule, carefully managed. The class of wood they burn is clear, straight-splitting fir, the best logs obtainable—a most expensive form of fuel. Logging engines on the Pacific coast, in the United States, are adopting oil as fuel, as it is both cheaper and safer. There is no possibility of fires being started from oil-burning engines, and the sooner these can be introduced in British Columbia, or wherever else logging engines and locomotives are used, the better for the country.

The greatest fire danger in the logging business is the slash left by the operators. If the land logged were to be settled immediately, it would not make so much difference if it were burned over. But only a very small percentage of the logged-over land in Canada is ever settled. The rest is land fit for forest growth only, and after logging it should be left in the best possible condition for another crop of the most valuable timber. On the contrary, it is without exception left in the worst possible condition. After the merchantable timber has been cut the ground is covered, often to a depth of several feet, with a tangled mass of tops, broken timber, culled logs and underbrush which, as soon as it has dried out, is as inflammable as so much tinder and remains so for several years, or until burned. When this mass burns the heat generated is so great that all young or standing trees are killed. The soil is frequently utterly consumed and a very good imitation of a desert is the result.

SPRUCE.

The same method of handling cut-over lands cannot be applied to all parts of the country without experiment and modification. What is necessary, considered from a national and economic standpoint, is to handle the debris so as to prevent as far as possible, the danger of fire and, at the same time, leave a soil surface more suitable for the germination and growth of the valuable trees that the locality and land are best fitted to produce. For instance, in Nova Scotia, New Brunswick and large regions as far west as the Rocky Mountains, the only profitable crop is, and always will be, spruce. In a spruce forest the trees are of all ages and sizes, from seedlings to mature trees. After logging, there are, usually, a large number of small and medium-sized trees left. These gradually seed up the open spaces. If the brush were burned, the fire would probably kill many of these trees, and, owing to the demands of young spruce for moist, rich soil, would hinder rather than help the natural regeneration of spruce. Fire would also encourage the growth of such trees as poplar, birch and jackpine. In this country the snow-fall is heavy and it has been found by experiment that if the tops are lopped so as to be close to the ground the snow breaks them down and they soon decay. Lying close to the ground in the shade of the remaining timber they never dry out and there is, consequently, little danger of fire.

This simple scheme of lopping the tops in spruce timber has its advantages; it is inexpensive, simple and practicable; it reduces the fire danger; it enriches the soil and, by reducing the fire danger, encourages the natural reproduction of the valuable spruce timber. The New Brunswick government now requires that the tops be lopped on all timber cut on government lands.

DOUGLAS FIR.

In British Columbia, on the Douglas Fir land, another condition of affairs exists. Here the slash left is enormous in quantity, extremely inflammable and slow to decay. There is also a long dry season each summer. If the slash is left as at present, piled high around the few remaining trees, it is almost sure, sooner or later, to catch fire, and when it burns the fire is sure to kill all the trees, old and young, and thus destroy the

Photo by H. R. MACMILLAN, 1908.



Low stumps left in logging operations in Douglas Fir, Kaniksu National Forest, Washington State, U.S. A. The debris is afterwards burned.

Digitized by Google

future productivity of the soil so far as valuable timber is concerned. The best scheme for guarding against this seems to be that adopted by the United States Forest Service in handling timber sales on the Douglas Fir lands in the national forests.

In the first place they guard against having too much debris, by requiring the operators to cut low stumps, take all the tops and use all the timber which can be manufactured at a profit. The present law in British Columbia charging as high a royalty on cull timber as on the finest quality, encourages leaving all low grades in the woods, especially when the market has been crowded by an over-production from the too numerous mills.

Before the tract is cut over, the forest officers select patches of fairly young, thrifty fir, of an acre or so each, so situated as to be able to seed up the whole tract. These are not touched, but are protected by fire lines and left to stand until a future cutting and in the meantime seed up the cut-over land with the valuable fir. Everything else that can be utilized by the lumbermen or the contractors is taken off the tract. When the lumbering operation is completed the debris is all burned, care being taken to protect the standing patches of fir. The burning of the slash exposes the surface of the mineral soil and this produces the best possible seed-bed for Douglas Fir.

This plan of management has not as yet passed the experimental stage, but there is no doubt that it is far superior to the utter lack of provision for the future at present universal in lumbering operations on similar lands in Canada. That it imposes no hardship on the lumbermen is shown by the fact that lumbermen in Washington and Oregon are satisfied to pay from \$2 to \$3.50, or more, per thousand feet for the privilege of logging lands where these and other provisions are rigidly enforced.

WHITE PINE.

Similarly, an experiment made a few years ago by the United States Forest Service on white pine lands in Minnesota shows that there is room for vast improvement in the manner of logging such lands in the region where they are of the utmost importance for future timber production, i.e., in Ontario and Quebec. In Minnesota the lumbermen were required to leave about 5 per cent of the original stand of pine, the trees to be selected and marked by the forest officers, and to pile and burn all the slash. At first there were objections, but the regulations were carried out at a cost to the lumbermen of from 15 to 50 cents per thousand feet. The burning of the brush was a precaution against the fires which so commonly sweep over cut-over white pine lands. It also provided a mineral soil seedbed for the pine, and, as care was taken to protect the seed-trees during the burning, there is at present a splendid reproduction of white pine on the land, a young crop which is practically free from the great fire danger which is so characteristic of cut-over pine lands in Canada.

The handling of cut-over lands is the greatest problem in forest protection and forestry in Canada to-day. It cannot be solved by rules issued from headquarters. It cannot be solved satisfactorily by inexperienced and untrained men. But the United States Forest Service is yearly proving on 200,000,000 acres of forest lands, carrying practically every kind of merchantable timber in America, that it can be solved by trained men in such a way as to provide for the future timber supply of the country, satisfy the lumbermen of the present, and, at the same time, meet satisfactorily the varying conditions imposed by the market requirements, the characteristics of the principal species of trees and the physical features of each lumber region.

OTHER CAUSES OF FIRE.

The other causes of forest fires can be guarded against only by an effective patrol, covering the travelled routes leading into the timberland, and by the education of the people of the country to the point where they will be voluntarily careful with fire in the woods.

All the public lands departments of Canada now maintain such a patrol. But in all the provinces, and particularly in the district under the administration of the Dominion Forestry Branch, the territory is so large and inaccessible that the annual appropriations are not nearly sufficient.

Where it is possible to have only one man on several hundred miles of river, as in the case of the Athabaska and Peace rivers, and where, as is the case on the Dominion lands, the average district of a ranger is 2,900 square miles, in an inaccessible country which is becoming more thickly threaded with trails each year, it is obvious that the ranger cannot get over his territory very frequently in a season. His force is more moral than physical. He keeps fire notices posted along the trails, and wherever travellers congregate he distributes circulars of warning. He is a missionary in his district, and to make his teachings effective is given the authority, frequently exercised, to arrest careless or wilful offenders.

The general propaganda in favour of forestry is teaching the white people to be more careful with fire in the woods. The efforts of missionaries and Indian agents, with fire notices printed in Indian characters, are making the Indians more careful. But there will always be enough carelessness to render a fire protective organization necessary. As the settlement of the country extends farther each year, and as the remaining timber grows more valuable, this organization should be increased.

The fire protective organization can only be effective and economical if well organized, free from political control and composed of men who can ride or handle a canoe, according as the type of the country demands it, and who are not incapacitated by infirmities, age or deep disinclination from hard work in the woods. The effectiveness of the organization will be increased if as many as possible of the rangers are made permanent in connection with the forestry work, as is the case in the United States Forest Service, and if the whole organization can be placed under a close system of superintendence and inspection, such as will discourage neglect of duty and insure that all energy expended is properly directed.

Forest Fires in 1909.

So far as can be learned the season of 1909 was not marked by destructive fires, though, in keeping with the development of the country there was more settlement, railway construction, prospecting and travel through the woods than in any preceding year. That the reported fire damage is not great is explained by the following conditions; it is yet difficult or impossible to learn details of fires which may or may not occur in the vast unorganized wooded areas; where fires do not destroy merchantable timber they are commonly thought harmless; and perhaps the greatest cause of the decrease of fires is the increased attention which is being given to the protection of the public timberlands by the Dominion and provincial governments.

Below is given a synopsis of all that can be learned from official sources.

BRITISH COLUMBIA.

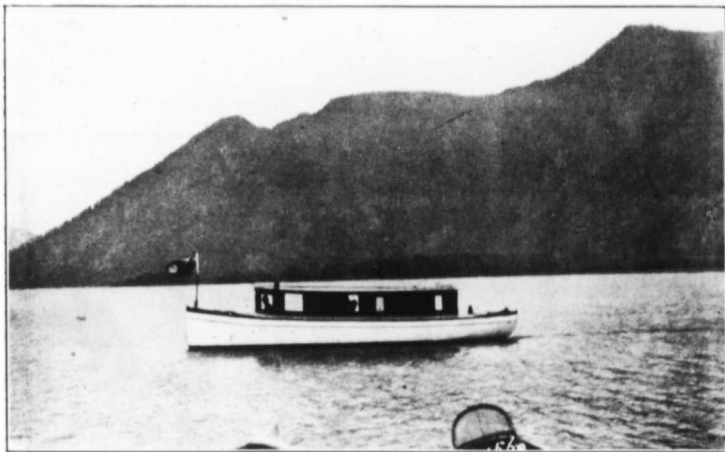
A large portion of the province is yet unreached by the fire protective service. There is a growing demand among the lumbermen for a more-extensive patrol and it is likely that the organization, which is very effective as far as it goes, will be considerably extended. There is under consideration the purchase of two gasoline launches to enable the patrol of the large areas of the most valuable coast timber which, on account of the extremely rough nature of the country, cannot be reached in any other manner. As British Columbia has the most valuable forest area in Canada, has a climate most favourable to forestry, large areas of land fit only for the production of timber, a public revenue largely dependent upon timber and a surplus of several millions of dollars in the bank, accumulated by the sale of timber, it would seem most business-like and wise for the province to spend larger sums of money in fire protection and to establish a forestry department.

For the season of 1909 there were employed by the government 1 chief warden, 36 deputy wardens and 86 assistant wardens. These men report in their territory 489 fires, none of which reached serious proportions. Eight hundred and fifty men were engaged temporarily in extinguishing fires. The total cost, exclusive of sums expended by Crown agents, was \$40,000.

The fires reported covered 70,000 acres of slashing and timberlands. There were destroyed or damaged over 8,000,000 feet of timber, 300 to 400 piles, 4,000 posts and a quantity of shingle bolts, cordwood and railroad ties.

Forest fires also destroyed or injured 30 fruit trees, a government bridge, and about \$7,000 worth of fencing, machinery and miscellaneous improvements.

Photo by R. H. CAMPBELL, 1909.



Launch used in the fire patrol work of the Dominion Forest Service, Shuswap Lake, B.C.

To encourage obedience to the law, 57 suspects were arrested, 26 of whom were convicted and fined to the extent of \$800, with four cases remanded for further trial.

The British Columbia fire law is one of the best, if not the best, in Canada. One especially good feature is that all settlers contemplating clearing land are required to get written permits from the nearest authority. Two thousand five hundred and thirty of these permits were issued and only 99 incipient fires were reported from settlers clearing land.

DOMINION LANDS: MANITOBA, SASKATCHEWAN, ALBERTA AND RAILWAY BELT IN BRITISH COLUMBIA.

The area of timberland under federal administration is the largest, the most inaccessible and the most scattered of any in Canada. The increase of settlement and travel has also made it the most dangerous as regards forest fires. The total area timbered is estimated at more than 700,000 square miles, the area covered by fire rangers about 250,000 square miles.

The annual appropriations are not sufficient to provide thoroughly efficient protection for the whole territory. Therefore, close watch is kept on developments throughout the timbered country, and the rangers are each year distributed so that the greatest number are in the regions where the timber is most valuable and the danger

from fire the greatest. The outlying regions, which in the past have had no protection at all are now being furnished with one or two men to patrol the main routes of travel. Thus the railway belt in British Columbia with 37 rangers is the most carefully guarded. Similarly all districts where timber limits are located such as the east slope of the Rocky mountains, the drainage basins of the rivers west of Edmonton, the territory north of Prince Albert and country on the Canadian Northern Railway tributary to Dauphin are given as good protection as possible.

Further north, in the Lac La Ronge district, the Beaver river, the Peace river, around Great Slave lake and on the Athabaska river men are stationed for the summer in districts comprising thousands of square miles. They cannot hope to see their whole districts in the course of the season, but they can watch the main avenues of travel and exercise a wholesome effect on Indian traders, prospectors, rivermen and travellers.

Every railway construction line through timber is made a special district and closely watched so long as work continues. All railroad lines running through timber are patrolled, but the number of men available is insufficient.

The forest reserves are special districts under permanent officers and rangers and, though not fully organized yet, are given the best fire protection possible.

There were no serious fires reported from Dominion Lands in 1909. The 96 rangers employed, covering all the timbered territory tributary to settlement, reported 486 fires, nearly all of which were controlled before reaching serious proportions.

The total expenditure on fire protection was about \$62,300; of this sum \$19,033.76 was refunded by railway and licensees.

The area burned over was 257,000 acres, all wooded, but only a small proportion covered with merchantable timber. The quantity of merchantable timber reported as destroyed was about 4,000,000 feet. This figure is probably much too small. The greatest loss was to the young timber which, though not merchantable now, is the only hope of a timber supply in another 60 or 100 years.

Forest fires destroyed houses, farm buildings, sawmills, implements, hay, lumber, cross-ties and cordwood, to the value of about \$41,000.

The rangers, by arresting offenders, are encouraging a respect for the local laws. Twelve men were arrested for setting fires. Of these, eleven were convicted and fined a total of \$514 and costs.

As settlement increases the number of rangers must be increased every year. The economy and efficiency of the field work of this large body of men could be increased if they were placed under some system of direct inspection.

ONTARIO.

As befits the province cutting the largest amount of timber per year, Ontario leads in the number of rangers employed and in the expenditure upon the protection of forests from fire.

Temporary rangers are maintained upon the forest reserves on areas of valuable timber along railway construction lines, along some lines of railway operating through valuable timber, and in districts where prospecting, development work or clearing land introduces fire danger. Of course, in common with the rest of Canada, Ontario possesses large areas of many thousands of square miles of land unfit for any use but forest growth. This land in Ontario, as elsewhere, is some of it already ruined and converted into rock barrens by past fires. The remainder of it, cut over, or covered only with young timber, is not thought valuable enough to protect from fire, and each year sees more of this territory, which in future would otherwise produce a crop and an income, turned by forest fires into perpetually profitless wastes.

The fire protective service of the province is credited with preventing many fires and protecting much timber. It is now devoted mostly to the mature timber of which

the pine can only last between 20 and 30 years. If it could be possibly extended to protect the young timber and prevent fires from running over waste land it would be doing for the future of the province what it is now doing for the present.

No general measures have yet been adopted to dispose of the slash left on the cut-over lands or to encourage the natural reproduction of valuable timber.

There were employed in 1909 a total of 822 fire rangers; of these 185 were employed on forest reserves, 187 on railways, and 450 on licensed timber lands.

The total cost of fire ranging was \$198,821.42, distributed as follows:—

Licensed timber lands.	\$66,114 71
Forest reserves.	65,992 22
Railway lines.	66,712 49

The license-holders choose the men to be engaged in their districts and refund one half of the expense. The railway companies, excepting the National Transcontinental,* refund all expense connected with the patrol of their lines.

No record is available of the number of fires occurring or the damage due to them. The report of the Crown Lands Department states that fires, some of them serious, occurred on the Mississauga, Timiskaming, Timagami and Nipigon Forest Reserves. About 78,000,000 feet of pine were damaged or destroyed in two of these fires. Beyond this no estimate is available as to the loss.

QUEBEC.

The reports for the province are very incomplete. The timberland is greater in area than that of Ontario and still more inaccessible, and as not so large an appropriation is available for protecting it from fire, it is safe to assume that there are as many destructive fires in Quebec as in Ontario, if not more.

In the season of 1909, about 500 men were employed as fire-rangers and temporary fire-fighters. In addition the owners of timber limits employ fire-rangers to safeguard their private property. This is especially the case with the paper and pulp companies.

The Forest Protection Branch of the Quebec Department of Lands and Forests has issued a pamphlet for distribution amongst settlers, campers, lumbermen and others, setting forth the precautions to be taken against forest fires and the best method of fighting fire. At the beginning of the danger season in the spring short warnings, calling for care on the part of settlers and others in the wooded districts, were sent to all the churches, Catholic and Protestant, in the outlying regions, with a request that they be read from the pulpit. This measure will probably be of considerable influence, especially in the country districts where all the population can be reached through the church, and where the words of the curé carry great weight.

Nearly every summer in Quebec, forest fires destroy whole villages, as well as large areas of timber. During the summer of 1909 two villages, Whitworth and Bonaventure, were destroyed with dwellings, mills and lumber yards.

NEW BRUNSWICK.

The comparatively small area of the province, its accessibility, its freedom from a foreign or new population and from mining or development works on a large scale, together with the high values set by the public on the timber land, make forest protection easier than in the western provinces.

The law provides that municipal officers are *ex officio* fire-wardens. The public lands of the province are divided into four districts, in each of which a chief fire and game protective warden has charge of the protective force. This force in 1909 consisted of 191 fire rangers, 68 of whom were specially appointed to guard the con-

* See foot note, page 25

struction lines of new railways. These were in addition to 70 fishery wardens, stationed along the angling waters, who were also constituted fire rangers and proved very useful. All fire rangers had authority to engage assistants to fight fires and to arrest suspected persons. In all there were about 300 men employed.

Sixty-six forest fires were reported covering about 103,000 acres, mostly old bush land. The only fatality reported for Canada occurred in New Brunswick, one boy being burned to death. The timber destroyed had a stumpage value of about \$30,000. A few houses also were destroyed.

The cost to the public of fire patrol and fire fighting was about \$10,000. An equal amount was spent by the lumbermen.

Such a large proportion of the fires—25 out of 66—were caused by settlers clearing land that the authorities are considering the advisability of adding to an otherwise stringent law by requiring all settlers who wish to clear land during the dry months to secure written permits from the local authorities.

NOVA SCOTIA.

This province differs from all the others possessing timber lands, in that the settlements are scattered throughout the timber lands and all districts are comparatively easy of access. It is probably due to this, to the high value of the timber lands, and to the law-abiding, careful character of the people that Nova Scotia escapes without serious forest fires.

The fire law in Nova Scotia differs in principle from that of other provinces. It imposes the same restrictions upon travellers, campers, railways, portable and other mills. Settlers are required to get written permits before clearing land in the dry season, and owners of saw-mills and portable engines are required to obtain written permits from the chief fire-ranger of the county before they may operate.

The provincial authorities appoint a chief fire ranger for each municipality. He has authority to call out assistants to fight fire, to appoint deputy rangers to guard against fire, to enforce all the provisions of the law and to arrest offenders. The deputies are permanent officials, but work only by the day as circumstances may require, and are paid only for the days actually spent on duty. The salary of the chief rangers is paid by the province. All other expenses (the *per diem* expense allowance of the chief rangers, the wages of deputy rangers and labour employed to fight fires, &c.) are met by the municipalities. Each municipality levies a tax of one quarter of a cent per acre per annum upon all uncultivated or waste or timber lands held in bodies of 300 acres or more. The proceeds of this tax are usually sufficient to meet the cost of fire protection.

This whole scheme is one possible only in a settled country. It appears to work well in Nova Scotia.

There were no destructive fires in 1909 in Nova Scotia. About 93 fires were reported in addition to many incipient blazes. The total area burned over was about 11,000 acres, nearly all of which was waste land previously burned or bush land not covered with merchantable timber. About 400,000 feet of lumber and 150,000 manufactured shingles were burned in addition to such improvements as fences, barns and dwellings.

There were 13 chief fire-rangers employed, with about 90 assistants appointed¹ some of whom were not called upon for active work.

The total cost to the municipalities was about \$4,930.

The chief rangers were very thorough in locating and arresting offenders, 18 of whom were convicted and fined a total of \$855. In addition several, to avoid trouble, paid the cost of extinguishing fires, and paid private owners for the damage done. The fire law appears to be enforced in Nova Scotia as it is nowhere else, probably because it has there a whole-hearted, aggressive public support.

Conclusions.

1. The area of merchantable timber has been, until within a very few years, grossly overestimated. The quantity of merchantable timber, never as large as is popularly believed, has been reduced more by forest fires than by any other cause.

2. These fires, though largely preventable, are still occurring. This is due not so much to lack of laws as to lack of enforcement of existing laws. The laws cannot be enforced unless they are supported by public spirit, backed by generous legislative appropriations and administered by permanent skilled officials free from political interference.

3. The destruction of the existing timber by fire is not only reducing the present timber supply but is destroying the value or possibility of a future crop, laying waste large areas of forest land, exercising a deleterious effect on navigable streams, water-powers and irrigation reservoirs, and is in every way directly opposed to the national welfare as represented by a progressive conservation policy.

4. Of all the civilized nations in the northern hemisphere Canada is doing the least to treat the public timber lands as a permanent asset.

Photo by G. C. PICHE.



Result of a Quebec Forest Fire.

Summary of Approximate Loss due to Forest Fires, 1909.

District	Area Burned over	No. of Fires Reported.	Expenses of Fire Protection and Fire Fighting (Govt. and Private.)	Value of Timber and Improvements Destroyed.	Lives Lost.
	Acres.		\$ cts.	\$ cts.	No.
British Columbia.....	70,000	489	40,700 00	18,400 00	None.
Dominion Lands	251,000	486	62,300 00	45,000 00	"
Ontario.....	?	?	198,821 42	100,000 00	"
Quebec.....
New Brunswick.....	103,000	66	20,000 00	37,000 00	1
Nova Scotia.....	11,000	93	10,000 00	10,000 00	None.
Total.....	475,000	1,134	331,821 42	210,400 00	1

NOTE.—All totals are too small, especially those for British Columbia, Dominion Lands, Ontario and Quebec, where there are immense areas of forest land beyond the reach of the fire protective organizations. Timber destroyed is valued at the arbitrary rate of \$1 per thousand feet, though it is worth much more to the country. In addition, an enormous quantity of cordwood destroyed in districts where it now has a value, and in other districts where it will soon be needed, has been neither estimated nor valued.

ADVICE TO SETTLERS REGARDING THE HANDLING OF FIRE.*

The timberland of western Canada has been seriously damaged every year by fires which have escaped from travellers, railways and settlers. The area is so large and settlement so scattered that it is impossible to accurately estimate the damage done, but in 1908 alone record was obtained of fires which in the western provinces destroyed property valued at \$25,029,575. There were countless other fires which were unnoticed and unrecorded.

Where the causes of large fires in the new country have been investigated it has nearly always been found that they were started in one of three ways.

These are:—

1. Freighters and travellers throw matches into the grass along the trail or neglect to put out their camp-fires and smudges.
2. Settlers clearing land allow fires to get away when burning brush.
3. Fires escape from settlers burning hay meadows.

Fires from these innocent causes have destroyed thousands of square miles of timber in the west. The timber is public property. The supply at best is too small for the settlement which is filling the prairies. It is to every western man's interest to endeavour to keep fire out of the timber, the destruction of which benefits no one, but is a loss to every one in the district. Poplar timber is well worth protecting; though it is generally despised, scarcity of other varieties is forcing it into the market, especially for settlers' use. There were 2,975,000 feet of poplar manufactured in the prairie provinces in 1908. If fires can be kept out there will always be an abundance of poplar lumber. Cheap poplar lumber is the farmer's insurance against expensive lumber from outside points.

Young timber is worth protecting until the land on which it stands is actually needed for settlement. It is growing rapidly, in 20 to 30 years it will produce cord-wood and lumber, when the timber which is now full-grown is nearly all gone. Every one who aids in keeping fire out of such timber is proving himself a worthy citizen and assisting in the development of the west.

Fires which escape always do more harm than good in clearing the land. They get beyond control and destroy fences, buildings, stock and occasionally lives. Fire running through the timber also injures the soil. The fierce heat destroys the rich vegetable mould, which is the equivalent of a fertilizer or top-dressing, and leaves only the mineral soil. Light lands inclined to be gravelly or sandy are very seriously injured by fire.

Fires which get beyond control always overrun more land than is needed for immediate settlement, and in doing so destroy timber, which, if it had escaped, would have been a source of profit to the settlers themselves.

The Forestry Branch does its best with the means at its disposal to employ fire-rangers in each district to patrol the dangerous areas, warn the residents against careless use of fire and take such steps as are necessary to extinguish any fire that may start. The travelled area of the west is increasing so rapidly each year and settlements are becoming so widely scattered that it is impossible with the funds available to cover the whole country with fire-rangers. But each settler by being careful with fire can do more to prevent extensive conflagrations than can any number of fire rangers.

* Circular issued by the Forestry Branch of the Department of the Interior.

Do not Neglect these Precautions.

When on the trail be careful of camp fires and smudges. Do not build fires larger than necessary. Do not build them in leaves, rotten wood, dry grass or other places where they are likely to spread. Do not build them against large or hollow logs where it is difficult to tell when the fire is out. In windy or very dry weather, or in dangerous situations, camp-fires should be confined to holes or should be built on the mineral soil from which all vegetable matter has been cleared away. Do not leave the fire even for a short time without first thoroughly extinguishing it.

Read carefully the law regarding using fire in clearing, and obey it. The fire rangers are employed to see that it is obeyed and are instructed to arrest all offenders. It is the fire-ranger's duty to advise and assist the settlers of his district in the setting out of fire for clearings. If there is a fire-ranger in your district see him before you set out fire.

Take every precaution to confine your fire to a small area and to your own land. Do not burn more brush at one time than you can constantly watch. Pile the brush so that fire cannot escape from it to neighbouring prairie, brush or woods. If possible surround by ploughed or well-cleared fire breaks. Do not burn it when there is a strong wind, nor when everything is dry and inflammable. A dull, quiet day after a rain in the spring or late fall is the best time. While a fire is burning watch it constantly and have water and tools near so that you can check it if necessary.

Do not burn hay meadows when everything is dry and the flames spread rapidly to the surrounding prairie or woods. Burn them when the woods are wet and on a dull day when there is only a slight breeze and burn them against the wind. The flames then can be readily checked and beaten out with brush if they threaten to spread beyond control. Do not burn a hay meadow without help near; watch the fire until it is extinguished.

General Instruction for Fighting Fires.

The tools necessary for fighting fire are sharp axes, round-pointed shovels, grubbing hoes or mattocks, buckets and blankets or sacking. If the fire is of serious proportions the local fire ranger should be immediately notified.

The best time to fight a fire is at night or in the early morning, as fires always die down during the night. If a fire covers an acre or more, especially if there be enough timber to make it very hot, it is frequently the best plan to do all possible to hold it in check during the day, gather as much help as is available and make a concentrated effort to put it out at night.

Fires under different circumstances vary a great deal, but there are a few general principles of fire-fighting which always hold.

Fires in a peaty soil cannot be absolutely extinguished, but can be checked by trenching. A trench about two feet wide, dug completely around the burning soil and deep enough to strike the permanent water-level, will keep the fire from spreading.

Fires running along the ground in the herbage may be beaten out with wet branches or sacking. Do not throw water by the pailful, except on burning logs or timber. It is a waste of water. Sprinkle or wet a wisp of branches; it is much more effective. Ground fires may also be checked by shovelling earth or sand on them.

Fire travels slowly in damp, heavy timber and a few men can check it by trenching, if they cannot put it out.

Fires in open dry woods, such as jackpine or spruce, can be checked from a trench or a natural break such as a stream, trail or open prairie.

Fire rushes uphill, pauses at the crest and travels more slowly down, so the best location for a fire-break is at the top or bottom of a slope.

When making a fire-break clear the ground of all materials in which fire might run and throw everything to the side next the fire so that there will be nothing to hold sparks that may leap across. A strip a few feet wide cleared to the mineral earth will usually check a fire. A fire-break should be patrolled until the fire is out.

Do not leave a fire unless driven from it until it is completely extinguished. Cut down dead trees that may hold sparks.

By the establishment of its patrol the government undertakes the protection of the property of settlers, contractors and timber owners from fire, and the protection of the public timber, so essential to the development of the west. The efficiency of the patrol can be greatly increased if the residents of the district co-operate with the fire rangers. It is the duty of the fire rangers to constantly patrol their districts throughout the danger season, to keep all residents and travellers acquainted with the danger from fire and to extinguish all fires that start. The forest ranger should be a well known visitor in every part of his district. He has the power to require the assistance of all residents in the extinguishing of fire and to arrest for trial any who carelessly or wilfully allow fire to spread.

Important Points in the Forest Laws.

The Canadian Criminal Code provides that any person who wilfully sets fire to timber or timberland is guilty of an indictable offence and liable to fourteen years imprisonment.

The Criminal Code also provides that any one who carelessly or in violation of a municipal or provincial law sets fire to timber or timberland is guilty of an indictable offence and is liable to two years imprisonment.

Manitoba Fire Law.

Any person who kindles a fire and allows it to run at large on property not his own, or wilfully allows a fire to escape from his own property to that of another, is liable to a fine of from twenty to two hundred dollars or imprisonment not exceeding one year.

Any one who kindles a fire and does not take effectual means to prevent the spreading to another person's property is liable to a fine of from twenty to one hundred dollars or imprisonment not exceeding six months.

No person shall set fire for the purpose of clearing land without first getting permission from the nearest fire guardian. If this precaution is neglected and if the fire escapes to destroy timber or property, the person who set it out is liable to a fine of two hundred dollars or imprisonment for one year. The law also requires that when such fires are set out, six men be present during the whole time the fire is burning, or that a fire-break ten feet wide be ploughed around the fire.

Any resident who sees that a fire has escaped is required to notify the nearest fire guardian. The fire guardians are given the power to require the assistance of all men between sixteen and sixty years of age to fight the fire. Any one who neglects his duty in this respect is liable to a fine of fifty dollars.

Alberta and Saskatchewan Fire Law.

Any person who, directly or indirectly, kindles a fire and allows it to run at large over another's property or permits it to escape from his own land is liable to a fine of from twenty-five to two hundred dollars, and to civil damages for the amount of property destroyed by the fire.

Any person who kindles or who is party to kindling a fire for camping or branding purposes and leaves it without extinguishing it is liable to a fine of one hundred dollars.

Any person who sets out a fire for clearing land without surrounding it with a fire-break twenty feet wide and patrolled by three adults is liable to a fine of one hundred dollars. The law provides that if the fire be set out before the 7th of May, a fire-break ten feet wide, guarded by three adults, will be considered sufficient.

Fire guardians are given the power to require the assistance of all men between sixteen and sixty years of age for fighting a fire within ten miles of their residence. The penalty for refusing to obey the fire guardian is a fine of five dollars.

British Columbia Fire Law.

No person shall set out fire between May 1 and October 1, for the purpose of clearing land, without obtaining a permit from the fire warden, assistant fire warden, government agent, gold commissioner, timber inspector, forest ranger, mining recorder, provincial police or constable. A fire thus set out must be constantly watched and prevented from spreading.

No one shall set out fire in the woods between May 1 and October 1, except for cooking, warmth or industrial purposes; and if a fire is set for these purposes it shall be in the cleared space and the fire must be extinguished before it is left.

Every person operating a logging engine between May 1 and October 1 must clear a reasonable space around the engine to prevent fire from spreading.

The penalties for violation of this law are fines of from fifty to two hundred dollars or imprisonment for six months.

⊕

