

ERINDALE COLLEGE



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Forest Protection
in Canada

1912-1914

Commission of Conservation
Canada

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Commission of Conservation

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MR. JAMES WHITE.

Commission of Conservation
Canada

COMMITTEE ON FORESTS

FOREST PROTECTION
IN CANADA
1913-1914

Compiled under the direction of
CLYDE LEAVITT, M.Sc.F.

*Chief Forester, Commission of Conservation
and*

*Chief Fire Inspector, Board of Railway Commissioners
Associated with*

C. D. HOWE, Ph.D., and J. H. WHITE, B.A., B.Sc.F.

1915
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Committee on Forests

SENATOR W. C. EDWARDS, *Chairman*

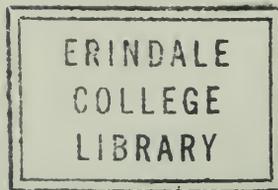
DR. FRANK D. ADAMS

DR. B. E. FERNOW

MR. JOHN HENDRY

HON. WILLIAM J. ROCHE

MR. W. B. SNOWBALL



TO FIELD-MARSHAL, HIS ROYAL HIGHNESS PRINCE ARTHUR WILLIAM
PATRICK ALBERT, DUKE OF CONNAUGHT AND OF STRATHEARN,
K.G., K.T., K.P., &c., &c., GOVERNOR GENERAL OF CANADA

MAY IT PLEASE YOUR ROYAL HIGHNESS:

The underigned has the honour to lay before Your Royal Highness the attached report on "Forest Protection in Canada, 1913-1914," which was compiled by Clyde Leavitt, Chief Forester of the Commission of Conservation, and Chief Fire Inspector, Board of Railway Commissioners, associated with C. D. Howe, Ph.D., and J. H. White, B.A., B.Sc.F.

Respectfully submitted

CLIFFORD SIFTON

Chairman

OTTAWA, November 10, 1915

OTTAWA, CANADA

November 9, 1915

SIR:

I beg to submit the attached report of Mr. Clyde Leavitt, the Chief Forester of the Commission of Conservation. Mr. Leavitt, in submitting his report, said:

"I have the honour to submit the accompanying report, which contains information collected under the direction of the Committee on Forests during the years 1913 and 1914. That portion of the report which relates to the railway fire situation in Canada was prepared principally in my capacity as Chief Fire Inspector for the Board of Railway Commissioners."

Respectfully submitted

JAMES WHITE

Assistant to Chairman and Deputy Head

SIR CLIFFORD SIFTON, K.C.M.G.

Chairman

Commission of Conservation, Ottawa

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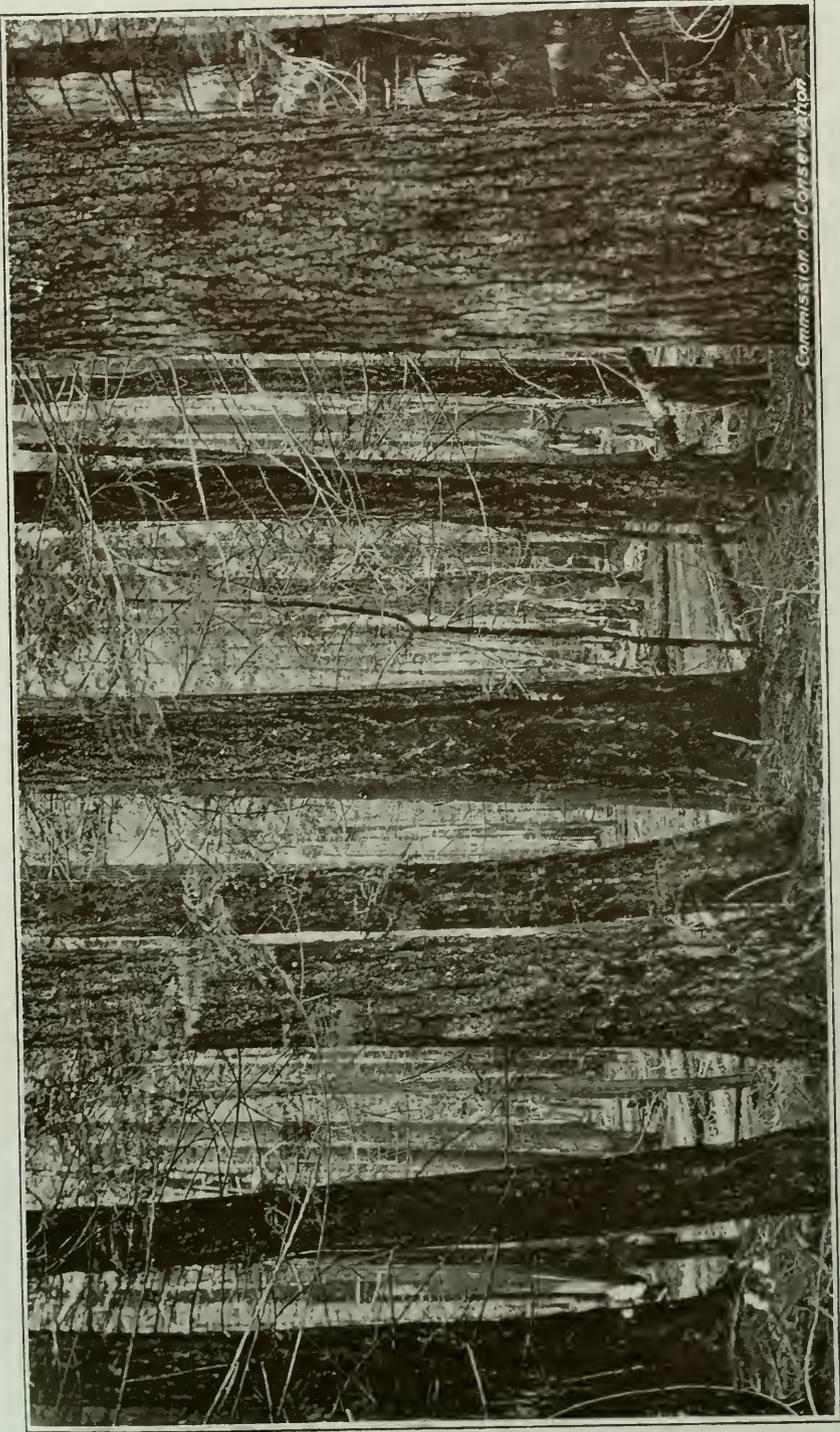
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Commission of Conservation

HEAVY STAND OF DOUGLAS FIR, HEMLOCK AND CEDAR

Douglas Fir Coast type, Southwestern British Columbia. The preservation of the forests from destruction by fire means permanence for all the industries depending upon the use of wood.

PART I

The Railway Fire Situation

BY

CLYDE LEAVITT

*Chief Fire Inspector, Board of Railway Commissioners, and
Chief Forester, Commission of Conservation*

THE Board of Railway Commissioners has jurisdiction over about 85 per cent of the railway mileage of the Dominion.

The outstanding feature of the railway fire situation in 1913 was the extension to eastern Canada of the fire protective organization of the Board of Railway Commissioners. Co-operative arrangements were entered into whereby certain officials of the forest fire protective organizations of Ontario, Quebec and New Brunswick were appointed officers of the Fire Inspection Department of the Board. This co-operation was continued and extended during 1914. Co-operation in Nova Scotia has been delayed, pending the appointment of a provincial Forester, for which, however, provision has been made by law. Co-operation in the west, with the Dominion Forestry and Parks Branches and the British Columbia Forest Branch, was continued and extended during both years, in accordance with the policy and procedure developed in 1912.

In general, the organization has fully demonstrated that it has passed the experimental stage, and has justified its existence by a more adequate handling of the patrol, right-of-way clearing and fire-guarding features of the Board's requirements than had previously been practicable. The results secured have amply justified the efforts made, and show that the practically complete solution of the railway fire problem may be expected with the steady increase in efficiency of the inspection staff, made available under the co-operative arrangements in effect between the Board and the fire protective organizations of the Dominion and Provincial Governments, coupled with the natural increase in the efficiency of the fire protection work of the railways.

It has been shown conclusively that in a broad way the efficiency of the fire protective measures of most of the railway companies is

in direct ratio to the efficiency and sufficiency of the inspection staff made available for the field work of the Fire Inspection Department of the Board. The necessity for so close a supervision, through a large inspectorial organization, will no doubt disappear to a considerable extent in future years, in the case of those railways whose officials and employees are genuinely impressed with the fact that the efficient prevention of fire is the highest type of business policy, and where a special organization is developed for the handling of fire protection work. Special organization for this work is almost imperative, if efficient results are to be secured, in the case of any except the smaller railway lines.

Fire protection has, in the past, been something apart from the regular routine of railway operation, and it, naturally, requires time and a distinct effort to secure complete compliance with the various instructions issued by managing officials of railway companies, under the requirements of the Board. In too many cases, the mere issuance of a circular of instructions, relative to fire protection, to railway employees may not be followed by the complete observance of these instructions, including the exercise of sufficient care in the use of fire in right-of-way clearing, and the extinguishing of fires having an accidental origin. Some provision for the following up of these instructions is needed, especially in the beginning; and in the case of a large organization, the development of a special department, or at least the assignment of one or more special inspectors, is highly desirable. In the absence of such voluntary provision by the railway company, it is obvious that a relatively large inspection staff must be provided by the Dominion or Provincial Government agency concerned, until such time as full compliance with the various requirements can be reliably secured otherwise.

There is great encouragement in the fact that, as a measure of good business policy, some of the railways are beginning to develop special organizations for the handling of fire protection work. The Canadian Northern and Canadian Pacific railways are the pioneers in this direction. In 1913 the Canadian Northern organized a department of fire protection, in charge of an expert, and the results are clearly evident in the greatly increased efficiency of the fire protection work along their lines. In the same year the Forestry branch of the Canadian Pacific railway appointed three special fire inspectors for its Western lines, and three men were similarly assigned on Eastern lines in 1914. Thus far the functions of these men have been purely of an inspectorial character, working in close co-operation with the respective operating departments. Since these two companies have fully demon-

strated the value of special organization in handling fire protection work, the adoption of similar measures by other railway companies may confidently be expected in the future.

While, on the whole, Canada undoubtedly has a strong lead over the United States, so far as efficient railway fire protection by the railways themselves is concerned, some of the American railway lines have voluntarily, from motives of economy, taken vigorous action in securing efficient fire protection by railway employees. As a result of serious fire losses, resulting in large damage claims, a special department was organized in 1912 by the Boston and Maine railroad, and stringent instructions to all officials and employees were put into effect. As a result, the department of fire claims of that railway reports that settlements of fire claims in 1912 aggregated about \$30,000, or nearly \$200,000 less than during the previous year. In 1913, which was a relatively bad fire year in that section, payments for fire claims totalled nearly \$70,000, or less than one-third the payments in 1911, before the appointment of the commissioner of fire claims. The aggregate for 1913 included \$10,318 for a fire not set by locomotives, but which got beyond the control of the railway employees when burning slash, etc., which was not cleared away after the lumber was cut on property adjoining the right-of-way. It also includes \$5,230 for claims originating prior to March 1, 1912, when the fire claims department was organized. These figures are highly suggestive of what fire loss means to the company, and demonstrate what may be accomplished through a systematic scheme of fire prevention.

Another example is the Atchison, Topeka and Santa Fé railway, which, in 1911 and 1912, undertook a special campaign for improvement in matters of fire protection. In 1910, the company had claims for 1,509 fire losses, aggregating \$100,605. In 1911, there were 574 fires, with claims amounting to \$51,000. In the fiscal year 1912, the number of fires had been reduced to 135, and the expenditure for payment of claims to only \$6,000.

**General Order
No. 107**

Following the issuance of Order No. 16,570, under date of May 22, 1912, objections to certain provisions of the order were made by the Canadian Pacific, Canadian Northern, and Grand Trunk Pacific railways. They claimed that some of the provisions in question were impracticable and would impose an unreasonable burden of expense upon the companies; also, that certain others were beyond the jurisdiction of the Board, as conferred by the Railway Act.

The Board considered very carefully the various objections, and finally decided that, while some of the points were not well taken, some

modification might be made as to others; thus removing even the semblance of a basis for a charge of arbitrariness, without impairing the efficiency of the order, while, at the same time, doing away with the necessity for final consideration by the Supreme Court of the complaint by the railways respecting lack of jurisdiction on the part of the Board. The result was the issuance of General Order No. 107, as follows.

THE BOARD OF RAILWAY COMMISSIONERS FOR CANADA

General Order No. 107

Friday the 14th day of July, A.D. 1913

H. L. DRAYTON, K.C.

Chief Commissioner

D'ARCY SCOTT

Asst. Chief Commissioner

JAMES MILLS

Commissioner

A. S. GOODEVE

Commissioner

IN THE MATTER OF THE Order of the Board No. 16,570, dated May 22nd, 1912; and the application by the Canadian Pacific, the Grand Trunk, the Canadian Northern, and the Grand Trunk Pacific Railway Companies to amend said Order.

UPON the hearing of the application at the sittings of the Board, held in the city of Ottawa, July 3, 1913, the Railway Companies interested, the Commission of Conservation, and the Government of the Province of British Columbia being represented by Counsel at the hearing, and what was alleged; and upon the report and recommendation of the Chief Operating Officer and the Chief Fire Inspector of the Board—

IT IS ORDERED as follows:

1. Order No. 16,570, dated May 22, 1912, is hereby rescinded.
2. Until further order, every railway subject to the legislative authority of the Parliament of Canada under construction or being operated by steam, shall, unless exempted by a special order of the Board, cause every locomotive engine used on the said railway, or portion of railway, being constructed or operated by it, to be fitted and kept fitted with netting mesh as hereinafter set forth, namely:

(a) On every engine equipped with an extension smoke box, the mesh shall not be larger than $2\frac{1}{2} \times 2\frac{1}{2}$ per inch of No. 10 Birmingham wire gauge, and shall be placed in the smoke box so as to extend completely over the aperture through which the smoke ascends, the openings of the said mesh not to exceed a quarter of an inch and one-

sixty-fourth (that is, seventeen sixty-fourths) of an inch to the square.

(b) On every engine equipped with a diamond stack, the mesh shall not be more than 3 x 3 per inch of No. 10 Birmingham wire gauge, and shall be placed at the flare of the diamond of the stack, so as to cover the same completely, the openings of said mesh not to exceed three-sixteenths and one sixty-fourth (that is, thirteen sixty-fourths) of an inch to the square.

3. Every such railway company shall cause:

(a) The openings of the ash pans on every locomotive engine used on the railway, or portion of railway, operated or being constructed by it, to be covered, when practicable, with heavy sheet iron dampers; and, if not practicable, with screen netting dampers $2\frac{1}{2} \times 2\frac{1}{2}$ per inch of No. 10 Birmingham wire gauge, such dampers to be fastened either by a heavy spring or by a split cotter and pins, or by such other method as may be approved by the Board.

(b) Overflow pipes from lifting injectors, or from water pipes from injector-delivery pipe, or from boiler, to be put into the front and back part of the ash pans and used from the first day of April to the first day of November, or during such portion of this period as the Board may prescribe, for wetting ash pans.

4. Every such railway company shall provide inspectors at terminal or divisional points where its locomotive engines are housed and repaired; and cause them, in addition to the duties to which they may be assigned by the officials of the railway companies in charge of such terminal or divisional points,—

(a) To examine at least once a week,

(1) The nettings;

(2) Dead plates;

(3) Ash pans;

(4) Dampers;

(5) Slides; and

(6) Any other fire-protective appliance or appliances used on any and all engines running into the said terminal or divisional points.

(b) To keep a record of every inspection in a book to be furnished by the railway company for the purpose, showing:

(1) The numbers of the engines inspected;

(2) The date and hour of day of such inspection;

(3) The condition of the said fire-protective appliances and arrangements, and

(4) A record of repairs made in any of the above-mentioned fire-protective appliances.

The said book to be open for inspection by any authorized officer of the Board.

(c) In case any of the said fire-protective appliances in any locomotive are found to be defective, said locomotive shall be removed from service and shall not (during said prescribed period) be returned to service, unless and until such defects are remedied.

(d) Every such railway company shall also make an independent examination of the fire-protective appliances on all the locomotives of such company, at least once each month, and the conditions of such fire-protective appliances shall be reported direct to the Chief Mechanical Officer of the railway company, or other chief officer, held responsible for the condition of the motive power of the said company.

5. No employee of any such railway company shall—

(a) Do, or in any way cause, damage to the netting on the engine smoke-stack or to the netting in the front end of such engine;

(b) Open the back dampers of such engine while running ahead, or the front dampers while running tender first, except when there is snow on the ground, and it is necessary to take such action in order to have engine steam properly;

(c) Or otherwise do or cause damage or injury to any of the fire-protective appliances on the said engines.

6. No such railway company shall permit fire, live coals, or ashes to be deposited upon its tracks or right-of-way, unless they are extinguished immediately thereafter, except in pits provided for the purpose.

7. No such railway company shall burn lignite coal on its locomotive engines as fuel for transportation purposes, unless otherwise ordered by the Board—lignite coal consisting of and including all varieties of coal between peat and bituminous, with a carbon-hydrogen ratio of 11.2 or less, such ratio being based on analysis of air-dried coal.

8. Every such railway company shall establish and maintain fire-guards along the route of its railway as the Chief Fire Inspector may prescribe. The nature, extent, establishment and maintenance of such fire-guards shall be determined as follows:

(a) The Chief Fire Inspector shall each year prepare and submit to every such railway company a statement of the measures necessary for establishing and maintaining the routes of such railways in a condition safe from fire, so far as may be practicable.

(b) Said measures may provide for the cutting and disposal by fire, or otherwise, of all or any growth of an inflammable character, and the burning or other disposal of debris and litter, on a strip of sufficient width on one or both sides of the track; the ploughing or digging of land in strips of sufficient width on one or both sides of the track; and such other work as may, under the existing local conditions and at reasonable expense, tend to reduce to a minimum the occurrence and spread of fire.

(c) Said statements of the Chief Fire Inspector shall be so arranged as to deal with and prescribe measures for each separate portion of such railway upon and adjacent to which the fire risk calls for specific treatment. The intention shall be to adjust the protective measures to the local conditions, and to make the expense proportionate to the fire risk and possible damage.

(d) Said statements of the Chief Fire Inspector shall prescribe dates on or within which the foregoing protective measures shall be

commenced and completed, and the fire-guards maintained in a clean and safe condition.

(e) No such railway company shall permit its employees, agents, or contractors to enter upon land under cultivation, to construct fire-guards, without the consent of the owner or occupant of such land.

(f) Wherever the owner or occupant of such land objects to the construction of fire-guards, on the ground that the said construction would involve unreasonable loss or damage to property, the Company shall *at once* refer the matter to the Board, giving full particulars thereof, and shall, in the meantime, refrain from proceeding with the work.

(g) No agent, employee, or contractor of any such railway company shall permit gates to be left open or to cut or leave fences down whereby stock or crops may be injured or to do any other unnecessary damage to property, in the construction of fire-guards.

9. In carrying out the provisions of Section 297 of the Railway Act, which enacts that "the Company shall at all times maintain and keep its right-of-way free from dead or dry grass, weeds, and other unnecessary combustible matter," no such railway company or its agents, employees or contractors shall, between the first day of April and the first day of November, burn, or cause to be burned, any ties, cuttings, debris, or litter upon or near its right-of-way, except under such supervision as will prevent such fires from spreading beyond the strip being cleared. The Chief Fire Inspector or other authorized officer of the Board may require that no such burning be done along specified portions of the line of any such railway, except with the written permission or under the direction of the Chief Fire Inspector or other authorized officer of the Board.

10. The railway company shall provide and maintain a force of fire rangers fit and sufficient for efficient patrol and fire-fighting duty during the period from the first day of April to the first day of November of each year; and the methods of such force shall be subject to the supervision and direction of the Chief Fire Inspector or other authorized officer of the Board.

11. The Chief Fire Inspector shall, each year, prepare and submit to each and every railway company a statement of the measures such railway companies shall take for the establishment and maintenance of said specially organized force. Said statements among other matters may provide for—

(a) The number of men to be employed on the said force, their location and general duties, and the methods and frequency of the patrol.

(b) The acquisition and location of necessary equipment for transporting the said force from place to place, and the acquisition and distributing of suitable fire-fighting tools; and

(c) Any other measures which are considered by him to be essential for the immediate control of fire and may be adopted at reasonable expense.

12. Whenever and while all the locomotive engines used upon any such railway, or any portion of it, burn nothing but oil as fuel, dur-

ing the aforesaid prescribed period, under such conditions as the Board may approve, the Board will relieve the said railway of such portion of these regulations as may seem to it safe and expedient.

13. Every such railway company shall instruct and require its sectionmen and other employees, agents and contractors to take measures to report and extinguish fires on or near the right-of-way as follows:—

(a) Conductors, engineers, or trainmen, who discover or receive notice of the existence and location of a fire burning upon or near the right-of-way, or of a fire which threatens land adjacent to the right-of-way, shall report the same by wire to the Superintendent, and shall also report it to the agent or persons in charge at the next point at which there shall be communication by telegraph or telephone, and to the first section employees passed. Notice of such fire shall also be given immediately by a system of warning whistles.

(b) It shall be the duty of the superintendent or agent or person so informed to notify immediately the nearest forest officer and the nearest section employees of the railway, of the existence and location of such fire.

(c) When fire is discovered, presumably started by the railway, such sectionmen or other employees of the railway as are available, shall either independently or at the request of any authorized forest officer proceed to the fire immediately and take action to extinguish it; provided such sectionmen or other employees are not at the time engaged in labours immediately necessary to the safety of trains.

(d) In case the sectionmen or other employees available are not a sufficient force to extinguish the fire promptly, the railway company shall, either independently or at the request of any authorized forest officer, employ such other labourers as may be necessary to extinguish the fire; and as soon as a sufficient number of men, other than the sectionmen and regular employees, are obtained, the sectionmen and other regular employees shall be allowed to resume their regular duties.

(e) The provisions of this section shall apply to all fires occurring within 300 feet of the railway track, unless proof shall be furnished that such fires were not caused by the railway.

14. Every such railway company shall give particular instructions to its employees in relation to the foregoing regulations and shall cause such instructions to be posted at all stations, terminals and section houses along its lines of railway. In case said instructions are not also carried in employees' time tables during said prescribed period, or in "operating" and "maintenance of way" rule books, they shall, previous to April 1 of each year, be re-issued to all employees concerned, in the form of special instructions. The Chief Fire Inspector may waive the above requirements in whole or in part, as to lines or portions of lines where, in his judgment, the fire danger is not material.

15. Every such railway company allowing or permitting the violation of, or in any respect contravening or failing to obey any of the foregoing regulations, shall, in addition to any other liability which the said company may have incurred, be subject to a penalty of one hundred dollars for every such offence.



EFFECT OF REPEATED FIRES

Merchantable timber and young growth entirely destroyed and no seed trees left to establish a new forest. The fertile upper layer of soil has been burned, and the mineral eroded, exposing the bare rocks. Millions of acres of such barren desert exist in many parts of Canada.



FIRE HAZARD ON RAILWAY RIGHT-OF-WAY

At the right, inflammable debris upon the right-of-way of the National Transcontinental Ry. in Quebec, resulting in great fire hazard. Similar conditions exist along hundreds of miles of this line in New Brunswick, Quebec and Ontario. At the left, clearing for station grounds.

16. If any employee or other person included in the said regulations, fails or neglects to obey the same, or any of them, he shall, in addition to any other liability which he may have incurred, be subject to a penalty of twenty-five dollars for every such offence.

17. The Board may, upon the application of any railway company or other party interested, vary or rescind any order or direction of the Chief Fire Inspector made pursuant to the provisions of this Order.

(Sgd.) H. L. DRAYTON
Chief Commissioner,
Board of Railway Commissioners for Canada

BOARD OF RAILWAY COMMISSIONERS FOR CANADA

Examined and certified as a true copy under
 Section 23 of "The Railway Act."

A. D. CARTWRIGHT

Secretary of Board of Railway Commissioners for Canada
 Ottawa, July 8th, 1913

Changes made by General Order No. 107 Since Order No. 16,570 was quoted at length in the report on "Forest Protection in Canada," 1912, it is not reprinted here.

The changes from Order No. 16,570 are briefly as follows:

It will be noted that in several respects the order is materially strengthened, while in no case is its efficiency impaired.

In Regulation 4 (b) the change is wholly a matter of form. In Regulation 4 (d) the requirement is so changed as to specify the results to be accomplished in the matter of locomotive inspections by railway companies, without specifying the manner in which the results shall be brought about.

In General Order No. 107 the provisions contained in Regulation 5 of Order No. 16,570 are omitted, since, under the Railway Act, officers of the Board already have authority to inspect fire-protective appliances on locomotives; and the provision for the removal of defective engines from service is not needed, in view of the provision in Regulation 4 (c), that locomotives defective as to fire-protection appliances shall not be used until such defects are remedied.

Regulation 6 (b) of Order No. 16,570 is amended in Regulation 5 (b) of General Order No. 107 to permit the opening of back dampers of engines when running ahead, or the front damper while running tender first, in case there is snow on the ground and it is necessary to take such action in order to have engine steam properly.

Regulation 7 of Order No. 16,570 is amended in Regulation 6 of the new order, so that yard limits are also included in the prohibition against the depositing of fire, live coals and ashes upon tracks or rights-

of-way, unless same are extinguished immediately thereafter. The only exception is in case pits are provided for this purpose.

Regulation 14 of Order No. 16,570 is so amended in Regulation 13 of General Order No. 107 as to require the railway companies to instruct their employees relative to reporting and extinguishing fire, instead of making the order apply directly to the employees, as previously.

A very important change is contained in Regulation 13 (*e*) of the new order, which makes it clear that the intent of the Board is to place the burden of proof upon the railway companies to extinguish fires occurring within 300 feet of the track, unless proof shall be furnished that such fires were not caused by the railway. The corresponding provision of Regulation 14 (*e*) of Order No. 16,570 was easily liable to misconstruction, the understanding being in some cases that the throwing of the burden of proof upon the railway companies was intended by the Board to extend to financial responsibility in connection with damage claims, instead of being limited to the extinguishing of fires. As the regulation now stands, it clearly has no bearing upon the question of damage claims.

The revision contained in Regulation 14 of General Order No. 107 provides for the posting of instructions to employees at terminals and section houses, in addition to stations, as required in the previous order. Provision is also made for the reissuance of such instructions to employees each year, under conditions stated. In addition, provision is made for elasticity in the enforcement of this regulation, by giving the Chief Fire Inspector full discretionary authority in the matter.

Regulation 17 of General Order No. 107 makes clear that any railway or other party interested may appeal to the Board from any order or direction of the Chief Fire Inspector. This privilege had of course existed previously, without specific inclusion in Order No. 16,570.

Jurisdiction of the Board Following is a list of steam railways in operation or under construction, subject to the jurisdiction of the Board of Railway Commissioners for Canada.

Algoma Central and Hudson Bay.

Algoma Eastern.

Atlantic, Quebec and Western.

Bay of Quinte (C.N.R. system).

Boston and Maine (Massawippi Valley).

British Yukon (White Pass and Yukon).

Brockville, Westport and Northwestern (C.N.R. system).

Calgary and Fernie (under construction).

Canadian Northern.

Canadian Northern Ontario (C.N.R. system).
Canadian Northern Quebec (C.N.R. system).
Canadian Pacific.
Central Ontario (C.N.R. system).
Central Railway Company of Canada (under construction).
Central Vermont (G.T.R. system).
Cumberland Railway and Coal Co. (Dominion Coal Company).
Dominion Atlantic (C.P.R. system).
Edmonton, Dunvegan and British Columbia (under construction).
Elgin and Havelock.
Esquimalt and Nanaimo (C.P.R. system).
Essex Terminal.
Glangarry and Stormont (C.P.R. system).
Grand Trunk.
Grand Trunk Pacific.
Great Northern.
Halifax and Southwestern (C.N.R. system).
Interprovincial and James Bay (C.P.R. system, under construction).
Irondale, Bancroft and Ottawa (C.N.R. system).
James Bay and Eastern (C.N.R. system, under construction).
Kettle Valley (C.P.R. system, under construction).
Klondike Mines.
Kootenay and Alberta.
Lake Erie and Northern (C.P.R. system).
Maine Central.
Marmora Railway and Mining Co. (C.N.R. system).
Michigan Central (Canada Southern).
Moncton and Buctouche.
New Brunswick Coal and Railway (C.P.R. system).
Ottawa and New York (N.Y.C. & H.R.R. system).
Pere Marquette.
Quebec and Lake St. John (C.N.R. system).
Quebec, Montreal and Southern (Rutland).
Quebec Oriental.
Rutland and Noyan (Rutland).
Salisbury and Albert.
Schomberg and Aurora.
St. Lawrence and Adirondack (N.Y.C. & H.R.R. system).
St. Martins.
Temiscouata.
Thousand Islands.
Toronto, Hamilton and Buffalo (C.P.R. and M.C.R.R.).

Victoria and Sidney (G.N.R. system).
 Victoria Terminal Railway and Ferry Company (G.N.R. system).
 Wabash.
 Western Canada Power Co.
 Western Dominion (under construction).

RAILWAYS SUBJECT TO BOARD BY PROVINCES

In the following list, the above railways are subdivided according to provinces. When a particular railway is situated in more than one province, the name is repeated:

Yukon Territory—

British Yukon (White Pass and Yukon).
 Klondike Mines.

British Columbia—

British Yukon (White Pass and Yukon).
 Calgary and Fernie (under construction).
 Canadian Pacific.
 Esquimalt and Nanaimo (C.P.R. system).
 Grand Trunk Pacific.
 Great Northern.
 Kettle Valley (C.P.R. system, under construction).
 Victoria and Sidney (G.N.R. system).
 Victoria Terminal Railway and Ferry Company (G.N.R. system).
 Western Canada Power Company, Limited.

Alberta—

Calgary and Fernie (under construction).
 Canadian Northern.
 Canadian Pacific.
 Edmonton, Dunvegan and British Columbia (under construction).
 Grand Trunk Pacific.
 Kootenay and Alberta.
 Western Dominion (under construction).

Saskatchewan—

Canadian Northern.
 Canadian Pacific.
 Grand Trunk Pacific.

Manitoba—

Canadian Northern.
 Canadian Pacific.
 Grand Trunk Pacific.
 Great Northern (of the United States).

Ontario—

Algoma Central and Hudson Bay.
Algoma Eastern.
Bay of Quinte (C.N.R. system).
Brockville, Westport and Northwestern (C.N.R. system).
Canadian Northern.
Canadian Northern Ontario (C.N.R. system).
Canadian Pacific.
Central Ontario (C.N.R. system).
Central Railway Company of Canada (under construction).
Essex Terminal.
Grand Trunk.
Grand Trunk Pacific.
Irondale, Bancroft and Ottawa (C.N.R. system).
Lake Erie and Northern (C.P.R. system).
Marmora Railway and Mining Co. (C.N.R. system).
Michigan Central (Canada Southern).
Ottawa and New York (N.Y.C. & H.R.R. system).
Pere Marquette.
Schomberg and Aurora.
Thousand Islands.
Toronto, Hamilton and Buffalo (C.P.R. and M.C.R.R. systems).
Wabash.

Quebec—

Atlantic, Quebec and Western.
Boston and Maine (Massawippi Valley).
Canadian Northern Quebec (C.N.R. system).
Canadian Pacific.
Central Railway Company of Canada (under construction).
Central Vermont (G.T.R. system).
Grand Trunk.
Interprovincial and James Bay (C.P.R. system, under construction).
James Bay and Eastern (C.N.R. system, under construction).
Maine Central (Hereford).
Quebec and Lake St. John (C.N.R. system).
Quebec, Montreal and Southern (including Napierville Junction).
Quebec Oriental.
Rutland and Noyan (Rutland).
St. Lawrence and Adirondack (N.Y.C. & H.R.R. system).
Temiscouata.

New Brunswick—

Canadian Pacific (including New Brunswick Coal and Railway).
 Elgin and Havelock.
 Moncton and Buctouche.
 Salisbury and Albert.
 St. Martins.
 Temiscouata.

Nova Scotia—

Cumberland Railway and Coal Co. (Dominion Coal Co.).
 Dominion Atlantic (C.P.R. system).
 Halifax and Southwestern (C.N.R. system).

STEAM RAILWAYS NOT SUBJECT TO BOARD

British Columbia—

Canadian Northern Pacific (C.N.R. system, under construction).
 Eastern British Columbia.
 Morrissey, Fernie and Michel.
 Pacific Great Eastern (under construction).
 Vancouver Copper Co. (Lenora Mount Sicker).
 Wellington Colliery Co.

Alberta—

Alberta Great Waterways (under construction).
 Canada Central (under construction).
 Canadian Northern Western (C.N.R. system).*

Saskatchewan—

Canadian Northern Saskatchewan (C.N.R. system).*

Ontario—

Lake Huron and Northern Ontario (formerly Bruce Mines and Algoma).
 Maganatawan River.
 National Transcontinental (under construction).
 Timiskaming and Northern Ontario (Ontario Government line).

Quebec—

Canada and Gulf Terminal.
 Ha Ha Bay.
 Intercolonial (Canadian Government lines).
 Lotbinière and Megantic.

*Under the Canadian Northern Railway Guarantee Act, these lines will become subject to the Board, upon proclamation by the Governor in Council, following their completion and opening for operation.

Quebec.—Continued.

National Transcontinental (under construction).
 Philipsburg Railway and Quarry Company.
 Quebec Central (C.P.R. system).
 Quebec and Saguenay (under construction).
 Salmon River and Northern.

New Brunswick—

Caraquet and Gulf Shore.
 Fredericton and Grand Lake Coal and Railway Company (C.P.R. system).
 Intercolonial (Canadian Government lines).
 International Railway of New Brunswick (Canadian Government lines).
 Kent Northern (including St. Louis and Richibucto).
 National Transcontinental (under construction).
 New Brunswick and Prince Edward Island (Canadian Government lines).
 Northern New Brunswick and Seaboard.
 North Shore.
 Southampton (C.P.R. system).
 St. John Valley (Canadian Government lines).
 York and Carleton.

Nova Scotia—

Cape Breton.
 Intercolonial (Canadian Government lines).
 Inverness Railway and Coal Company (C.N.R. system).
 Maritime Railway, Coal and Power Company.
 Sydney and Louisburg (Dominion Coal Co.).

Prince Edward Island—

Prince Edward Island (Canadian Government lines).

ORGANIZATION

As noted above, the co-operation begun in 1912 with the fire-protective organizations of the Dominion and Provincial governments has been continued and extended. In this way has been handled practically all of the detailed field inspection in connection with right-of-way clearing, establishment and maintenance of patrols, reporting and extinguishing of fire by railway employees, and the construction of fire-guards. In each case, the plan of co-operation includes the payment of salary and expenses of the inspecting officer by the co-operating

agency, so that, aside from the head office at Ottawa, the work of the Fire Inspection Department has been handled without cost to the Board.

The following shows the organization in effect in 1914. The organization in 1913 differed only in minor details, being in general not quite so complete.

Co-operation with British Columbia Forest Branch The inspection work handled by the British Columbia Forest Branch embraces all lines in British Columbia except those within the railway belt.

H. R. MacMillan, Chief Forester, appointed provincial fire inspector, to exercise general supervision over the Board's fire inspection work in the province outside the railway belt. R. E. Benedict, H. R. Christie and W. C. Gladwin, assistant provincial fire inspectors.

Cranbrook District—J. D. Gilmour, divisional fire inspector; G. B. Watson, R. J. Long and J. C. Hart, assistant divisional fire inspectors.

Nelson District—G. H. Prince, divisional fire inspector; J. T. Price, A. M. Black, H. S. Nelson and C. A. Mix, assistant divisional fire inspectors.

Vernon District—L. R. Andrews, divisional fire inspector; M. V. Allen and H. H. Thomas, assistant divisional fire inspectors.

Vancouver District—G. D. McKay, divisional fire inspector; A. T. Kennedy and W. H. Smith, assistant divisional fire inspectors.

Island District—H. K. Robinson, divisional fire inspector; W. F. Loveland and J. E. Stilwell, assistant divisional fire inspectors.

Prince Rupert District—H. S. Irwin, divisional fire inspector.

Hazelton District—R. E. Allen, divisional fire inspector; George Dover, Thomas Brewer and James Latham, assistant divisional fire inspectors.

Fort George District—H. G. Marvin, divisional fire inspector; F. W. Heath and R. M. Pellatt, assistant divisional fire inspectors.

Tête Jaune District—C. MacFayden, divisional fire inspector.

The divisional fire inspectors above enumerated were under appointment by the British Columbia Forest Branch as district foresters, and the assistant divisional fire inspectors, as district rangers.

Divisional fire inspector-at-large—George A. Kerr.

Dominion Forestry Branch The inspection work handled by the Dominion Forestry Branch, Department of the Interior, is as follows—

D. Roy Cameron, district inspector of forest reserves, Kamloops, B.C., appointed fire inspector for the railway belt, exclusive of Dominion parks. This includes the main line of the Canadian Pacific railway



HEAVY FOREST GROWTH IMMEDIATELY ADJACENT TO NEWLY-CONSTRUCTED RAILWAY
Note logs and small debris, from right-of-way clearing, piled at edge of timber. A small grass fire on the right-of-way might, by igniting this material, cause great damage to green timber before men could reach the scene and control the fire. Ontario.



ANOTHER PORTION OF THE SAME LINE
Note how the right-of-way has been cleared of inflammable matter. All debris has been piled and burned under careful supervision at a safe time. Danger of fire greatly reduced. The control of right-of-way burning is an important duty of the Fire Inspector of the Railway Commission.

through British Columbia, west of Leancoil, and branches within the railway belt; also Kettle Valley railway lines within the railway belt. Mr. Cameron was assisted by three divisional fire inspectors, W. R. Peacock, R. D. McDonald and James Selkirk.

W. N. Millar, district inspector of forest reserves, Calgary, Alberta, appointed fire inspector for Dominion forest reserves in Alberta. This includes those portions of the Canadian Pacific, Canadian Northern and Grand Trunk Pacific lines within the forest reserves on the east slope of the Rockies. Mr. Millar was assisted by Messrs. S. H. Clark and R. M. Brown, divisional fire inspectors.

E. H. Finlayson, inspector of fire ranging, Winnipeg, Man., appointed fire inspector; to handle inspection work in the forested portions of Manitoba and Saskatchewan, and in Alberta outside Dominion forest reserves and parks. This includes portions of the Canadian Pacific, Canadian Northern and Grand Trunk Pacific railways. Mr. Finlayson was assisted by T. McNaughton, divisional fire inspector.

R. C. Miller, assistant gold commissioner, Whitehorse, Y. T., was appointed district fire inspector. Through co-operative arrangement, Mr. Miller covered the White Pass and Yukon lines in Yukon and British Columbia as well as the Klondike Mines railway, in Yukon.

**Dominion
Parks Branch** The inspection work handled by the Dominion Parks Branch, Department of the Interior, embraces lines within Dominion parks in Alberta and the railway belt of British Columbia.

P. C. B. Hervey, chief superintendent Dominion parks, Edmonton, Alberta, appointed fire inspector for Dominion parks.

E. N. Russell, superintendent of Yoho and Glacier parks, Field, B.C., appointed divisional fire inspector for Yoho and Glacier parks.

S. J. Clarke, superintendent, Rocky Mountains park, Banff, Alberta, appointed fire inspector for Rocky Mountains park; H. E. Sibbald, assistant fire inspector.

N. C. Sparks, superintendent, Jasper Park, Jasper, Alberta, appointed fire inspector for Jasper park.

Railways covered by the above organization are those portions of the Canadian Pacific, Canadian Northern, and Grand Trunk Pacific, which are included within the various park boundaries.

Fire-guard Inspection, Alberta—Benj. Lawton, chief game and fire guardian, Department of Agriculture, Edmonton, appointed provincial fire-guard inspector. Mr. Lawton was assisted by Messrs. Donald McEachern, James I. Brewster and Chas. H. Pinnell, fire-guard inspectors. Railways covered are the Canadian Pacific, Canadian

Northern and Grand Trunk Pacific, within the prairie sections of Alberta.

Fire-guard Inspection, Saskatchewan—R. J. McLean, fire commissioner, Regina, appointed provincial fire-guard inspector. Railways covered are the Canadian Pacific, Canadian Northern and Grand Trunk Pacific, within the prairie portions of the province.

Ontario—The inspection work handled by the Department of Lands and Forests of the Province of Ontario is as follows:

E. J. Zavitz, provincial forester, Toronto, appointed provincial fire inspector, to exercise general supervision over the Board's fire inspection work in the province.

Max Rabbitts, district fire inspector: Canadian Pacific railway between Port Arthur and Ingolf, and Grand Trunk Pacific railway between Fort William and the Manitoba boundary.

Jas. Windle, district fire inspector: Canadian Pacific railway between Sudbury and Sault Ste. Marie and between Sudbury and Coldwater junction, and the Canadian Northern Ontario railway between Sudbury and Washago.

R. A. Allen, district fire inspector: Canadian Pacific railway between Sudbury and Nipigon.

C. Liddon Bliss, district fire inspector: Canadian Pacific railway between Port Arthur and Nipigon, Canadian Northern Ontario railway between Port Arthur and Nipigon, and the Canadian Northern railway between Port Arthur and Rainy River and North Lake.

L. P. Didier, district fire inspector: Canadian Pacific railway between Sudbury and Pembroke, and Grand Trunk railway between North Bay and Atherley junction, and between Depot Harbour and Pembroke.

Quebec—The inspection work handled by the Forest Protection Branch, Department of Lands and Forests, of the Province of Quebec, is as follows:

W. C. J. Hall, chief of the Forest Protection Branch, Quebec, appointed provincial fire inspector, to exercise general supervision over the Board's fire inspection work in the province.

N. McCuaig, district fire inspector: Canadian Pacific railway between Ottawa, Maniwaki and Waltham, and between Mattawa and Kipawa.

Art. Bedard, district fire inspector: Canadian Pacific lines in Quebec north of the St. Lawrence river, between Quebec and Ottawa, and branches; Canadian Northern Quebec railway between Quebec and Grenville, and branches.

Henry Sorgius, district fire inspector: Canadian Pacific, Piles and Shawinigan branches and Canadian Northern Quebec railway from Shawinigan to Rivière-à-Pierre; Quebec and Lake St. John from Rivière-à-Pierre to Kiskisink, and La Tuque branch.

Nath. Lebel, district fire inspector: Temiscouata railway in Province of Quebec.

Jos. Legacé, district fire inspector: Atlantic, Quebec and Western and Quebec Oriental railways, in Gaspé peninsula.

F. N. Roche, district fire inspector: Canadian Pacific lines in the province south of the St. Lawrence river; Grand Trunk, Boston and Maine, Central Vermont, and Maine Central railways.

Isaie Dubuc, district fire inspector. Mr. Dubuc covers same territory as Mr. Roche given above, with the following additional lines: St. Lawrence and Adirondack; Quebec, Montreal and Southern, Napierville Junction, and Rutland and Noyan.

W. A. Bignell, district fire inspector: Canadian Pacific railway between Quebec and Ottawa, including branches north of the St. Lawrence and Ottawa rivers; Canadian Northern Quebec railway, including branches north of the St. Lawrence river.

Arthur H. Graham, district fire inspector: Canadian Pacific railway between Montreal and Ottawa (north shore), including branches, and the Canadian Northern Quebec railway, between Montreal and Ottawa, including branches.

New Brunswick—The inspection work handled by the Crown Lands Department of the Province of New Brunswick is as follows:—

A. E. O'Leary, chief fire and game guardian, Richibucto, appointed provincial fire inspector. The territory covered includes the Canadian Pacific, St. Martins, Elgin and Havelock, New Brunswick Coal and Railway, Salisbury and Albert, and Temiscouata railways.

John McGibbon, assistant provincial fire inspector. Mr. McGibbon assisted Mr. O'Leary in handling the fire inspection work on the above named lines.

Nova Scotia—Co-operation for the handling of inspection work in Nova Scotia was promised by the Provincial Government, but the putting of the plan into effect has been delayed, pending the appointment of a provincial Forester, for which appointment provision has been made by Act of the Provincial Parliament.

**Railway
Fire Patrols** The plan adopted in 1912 has been continued, of requiring the establishment and maintenance of special fire patrols in forest sections where the fire hazard is considered high. The special patrols consisted, for the most part, of men with railway velocipedes, although, in some cases where the traffic

was not too heavy to prevent, the patrols consisted of men with power speeders. In the case of grades too heavy for the use of velocipedes or power speeders, foot patrols were prescribed.

In sections where the fire danger was considered medium, special patrols were required by members of the section crews, as a part of their regular work. The matter of reporting and extinguishing fire on lines or portions of lines where the fire hazard is considered light, was satisfactorily taken care of by the issuance of instructions by the railway companies, to their regular employees, under Regulation 14 of General Order No. 107. Such instructions were issued by nearly all the railway lines subject to the Board's jurisdiction.

In every case the question of the patrols to be required was fully taken up in advance with representatives of the railways concerned, so that, as a rule, the patrol letters as issued represent substantial agreement between the railways, the Board and the Dominion or Provincial fire-protective organization having primary responsibility for the protection from fire of the lands adjacent to the railway rights-of-way. In this way, the element of arbitrariness in the handling of the work has been practically removed. The consistent following out of this policy has, in view of the admirable spirit of co-operation exhibited by most of the railway officials concerned, resulted in the almost complete elimination of friction in the administration of this feature of the Board's requirements.

Although minor modifications were made in both 1913 and 1914, the requirements as to lines in the four western provinces were, as a rule, closely similar to those prescribed in 1912. The organization of this work did not extend to the east in that year.

Letters prescribing patrols or other special measures to be taken in connection with railway fire protection were issued to the following railway companies in both 1913 and 1914: Canadian Pacific western lines, Canadian Pacific eastern lines, Canadian Northern, Canadian Northern Ontario, Canadian Northern Quebec, Grand Trunk Pacific, Grand Trunk, Great Northern, Victoria and Sidney, Esquimalt and Nanaimo, Kettle Valley, Edmonton, Dunvegan and British Columbia, and Temiscouata. As to other lines, the issuance of special instructions to regular employees, under Regulation 14 of General Order No. 107, was considered sufficient. The Quebec and Lake St. John railway came under the Board's jurisdiction in July, 1914, by virtue of the Canadian Northern Railway Guarantee Act. During the balance of the fire season of that year, the patrol requirements previously prescribed by the Quebec Public Utilities Commission were continued, under the authority of the Board.

From the beginning, the policy has been consistently followed of relieving the railway companies from the necessity of maintaining special patrols, so far as weather conditions rendered such action practicable. The extent to which this policy could be carried out naturally depended also, to some degree, upon the extent to which the railway companies had specially organized their fire protection work, so as to ensure the prompt resumption of patrols when the weather became dry. The handling of this patrol work constitutes an important feature of the activities of the local officers of the Board. As a rule, these officers maintained a close degree of co-operation with the local railway officials, thus securing a maximum of efficiency in fire protection at a minimum of cost to the companies.

In order to show fully the degree of railway fire protection secured under the patrol requirements of the Board, the letter covering Canadian Northern lines in 1914 is quoted at length, with a summary of the measures required on other lines. The formal letter in each case contained substantially the same general provisions as those included in the Canadian Northern letter. The 1913 requirements are not quoted, since they differ only in minor details from the patrols prescribed in 1914.

CANADIAN NORTHERN RAILWAY PATROLS

March 14, 1914.

The Canadian Northern Railway,
Mr. M. H. MacLeod, General Manager,
Winnipeg, Manitoba.

Dear Sir:—

You are hereby notified that, in accordance with the provisions of General Order No 107 of the Board of Railway Commissioners, you are required to establish upon such portions of the Canadian Northern railway and of the lines under its control as are hereinafter described, a force of fire rangers fit and sufficient for efficient patrol and fire-fighting duty during the period from April 1st, 1914, to November 1st, 1914, except in so far as you may be relieved in writing from such patrol by the Chief Fire Inspector or other authorized officer of the Board.

The details of the patrols required are as follows, it being understood that unless otherwise specified, the patrol shall be continuous between the hours of seven in the morning and six in the evening of each day, including Sundays, with a minimum patrol of one round trip per day.

CENTRAL DIVISION

Port Arthur, Atikokan, and North Lake Subdivisions—Between Port Arthur and Rainy River, Ont., 285.8 miles, and between Twin

City junction and North Lake, 56.4 miles, patrol shall be by the section men, track walkers, and watchmen; minimum of one round trip per day.

Rainy River Subdivision—Between International boundary and South junction, Man., 18.6 miles, one man with velocipede; this man shall also provide a patrol of two round trips per day over the gravel pit spur, approximately 1.5 miles in length.

Between South junction and Carrick, 19.7 miles, one man with velocipede; special attention shall be paid the grades near Badger.

Between Carrick and Marchand, 22.6 miles, one man with velocipede.

Ridgeville Subdivision—Between Sundown and South junction, 24.7 miles, one man with velocipede.

Oak Point Subdivision—Between St. James and Gypsumville, 156.7 miles, the patrol and fire-fighting work shall be a part of the regular duties of the section men, track walkers and watchmen.

WESTERN DIVISION

Swan River Subdivision—Between Ethelbert and Minitonas, 57.5 miles, three men with velocipedes, distributed as follows: Between Ethelbert and Pine River, 18.9 miles; between Pine River and Cowan, 18.1 miles; between Cowan and Minitonas, 20.5 miles.

Erwood Subdivision—Between Bowsman and Hudson Bay junction, Sask., 91.6 miles, four men with velocipedes; with approximately equal mileages.

Prince Albert Subdivision—Between Hudson Bay junction and mileage 265 (between Osgoode and Tisdale), 65.3 miles, three men with velocipedes, with approximately equal mileages.

Hudson Bay Subdivision—Between Hudson Bay and The Pas, 87.5 miles, four men with velocipedes, with approximately equal mileages. At the option of the Company, there may be substituted for the above two men with power speeders, one between Hudson Bay junction and Cantyre, 43 miles, and one between Cantyre and The Pas, 44.5 miles.

Duck Lake Subdivision—Between Macdowall and the water tank at mileage 217, 11.6 miles, within The Pines forest reserve, one man with velocipede; minimum patrol of two round trips per day.

Shellbrook and Crooked Lake Subdivisions—Between Prince Albert and Big River, four men with velocipedes, to be distributed as follows: Between Prince Albert and Holbein, 20.4 miles; between Holbein and McOwan, 22.7 miles; between McOwan and Eldred, 22.3 miles; between Eldred and Big River, 19.6 miles. Special attention is required with regard to logging engines.

Athabaska Subdivision—Between Edmonton and Athabaska Landing, Alta., approximately 95 miles, patrol shall be maintained by the section men, track walkers and watchmen.

LINES UNDER CONSTRUCTION

Between St. Albert and the Pembina river, the patrol and fire-fighting work shall be a part of the regular duties of the section men, track walkers and watchmen.

Between Pembina river and McLeod river, approximately 64 miles, three men with velocipedes, with approximately equal mileages.

Between McLeod river and the Jasper Park boundary, at construction mileage 190 (this point is coincident with the G. T. P. station at Dyke), approximately 61 miles, three men with velocipedes, with approximately equal mileages.

Between the Jasper Park boundary at construction mileage 190, and Moose creek, at construction mileage 204.6, 14.6 miles, one man with velocipede.

Between Moose creek and Jasper, approximately 30 miles, one man with power speeder, or two men with velocipedes, with approximately equal mileages.

Between Jasper and Yellowhead, 17 miles, one man with velocipede.

INSPECTION

For the efficient inspection of and general supervision over the work of the Company under General Order No. 107, with special reference to the patrols above specified, the following field officers have been appointed by the Board, with jurisdiction as indicated.

E. J. Zavitz, Provincial Fire Inspector, address, Lands Department, Toronto, Ontario: Central Division lines in Ontario.

P. C. Barnard Hervey, Fire Inspector for Dominion Parks, address, Parks Branch, Edmonton, Alta.: Lines within Jasper Park, which extends from a point approximately three miles west of Prairie Creek crossing to Yellowhead.

E. H. Finlayson, Fire Inspector, address, Forestry Branch, Customs Building, Winnipeg, Man.: All lines in Manitoba and Saskatchewan, and all in Alberta, with the exception of lines within Jasper Park, above indicated as being under the jurisdiction of P. C. Barnard Hervey. Mr. Finlayson will be assisted by Thomas McNaughton, Divisional Fire Inspector.

A number of other officials of the Dominion and Provincial Governments have been appointed officers of the Board and will assist the above-named superior field officers in carrying on this work. The superior field officer in each case will notify the superintendent of your company of the name, title and jurisdiction of the subordinate field officer or officers responsible for the inspection of fire work in his district.

GENERAL PROVISIONS

So far as practicable, the work of patrol has been combined with the other regular duties of your employees, but, where this action has not been specifically indicated, the patrol force is to be a specially organized and specially supervised body of men, who shall perform, to the

exclusion of other duties, the patrol and other fire-protective work indicated in the regulations of the Board and specified herein.

In every case where special or section patrols are required special instructions must be issued and special supervision must be provided by the company.

As a matter of record, velocipede and power speeder patrolmen passing telegraph stations shall be reported the same as passing trains, and such records shall be freely open to the inspection of any authorized officer of the Board. Where there are no regular registering points for trains, registering points shall be established and each patrolman shall be required to register in a small book placed at some convenient point at or near each end of his beat.

Each foot patrolman shall be equipped with one shovel and one canvas bucket. Each velocipede patrolman shall be equipped with two shovels, two canvas buckets and one axe. In addition to the above, and to the regular section equipment, there shall be stored at the tool-house for each section in each patrol district the following emergency fire-fighting equipment: one axe, three mattocks, and four buckets of not less than twelve quarts capacity each. Equipment for the transportation of patrolmen shall also be furnished by the company as indicated.

The object sought to be obtained by the regulations of the Board and by the instructions issued under them, is the prevention of railway fires. It is desired to avoid, so far as possible, the imposition of unnecessary expense upon railway companies, and it is fully realized that the danger of fire will necessarily vary between wide limits during the long season prescribed by the regulations. There is no doubt that a very efficient system of fire patrol can be established at a minimum of expense if proper provision is made for increasing or decreasing the force as conditions may require or permit. To this end, an average patrol force has been prescribed, with which to begin work, and the various fire inspectors appointed by the Board have authority to waive the requirements wholly or in part, from time to time, as may be practicable, it being understood that the company will immediately restore such patrol upon request of the Board's representative.

In order to make the system properly effective, it is essential also that your general superintendents be authorized and directed to furnish additional men for patrol work from time to time, as requested by the superior field officer of the Board having jurisdiction.

It is essential also that the necessity be impressed upon your employees of complying in the utmost good faith with the provisions of Regulation 13 of General Order 107. In particular, sectionmen should be instructed that they must give the same attention to fire that they do to the safety of the track. On this basis, it is believed that further damage by railway fires can be very greatly reduced in the future, at a minimum of cost to the company.

Yours very truly

CLYDE LEAVITT

Chief Fire Inspector, B.R.C.

CANADIAN PACIFIC RAILWAY (WESTERN LINES)

MANITOBA DIVISION

On the Fort William, Ignace and Kenora subdivisions, between Fort William and Whitemouth, 365.5 miles; on the Arborg subdivision, between Teulon and Arborg, 36.7 miles; and on the Lac du Bonnet subdivision, between Molson and Lac du Bonnet, 21.5 miles, patrol by sectionmen; minimum of one round trip per day, including Sundays. On the Lac du Bonnet subdivision, particular care shall be exercised after the passing of each train in the day time. On portions of the above lines where no trains are operated on Sundays, special Sunday patrol will not be required.

ALBERTA DIVISION

Laggan Subdivision—Seven men with velocipedes, to be distributed as follows: Between Bow River bridge at mileage 53.2 and Canmore, 14.1 miles; between Canmore and Bankhead, 12.2 miles; between Bankhead and mileage 89, 9.7 miles; between mileage 89 and Castle, 9.7 miles; between Castle and mileage 108, 9.8 miles; between mileage 108 and Laggan, 8.6 miles; between Laggan and Stephen, 5.9 miles. Minimum patrol, so far as possible, of two round trips per day, one in the forenoon and one in the afternoon. Between Stephen and Field, 14 miles, one man, to work on foot or ride on pushers, as may be most practicable; this patrol to be supplemented by tunnel watchmen and section crews.

Crowsnest Subdivision—Between Burmis and Hillcrest, 5.4 miles, one foot patrolman, who may also be watchman or track walker. Between Frank and Sentinel, 9.4 miles, one man with velocipede. Between Sentinel and Crowsnest, 5.3 miles, one foot patrolman, who may also be track walker.

Cranbrook Subdivision—Between Crowsnest and Loop tunnel at mileage 5.1, 5.1 miles, one foot patrolman. Between mileage 5.1 and Cranbrook, 93.9 miles, six men with velocipedes, distributed as follows: Between Loop tunnel at mileage 5.1 and Wardrop, 15.4 miles; between Wardrop and Fernie, 15.4 miles; between Fernie and Courier, 12.5 miles; between Courier and Jaffray, 18.5 miles; between Jaffray and Tokay, 13.7 miles; between Tokay and Cranbrook, 18.4 miles.

Sirdar Subdivision—Between Cranbrook and Kootenay Landing, 83 miles, 5 men with velocipedes, as follows: Between Cranbrook and Moyie, 19.8 miles; between Moyie and Yahk, 20.9 miles; be-

tween Yahk and Kitchener, 14.7 miles; between Kitchener and Creston, 12.1 miles; between Creston and Kootenay Landing, 15.5 miles.

Kimberley Subdivision—Between Cranbrook and Marysville, Kimberley and the end of the track, 21.2 miles, one man with velocipede, one round trip per day. An additional foot patrol shall be maintained between mileage 10 and 15, should such action become necessary in the judgment of the divisional fire inspector at Cranbrook.

Waldo Subdivision—Between Caithness and the end of the track south of Waldo, approximately 10.7 miles, one man with velocipede, who shall also patrol the spur from branch line to Bain lake, a distance of approximately 2.5 miles; to patrol thirty minutes after each train.

Fort Steele Subdivision—Between Colvalli and Fort Steele, 23 miles, one man with velocipede, to patrol continuously. As new line is put under operation, an equivalent patrol shall be established and maintained, as directed by the divisional fire inspector at Cranbrook.

Kingsgate Subdivision—Between Yahk and Kingsgate, 10.5 miles, one man with velocipede.

BRITISH COLUMBIA DIVISION

District No. 1

On the Mountain subdivision (between Field and Revelstoke, 130.3 miles), the Shuswap subdivision (between Revelstoke and Kamloops, 129.1 miles), the Okanagan subdivision (between Sicamous and Okanagan Landing, 50.8 miles), and on the Arrow Lake subdivision (between Revelstoke and Arrowhead, 27.4 miles), patrol by sectionmen, track walkers, and watchmen, with a minimum patrol of one round trip per day, including Sundays. No special patrol is required between Chase and Kamloops on the Shuswap subdivision, and between Mara and Okanagan Landing on the Okanagan subdivision. The above is based on the assumption that oil will be used exclusively as locomotive fuel during the fire season, and that the right-of-way will be maintained in a condition free from inflammable material, as required by Section 297 of the Railway Act. Should either of these conditions not be fulfilled to the satisfaction of the fire inspector for the railway belt, or should additional fire hazards be found to exist on account of conditions resulting from tunnel construction or double tracking or main line diversions not adequately protected against fire by the above measures, such additional measures shall be taken by the company as shall be prescribed by the fire inspector for the railway belt. These additional measures may include any of the special meas-

ures relating to the above portion of the line enumerated in patrol letter to the company dated June 15, 1912. In particular, a special patrol shall be provided by the company, following thirty minutes after any coal-burning locomotive passing over any portion of District No. 1 in the daytime.

District No. 2

Thompson Subdivision—Between Drynoch and North Bend, 42.3 miles, patrol by sectionmen, track walkers and watchmen; minimum of two round trips per day, including Sundays.

Nicola Subdivision—Between the water tank at mileage 15 and Nicola, 32 miles, patrol by sectionmen, track-walkers and watchmen; minimum of two round trips per day, including Sundays.

Cascade Subdivision—Between North Bend and Waleach, 53.4 miles, four men with velocipedes, distributed as follows: Between North Bend and mileage 14, 14 miles; between mileage 14 and Yale, 13.1 miles; between Yale and Hope, 13 miles; between Hope and Waleach, 13.3 miles.

Whenever oil shall be used exclusively as locomotive fuel on any portion of the above lines, and satisfactory compliance with Section 297 of the Railway Act shall have been secured, relief will be granted in whole or in part from the above special requirements, upon application to the fire inspector for the railway belt.

District No. 3

Procter Subdivision—Between Nelson and Procter, 20.4 miles, patrol by sectionmen, track-walkers and watchmen; minimum of one round trip per day. An additional patrol shall be made, following thirty minutes after each train running from Nelson to Procter in the day time.

Lardo Subdivision—Between Lardo and Gerrard, 33.2 miles, one man with velocipede, to patrol thirty minutes after each train.

Two patrolmen with velocipedes shall be substituted for the above should such action at any time become necessary, in the judgment of the divisional fire inspector at Nelson.

Boundary Subdivision—Between Nelson and Castlegar, 25.7 miles, patrol by sectionmen, track-walkers and watchmen; minimum of one round trip per day. Between Castlegar and Shields, 13.3 miles, one man with velocipede. Between Shields and mileage 41.8, 2.8 miles, one foot patrolman, who may also be bridge watchman. Between mileage 41.8 and mileage 50, 8.2 miles, one foot patrolman. Between mileage 50 and mileage 55, 5 miles, one man with velocipede, who may

also be bridge watchman. Between mileage 55 and Paulson, 7.4 miles, one foot patrolman. Between Paulson and Coryell, 4 miles, one man with velocipede, who may also be bridge watchman. Between Coryell and mileage 74, 7.6 miles, one foot patrolman. Between mileage 74 and Cascade, 7.9 miles, one foot patrolman. Between Cascade and mileage 92.3, 10.4 miles, one man with velocipede. Between mileage 92.3 and Grand Forks, 2.5 miles, one foot patrolman, who may also be bridge watchman. Between Grand Forks and Fisherman, 5.6 miles, one man with velocipede, who may also be bridge watchman. Between Fisherman and Eholt, 8.4 miles, one foot patrolman. Between Eholt and Greenwood, 8.5 miles, one man with velocipede. Between Greenwood and Midway, 9.3 miles, one man with velocipede. Between Greenwood and Mother Lode Mine, 6.3 miles, one foot patrolman, who may also be bridge watchman. Between East Granby and Granby Smelter, 2.2 miles, one foot patrolman, who may also be bridge watchman.

Slocan Subdivision—Between South Slocan and Perry, 23.4 miles, one man with velocipede to patrol thirty minutes after each train. Between Perry and Slocan City, 7.9 miles, patrol by sectionmen and other regular employees, with a minimum of one round trip per day, to follow as closely as possible thirty minutes after each train passing over the line in the day time.

Phoenix Subdivision—Between Eholt and Athelston, 5.5 miles, and between Coltern and B.C. Mines, 2.4 miles, total 8 miles, one foot patrolman. Between Reffek and Athelston, 3.1 miles, and between Athelston and Phoenix, 4.2 miles, total 7.3 miles, one foot patrolman.

Rossland Subdivision—Between Castlegar junction and Smelter junction, 18.7 miles, one man with velocipede. Between Smelter junction and Rossland, 10.6 miles, one foot patrolman. An additional foot patrolman shall be assigned should such action become necessary at any time in the judgment of the divisional fire inspector at Nelson.

Nakusp Subdivision—Between Nakusp and Sandon, 40.7 miles, three men with velocipedes to patrol thirty minutes after each train, as follows: Between Nakusp and Summit Lake, 12.7 miles; between Summit Lake and Rosebery, 15.7 miles; between Rosebery and Sandon, 12.3 miles.

Kaslo Subdivision—Between Three Forks and Kaslo, approximately 25 miles, one man with power speeder.



TANK CAR CONSTRUCTED BY THE GRAND TRUNK RAILWAY

For use in extinguishing forest fires along the railway line between Ottawa and Depot Harbour, Ontario, with especial reference to the protection of Algonquin Park.



THE ABOVE TANK CAR BEING TESTED

The pressure is furnished by the locomotive which moves the car from place to place. From one to four streams of water can be thrown at once. Extra lengths of hose enable fires to be extinguished at a distance from the track. The railways have greatly improved the efficiency of their fire protection work.

LINES UNDER CONSTRUCTION

Kootenay Central

Between Golden and mileage 9 south, 9 miles, one man with velocipede, to patrol thirty minutes after each train running over the line in the day time.

Between Fort Steele and the southern boundary of the railway belt, one patrolman on foot or horseback for each ten miles of the line under construction; provided, however, that if a co-operative agreement shall be entered into between the company and the Lands Department of the province of British Columbia, whereby the patrol along this portion of the line is to be handled by said Department of Lands, such arrangement shall be considered a satisfactory substitute for the special patrols above enumerated.

Under the preceding requirement, an arrangement was entered into between the railway company and the provincial Department of Lands, by which the following system of patrols was maintained along the line under construction between Fort Steele and Spillimacheen, 104 miles: Between Fort Steele and Skookumchuck, 24 miles, one patrolman with hand speeder; between Skookumchuck and Canal Flats, 23 miles, one mounted patrolman; between Canal Flats and Goldie Creek, 25 miles, one mounted patrolman; between Goldie Creek and Edgewater, 18 miles, one mounted patrolman; between Edgewater and Spillamacheen, 20 miles, one patrolman on hand speeder. As soon as track laying was completed, the mounted patrols were replaced by speeder patrolman with approximately same mileage to patrol.

As a result of conferences between representatives of the railway company and the fire inspection staff of the Board in the field, power speeder patrols were substituted early in the season for nearly all of the velocipede patrols prescribed in the above letter for the Laggan, Cranbrook and Sirdar subdivisions of the Alberta division, and the Procter, Lardo, Slocan, Boundary, Phoenix, Rossland, Nakusp, Sandon and Kaslo subdivisions of the British Columbia division.

GRAND TRUNK PACIFIC RAILWAY

LAKE SUPERIOR DIVISION

Between Dona, Ont., and the Ontario-Manitoba boundary, 331.2 miles, special patrol by the section force and other regular employees, with a minimum of one round trip per day. The work of these men shall be supervised by a competent man, with power speeder, who

shall devote his whole time to the supervision and inspection of the patrol and other fire protective work of the section crews. Between the Ontario-Manitoba boundary and Elma, Man., 35 miles, one man with power speeder.

MOUNTAIN DIVISION

Between Edmonton and Entwistle, Alberta, 66.1 miles, section patrol. Between Entwistle and Peers, 43.6 miles, one man with power speeder.

On the Alberta Coal Branch, three men with power speeders as follows: Between Bickerdike and Coalspur, 37 miles; between Coalspur and Lovett, 19.5 miles; and between Coalspur and Mountain Park, approximately 30 miles.

Between Peers and Galloway, 39.7 miles, one man with power speeder; between Galloway and Dyke, 40.8 miles, one man with power speeder; between Dyke and Pocahontas, 18 miles, one man with velocipede; between Pocahontas and Jasper, 26 miles, one man with power speeder; between Jasper and Yellowhead, 17 miles, one man with velocipede.

Between Yellowhead and Shelley, B.C., 225.3 miles, five men with power speeders, as follows: Between Yellowhead and Albreda, 44.8 miles; between Albreda and McBride, 45.4 miles; between McBride and Kidd, 50.8 miles; between Kidd and Dewey, 40.4 miles; between Dewey and Shelley, 43.9 miles. Between Shelley and the end of steel, as it is laid in a westerly direction, an equivalent patrol shall be maintained, as directed by the divisional fire inspector having jurisdiction. Between the end of steel which is being laid westerly from Prince George, and the end of steel which is being laid easterly from Wordsworth, one foot patrolman shall be assigned for each ten miles of the line under construction: provided, however, that if a co-operative agreement shall be entered into between the company and the Lands Department of the Province of British Columbia, whereby the patrol along this portion of the line is to be handled by said Department of Lands, such arrangement shall be considered a satisfactory substitute for the special patrols above enumerated.

As track-laying is completed on the two portions of the line between Shelley and Rose Lake, power speeder patrols shall be established by the company, on the basis of one man for each 40 to 50 miles of track, as directed by the divisional fire inspector having jurisdiction.

Between Rose Lake and Amsbury, 215.3 miles, four men with power speeders, as follows: Between Rose Lake and Knockholt, 55.6 miles; between Knockholt and Beament, 50.1 miles; between Beament

and Cedarvale, 54.2 miles; between Cedarvale and Amsbury, 55.4 miles. Between Amsbury and Prince Rupert, 85 miles, patrol by sectionmen, track-walkers and watchmen.

GREAT NORTHERN RAILWAY (BRITISH COLUMBIA)

CASCADE DIVISION (OIL FUEL)

Between Vancouver and the International boundary, 36.2 miles; between Guichon and the International boundary via Cloverdale, 46.5 miles; between Fraser River junction and Hazelmere, 20.3 miles; and between Kilgard and Abbotsford, 5 miles; patrol by sectionmen, track-walkers and watchmen. Should coal fuel be used, special patrol to follow twenty minutes after each train.

MARCUS DIVISION

Second District—Between Waneta and Troup junction, 54.2 miles, two men with power speeders.

Third District—Between Laurier and Grand Forks, 14.4 miles, one man with power speeder; between the International boundary at mileage 66 near Midway and the International boundary at mileage 95.3 near Bridesville, 29.3 miles, one man with power speeder supplemented by sectionmen if necessary.

Fifth District—Between Rossland and mileage 12.3, 5 miles, one foot patrolman; between mileage 12.3 and Paterson, 3.9 miles, one foot patrolman.

Sixth District—Between Grand Forks and Phoenix, 23.8 miles, patrol as follows: Between Spencer and mileage 11, 4.4 miles, special section patrol to follow all trains; between mileage 11 and mileage 15, 4 miles, one foot patrolman; between mileage 15 and mileage 19.5, 4.5 miles, one foot patrolman; between mileage 19.5 and Phoenix, 4.3 miles, one foot patrolman.

Seventh District—Between Chopaka and Coalmont, 69.9 miles, one man with power speeder. On the line under construction between Coalmont and Otter Summit, approximately 32 miles, three foot patrolmen with approximately equal mileages. On the completion of this line, such power speeder patrols shall be established as shall be prescribed by the district fire inspector.

KALISPELL DIVISION

Between Michel and the International boundary at mileage 72.67, near Gateway, 72.67 miles, three men with power speeders as follows:

Between Michel and Fernie, 20.9 miles; between Fernie and Mott, 23.77 miles; between Mott and the International boundary near Gateway, 26 miles.

SPOKANE DIVISION

Between Port Hill and Wynndel, 12.1 miles, special section patrol to follow twenty minutes after each train.

KETTLE VALLEY RAILWAY (BRITISH COLUMBIA)

Between International boundary and Lynch Creek, approximately 24 miles, section patrol; between Midway and Carmi, approximately 46 miles, section patrol; between Carmi and Hydraulic summit, approximately 30 miles, two foot patrolmen with equal mileage; between Hydraulic summit and Cañon creek, 11 miles, one foot patrolman.

As soon as track is ballasted between Carmi and Cañon creek, 41 miles, the patrols specified for this part of the line shall be replaced by one foot patrolman between Carmi and Arlington lake, approximately 10 miles, the balance of the section, that is, between Arlington lake and Cañon creek, approximately 31 miles, to be patrolled by sectionmen.

Between Cañon creek and Sawmill creek, 11 miles, one foot patrolman: between Sawmill creek and the long tunnel at mile 104 west of Midway, approximately 15 miles, one foot patrolman, to be replaced by section patrol when track laid and ballasted to Sawmill creek. Between the long tunnel at mile 104 west of Midway and Pentiction, approximately 20.5 miles, patrol by sectionmen; between Pentiction and Osprey lake, approximately 39 miles, patrol by sectionmen: between Osprey lake and Christina creek, approximately 20 miles, patrol by two foot patrolmen with equal mileages; between Merritt and Otter Summit, approximately 30 miles, patrol by sectionmen.

Power speeder shall follow twenty minutes after all trains over operated portions. Between Coquihalla summit and Hope, approximately 35 miles, two mounted patrolmen, patrol to be carried on continuously between Hope and the summit. Patrols to be divided as follows: One man between Hope and Boston Bar creek and one man between Boston Bar creek and Coquihalla summit.

ESQUIMALT AND NANAIMO RAILWAY (VANCOUVER ISLAND, B.C.)

As oil fuel is used on the locomotives of this line, it is deemed unnecessary to prescribe special patrols. In view, however, of the

existence of other sources of railway fire danger than sparks from the locomotive stacks, it is considered necessary to require that you provide a patrol of not less than one round trip per day over the various portions of your line, through the sectionmen or other regular employees. This requirement shall include the line between McBride junction and Courtenay, 45 miles, as soon as this line shall be placed under operation.

Should any coal burning engine be operated over any portion of your line, a special patrol following thirty minutes after such engine shall be provided.

VICTORIA AND SIDNEY RAILWAY (VANCOUVER ISLAND, B.C.)

The requirement with regard to the establishment of a specially organized force of employees, who shall devote all, or a considerable portion of their time to fire protection work, is waived, on the basis of the performance by the company of the following requirements:

Between Victoria and Royal Oak, 5.5 miles, no special patrol will be necessary.

Between Royal Oak and Sidney, 12.7 miles, two patrols each day by sectionmen or other employees to be designated by company.

Locomotives to be equipped with 150 feet of one-inch hose, with facilities for attaching to injector feed pipe.

Engineers to watch out for fires along track, train crews to extinguish fire discovered if possible; if not possible for train crew to extinguish, to stop and notify nearest section foreman, who shall immediately proceed to fire.

The company shall make arrangements with the city water station at Elk Lake, and with persons having telephone service at Keating, Saanichton, at Basin Bay Brick Co., and with James A. Johns, and with a resident in the vicinity of Elk Lake, under which arrangement the section foreman or the Victoria office of the company will be notified immediately of any fire discovered burning along the right-of-way.

EDMONTON, DUNVEGAN AND BRITISH COLUMBIA RAILWAY (ALBERTA)

Between Edmonton and mileage 65, 65 miles, patrol by sectionmen. Between mileage 65 and Athabaska Crossing, 65 miles, three men with velocipedes with approximately equal mileage.

As the steel is laid westward from Athabaska Crossing, an equivalent velocipede patrol shall be established and maintained by the company.

Between the end of steel and the western limit of construction work, one special patrolman shall be assigned for each 15 miles of the right-of-way through forest country upon which construction work is

being carried on. These patrolmen shall so far as possible be mounted, but where this action is not practicable a foot patrol shall be maintained.

CANADIAN PACIFIC RAILWAY (EASTERN LINES)

ATLANTIC DIVISION

Bay Shore Subdivision—Between St. John and St. Stephen, 83.7 miles, special patrol by sectionmen, or by special patrolmen at option of company.

Fredericton Subdivision—Between Fredericton Junction and Fredericton, 22.15 miles, one man with velocipede.

St. Andrews Subdivision—Between Watt junction and Chamcook, 23.11 miles, patrol by sectionmen.

St. Stephen Subdivision—Between McAdam junction and St. Stephen, 33.91 miles, one man with power speeder.

Woodstock Subdivision—Between McAdam junction and Canterbury, 22.47 miles, one man with power speeder.

Tobique Subdivision—Between Perth Junction and Plaster Rock, 27.49 miles, one man with velocipede.

Gibson Subdivision—Between Newburg and Millville, 20.63 miles, and between Millville and Keswick, 26.59 miles, one man with power speeder.

LINES IN QUEBEC

Moosehead Subdivision—Between Boundary and Megantic, 16.26 miles, one man with velocipede.

EASTERN DIVISION

Megantic Subdivision—Between Megantic and Scotstown, 25.00 miles, one man with velocipede.

Laurentian Subdivision—Between Nominig and Mont Laurier, 34.47 miles, two men with velocipedes with approximately equal mileages.

Waltham Subdivision—Between Davidson and Fort Coulonge, 1.94 miles, patrol by sectionmen.

Timiskaming Subdivision—Between Mattawa and Timiskaming, 37.5 miles, two men with velocipedes.

Kipawa Subdivision—Between Timiskaming and Kipawa, 10.5 miles, one patrolman.

GRAND TRUNK RAILWAY

Province of Quebec—Between Lyster and Methot Mills, 17.84 miles, one man with velocipede; between Walker's Cutting and St. Gregoire, 26.75 miles, patrol by track-walkers and other employees of the company.

Province of Ontario—Between Pembroke and Depot Harbour, 199.79 miles, and between Washago and North Bay, 128.7 miles, patrol by sectionmen.

CANADIAN NORTHERN ONTARIO RAILWAY

Between Sudbury and Severn River, 153.6 miles, and between Sudbury and Ruel, 70.9 miles, patrol by sectionmen.

CANADIAN NORTHERN QUEBEC RAILWAY

Between Arundel and St. Sauveur, 20 miles, two men with power speeder, to make two round trips per day, once in the forenoon and once in the afternoon. This patrol to be made only on week days unless trains shall be run over the line in the day time on Sundays, in which event the company shall provide a special patrol following each train.

Between Rivière-à-Pierre and Hervey junction, 21 miles, two men with velocipedes, to make a minimum patrol of two round trips per day, including Sundays, once in the forenoon and once in the afternoon.

TEMISCOUATA RAILWAY

Between Whitworth and Ste. Rose, Que., 44.2 miles, special section patrol following all trains, with minimum patrol of two round trips per day.

On the balance of the line in Quebec and New Brunswick, the issuance of special instructions to employees will be considered satisfactory.

VELOCIPEDA VS. POWER SPEEDER PATROLS

There has been considerable discussion as to whether, everything considered, the best results are secured by equipping special patrolmen with track velocipedes or with power speeders. In the first case, using a velocipede, the patrolman must furnish his own motive power, by pumping the machine, and can, on an average, cover a beat of about twenty miles of track, making one round trip per day, or about ten miles if two round trips are required. In the second case, using a power speeder, the motive power is a gasolene engine, and the patrolman can, on an average,

cover at least twice as much mileage as a velocipede patrolman. This would be about forty miles of track, where one round trip per day is to be made, or twenty miles, where two round trips are required.

Patrol by men with velocipedes is preferred by the Canadian Northern railway, on the basis of both efficiency and economy. It is argued that velocipede patrols are much more reliable, since the machines do not get out of order, as is frequently the case with power speeders. At the relatively low rate of wages paid patrolmen, it is often very difficult to secure men with sufficient mechanical ability to keep power speeders in running order, and the interruption of a patrol at a critical time in the dry season may result in a fire doing more damage than the total cost of all patrols for many years. It is argued, further, that without a gasoline engine on which to spend his time in making adjustments and repairs, the velocipede patrolman can put in about half of his time during the fire season in clearing up bad places along the right-of-way, thus reducing the actual cost of fire patrol to a lower figure than is practicable in the case of the power speeder patrolman. The fire inspector for the Canadian Northern railway maintains that, when the above points are fully considered, and the first cost and annual depreciation of velocipedes and power speeders compared, the velocipede patrol is cheaper in the long run, where the grades are not too heavy to make such action impracticable.

On the other hand, there has been a strong tendency toward the use of power speeders on the Great Northern, Canadian Pacific and Grand Trunk Pacific railways, and their use has in general been approved by the British Columbia Forest Branch, notwithstanding some individual instances of failure due to the engine getting out of order.

The following extracts from a report by W. C. Gladwin, Assistant Provincial Fire Inspector for British Columbia, are of interest in this connection:

The most essential points in favour of power speeder patrol are these: First, a patrolman on a power speeder can keep within fifteen to twenty minutes of the train he is following, whether the grades are heavy or easy. He can carry tools to extinguish a fire that would equip four men and can carry a chemical fire extinguisher on his machine.

Second, if he discovers a fire that is too large for him to extinguish he can get quickly to where he can get help, and can carry two or three men besides himself back to the fire. This done quickly means everything in fire-fighting.

Third, he can cover and patrol more efficiently a district two or three times larger than a hand speeder patrolman can, and not be nearly so fatigued.

The following extracts from other reports by Mr. Gladwin throw additional light upon both advantages and disadvantages of



RAILWAY FIRE PATROLMAN WITH VELOCIPEDE

One man can in this way patrol about twenty miles of track, making one round trip per day, or ten miles of track if two round trips per day are required.



RAILWAY FIRE PATROLMEN WITH POWER SPEEDER

Such a patrol can cover about 40 miles of track, making one round trip per day, or 20 miles making two round trips. Ordinarily, these patrols are handled by one man, though in some cases two men work together as shown here.

power speeder patrols, as carried out during 1914 in southern British Columbia:

Great Northern Railway Power speeder patrolmen not capable, and unable to keep speeder in repair. Example:—August 1, speeder broke down. Patrolman stayed at Elko all day, the worst day for fires in four years. The northbound passenger started six fires between Baynes and Elko. They had to be looked after by Forest Branch officials. The next day the town of Elko was threatened, costing the Forest Branch several hundred dollars to control it.

In the early period of the dry season, a power speeder patrol can properly look after twenty-five to forty miles of track. As the danger increases, extra special foot patrolmen or hand speeder patrolmen should be placed in the most dangerous sections, supplemented again, as the hazard increases, by patrolmen sent out from section crews to inspect the most dangerous spots in their sections where a fire would probably start. Some days, when fires seem to start by the least little cause, a foot patrolman to every mile would pay in the long run.

When their speeders broke down and it was neglected to send a man out from the section crews, any fires that were started by sparks from locomotives did damage and generally cost a considerable sum to put out. Incident:—May 22, a fire was started on the right-of-way between Salmo and Ymir by passing freight train. The power speeder was broken and patrolman did not follow this train. The section foreman neglected to send out foot patrol from his crew to follow this freight. The patrolman following the passenger train some hours after discovered the fire and the result was that two section gangs and two Forest Branch officials worked ten hours to extinguish it.

Arrangements were also made that, in case the patrolman on power speeder did not appear within his time, the patrol was taken up by a man from the section crew who would follow the train. This was effective.

Another system they tried out proved effective. The patrolman on power speeder in a dangerous country for fires would, as he came to a section crew, take one of them with him, and if a fire was discovered he would put the sectionman off to put it out. If no fires were discovered, he would carry this man to the section boundary and drop him off, and he would walk back to his crew, and so on with each section crew, making practically a double check. This system they intend to adopt next season.

From Chopaka to Princeton, the power speeder patrol did not prove effective owing to the machine breaking down frequently. Whether this was the fault of not having a practical man in charge or not, is not known. Fires were started by locomotives and were not properly attended to by the employees of the company, causing considerable damage to standing timber. The engines were properly equipped with fire protective appliances, and were inspected frequently. The situation got so grave that the railway company put on an oil-burning locomotive, and no fires were started afterwards.

Canadian Pacific Railway Patrols were well maintained and relief granted when and where necessary. The patrolmen equipped with power speeders demonstrated that they could take care of a much larger section, and give more efficiency than patrolmen equipped with hand speeders, giving forty miles of a patrol and close inspection where the grades are easy and danger from fire not great. Also that the patrol should follow all trains not later than twenty minutes. Fires inside that time would not as a general rule be beyond control.

Results show that during a season that is not counted as extra dangerous a power speeder patrolman can effectively cover a patrol of thirty-five miles in length, going a round trip per day. During a spell of weather when the danger of fire is great, experience shows that the patrol should be doubled and all trains during the daytime followed as close as ten to fifteen minutes. On one occasion the company had forty men on the fire exactly twenty minutes after the train that started the fire had passed. Conditions were so dry and dangerous that the fire had spread beyond control. It was also found necessary to put on, besides the extra power speeder patrol, a foot patrolman to watch extra dangerous localities. This proved effective.

When patrolman followed trains within the prescribed time the patrol proved good, but when behind time more than thirty minutes, fires got away beyond control. Two destructive fires reported as originating from sparks from locomotives got beyond control, costing large amount to control them. Estimated damage, \$90,000. At present the cause of these fires is disputed by the railway company.

Kettle Valley Railway Excellent co-operation and results were secured from this company during construction. A great part of this line is built through splendid timber. The right-of-way was cleared and burned properly, and, although this is in the dry belt, no fires escaped from the right-of-way clearing, which furnishes a splendid example of what can be done by a close and rigid inspection. Another aspect of this railway building is that this line passes through the watersheds of four large irrigation systems, and, owing to the very close patrol supervision, not an acre was burned over, although the danger from camp fires of men looking for work was very great.

SUMMARY OF FIRE REPORTS

The fire season of 1913 was marked by relative freedom from serious fires, on account of the generally satisfactory distribution of rain. However, the season of 1914 was the most serious in many years in Ontario, Alberta and British Columbia and in the western portion of Quebec, dry spells of almost unprecedented severity occurring in both spring and autumn. In Nova Scotia, New Brunswick and the eastern half of Quebec the climatic conditions were such that very

little trouble from fire was experienced. The losses caused by fire over the whole Dominion were considerable, and there is no doubt that the losses along railway lines would have been very much greater had it not been for the preventive measures taken by the railways and by the Dominion and provincial agencies co-operating with them.

The accompanying statements show all the information available with regard to fires in forest sections, originating within 300 feet of railway tracks, during the seasons of 1913 and 1914. Many incipient fires were extinguished in both years, of which the record is incomplete. Figures are not available as to fires in agricultural sections.

The information available as to the situation in eastern Canada in 1913 is very much less satisfactory than that relating to the west, partly on account of delay in organizing the eastern work in that year, and partly on account of insufficient inspection having been provided by the provincial governments which have co-operated with the Board. On account of incomplete organization in Ontario, it was not practicable to secure information relative to some of the fires which occurred during that year, particularly in the Muskoka section. This situation was greatly improved in 1914, and promises to be very efficiently handled during 1915.

In general, it may safely be stated that the results which have been secured from the co-operative handling of the railway fire-protection work have been admirable. The occurrence and spread of railway fires has, beyond the possibility of a doubt, been greatly reduced. There is every reason to believe that the efficiency of the work will be still further increased during the coming year, through the extension and increased efficiency of the inspection staffs to be made available by the various co-operating agencies, especially in eastern Canada. For the most part, full credit must be given the railways for the fine attitude they have shown toward the work of the fire inspection department, and for their very general endeavor to comply honestly with the various requirements.

It is reported that, in 1913, no-fires originated within 300 feet of the track in the case of the following railways: White Pass and Yukon, Esquimalt and Nanaimo, Atlantic, Quebec and Western, Quebec Oriental, Rutland, Temiscouata, Central Railway of Canada, Western Canada Power Company.

On account of incomplete organization at that time, no information is available as to the fire situation in 1913 along the following lines, which operate at least in part through forest sections: Algoma Central and Hudson Bay, Algoma Eastern, Central Ontario, Dominion Atlantic, Elgin and Havelock, Moncton and Buctouche, St. Martins,

Cumberland Railway and Coal Company. Fairly satisfactory information was, however, secured during 1914, as to these lines.

No fires were reported during 1914 as originating within 300 feet of the track, along the Quebec Oriental, Atlantic, Quebec and Western, Quebec, Montreal and Southern, and Salisbury and Albert railways.

The following lines do not operate to any material extent through forest sections and fire statistics have accordingly not been secured: Bay of Quinte, Brockville, Westport and Northwestern, Klondike Mines, Michigan Central, Ottawa and New York, Pere Marquette, Schomberg and Aurora, Thousand Islands, Oshawa, Toronto, Hamilton and Buffalo, Wabash, Essex Terminal.

Summary of Reports on Fires in Forest Sections Originating within 300 feet of Track on Railway Lines Subject to the Jurisdiction of the Board of Railway Commissioners for Canada, Season of 1913

	Canadian Pacific (Western Lines)*	Canadian Northern	Grand Trunk Pacific	Great Northern	Kettle Valley	Edmonton, Dunvegan and British Columbia	Canadian Pacific (Eastern Lines)	Canadian Northern Ontario	Canadian Northern Quebec	Grand Trunk	Quebec, Montreal and Southern Junction	Miscellaneous†	Total
Number of fires reported as starting within 300 feet of track.....	202	190	43	28	15	5	43	9	31	93	42	8	709
Causes of fires:													
(a) Trains	163	93	18	22	...	...	34	3	...	30	...	2	365
(b) Tramps, etc., and camp fires	20	17	3	2	2	...	...	...	...	1	...	1	46
(c) Other known causes	4	42	15	1	13	5	8	1	...	...	...	1	90
(d) Unknown	15	38	7	3	...	...	1	5	...	62	...	...	131
(e) Not reported .....	...	...	...	...	...	...	...	...	31	...	42	4	77
Acres burned over by fires outside right-of-way:													
(a) Grass or cultivated land	141	129	31	70	17	...	...	...	2	89	...	7	463
(b) Young forest growth	15	126	1,115	8	40	40	13,337	1,384	3	3,897	...	40	19,982
(c) Timber land	3	25	500	109	...	305	...	...	...	...	...	3	945
(d) Slashing or old burn not re-stocking .....	...	40	18	60	...	...	...	...	...	...	...	...	118
(e) Total	159	320	1,664	247	17	345	13,337	1,384	5	3,986	...	50	21,514
Value of property destroyed:													
(a) Young growth	\$30	\$610	\$5,300	...	\$105	\$120	\$10,970	\$1,240	...	\$4,860	...	...	\$23,235
(b) Standing timber .....	...	\$1,200	\$5,000	\$110	...	\$900	...	...	...	...	...	...	\$6,910
(c) Forest products in process of manufacture .....	...	...	...	...	...	...	...	...	...	...	...	...	...
(d) Railway property not covered in above .....	...	...	...	...	...	...	...	...	...	...	...	...	...
(e) Other private property not covered in above .....	...	...	...	...	...	...	...	...	...	...	...	...	...
(f) Total	\$30	\$1,810	\$10,300	\$110	\$105	\$720	\$10,970	\$1,240	\$6,428	\$4,860	\$4,014	...	\$10,442
									\$6,428	\$4,860	\$4,014	...	\$40,587

*Includes Esquimalt and Nanaimo.

†This column includes statistics for the Boston and Maine, Maine Central and Salisbury and Albert railways. No fires reported on Elgin and Havelock, Western Canada Power, and White Pass and Yukon.

Summary of Reports on Fires in Forest Sections Originating within 300 feet of Track on Railway Lines Subject to the Jurisdiction of the Board of Railway Commissioners for Canada, Season of 1914

	Canadian Pacific* (Western Lines)*	Canadian Northern (Western Lines)	Grand Trunk Pacific	Great Northern	Kettle Valley	Edmonton, Dunvegan and British Columbia.	Canadian Pacific (Eastern Lines)	Canadian Northern (Eastern Lines) †	Grand Trunk System	Hudson Bay, and Algonia Central, and Algonia Eastern	Dominion Atlantic	Miscellaneous ‡	Totals
1. Total number of fires originating within 300 feet of track	317	168	126	116	17	250	206	80	27	8	10	21	1,346
2. Number of railway fires by causes:													
(a) Locomotive (sparks and ashpans) ...	223	67	61	110	4	200	87	32	15	1	4	18	822
(b) Carelessness or negligence of railway employees	4	23	11	.....	3	.....	22	11	3	.....	.....	.....	77
(c) Steam shovels, donkey engines, etc. ....	.....	2	2	1	.....	.....	.....	.....	.....	.....	.....	.....	5
3. Number of other than railway fires by causes:													
(a) Tramps, other travellers and camp fires	37	8	20	1	3	50	12	3	.....	2	.....	1	137
(b) Settlers (clearing, etc.)	4	19	17	1	1	.....	17	3	.....	.....	.....	.....	62
(c) Other known causes .....	.....	5	.....	1	1	.....	5	.....	3	1	.....	.....	16
4. Number of fires of which cause is unknown	49	44	15	2	5	.....	63	31	6	4	6	2	227
5. Acres burned over by fires originating within 300 feet of track:													
(a) Grass or cultivated land	1,821	4,742	82	1,741	12	1,020	1,807	252	36	.....	8	8	11,529
(b) Young forest growth	4,261	11,923	2,682	30	75	2,100	2,114	1,387	24,637	.....	.....	117	49,326
(c) Timber land	726	11,044	181	14,156	55	7,421	4,412	1,295	68,205	1	.....	.....	107,496
(d) Slashing or old burn not restocking	6,027	3,123	5,323	497	116	1	3,543	4,235	182	340	31	1	23,419
(c) Total area (a plus b plus c plus d)	12,835	30,832	8,268	16,424	258	10,542	11,876	7,169	93,060	341	39	126	191,770

6. Value of property destroyed, classified by causes:

(a) Locomotives	\$120,795	\$3,168	\$629	\$16,500	.....	\$81,000	\$5,000	\$16,489	\$92,746	\$5	\$5,117	\$336,454
(b) Carelessness or negligence of railway employees .....	.....	1,941	.....	.....	10	.....	5,500	544	40	.....	.....	8,085
(c) Steam shovels, donkey engines, etc. ....	.....	8,800	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,800
7. Value of property destroyed, classified as follows:												
(a) Young growth	2,472	21,114	3,342	2	60	29,400	2,423	703	.....	.....	108	59,624
(b) Standing timber	1,017	89,392	215	16,650	280	59,368	19,859	16,205	.....	1	.....	202,987
(c) Forest products in process of manufacture	113,230	25,000	498	150	.....	13,400	.....	.....	200	.....	.....	152,478
(d) Railway property not covered in above	500	5,161	700	.....	.....	150	552	65	1,230	.....	44	8,402
(e) Other private property not covered in above	5,920	1,829	60	776	.....	.....	1,050	216	.....	.....	100	9,951
(f) Total of above	\$123,139	\$142,496	\$4,815	\$17,578	\$340	\$102,318	\$23,884	\$17,189	\$1,430	\$1	.....	\$252,433,442

*Includes Esquimalt and Nanaimo.

†Includes Canadian Northern Ontario; Central Ontario; Irondale, Bancroft and Ottawa; Canadian Northern Quebec; Quebec and Lake St. John, and Halifax and Southwestern railways. Above statistics do not include that portion of Canadian Northern Ontario railway lines between Pembroke and Capreol, and between Ruel and Port Arthur, under construction.

‡This column includes statistics for the Boston and Maine; Maine Central; Elgin and Havelock; Western Canada Power and White Pass and Yukon.

Instructions to Railway Employees There has been very satisfactory compliance by railway companies with the Board's requirements for the issuance of instructions to employees relative to the reporting and extinguishing of fires along railway lines. The form of instructions issued follows closely, in most cases, the draft prepared by the Board and submitted to the railways for their consideration. While undoubtedly these instructions have not been strictly observed in all cases, their issuance has unquestionably improved the railway fire situation very materially, and this improvement may be expected to continue.

An example of such instructions may be seen at page 70 of this report.

Inspection of Fire Protective Appliances The inspection of fire-protective appliances on locomotives is under the jurisdiction of the operating department of the Board. However, during 1913 and 1914, 28 local officials of the fire inspection department were instructed in this work, in co-operation with the operating department. This makes a total of 33 of the local fire inspectors in this department who have been so instructed. The services of these men in connection with this line of work are especially valuable as to railway lines under construction, and the more remote branches of railways in forest sections, since they supplement materially the regular inspections by operating department officials.

Locomotive Fuel Oil fuel is in exclusive use on 477 miles of the Canadian Pacific railway, on 134 miles of the Esquimalt and Nanaimo railway, and on 115 miles of the Great Northern railway, a total of 726 miles, all in British Columbia. In no case has a definite report been submitted of a fire caused by an oil-burning engine in Canada. The Grand Trunk Pacific railway has announced that during the spring and early summer of 1915, oil-burning engines will be installed on that portion of its lines in British Columbia and Alberta between Prince Rupert and Jasper, a distance of 718 miles. It is expected that this action will materially decrease the danger of fire along this portion of the line. The use of oil fuel is purely voluntary with the railways, and its adoption is dictated altogether by business considerations.

During the past two years, complaints have been received by the Board as to fire danger resulting from the use as locomotive fuel of certain classes of western coals. In order to secure expressions of opinion from all concerned, the Board issued Circular No. 141, under date of January 25, 1915, containing the suggestion that it might be

considered advisable to require a different kind of spark-arresting device, on engines using such coals, than the standard screen prescribed in Regulation 2 of General Order No. 107. The replies received indicated the need for further investigation, and, as a result, the situation will be carefully studied during the coming year, in the hope that some solution of the problem may be found that will cause the least possible hardship to all the interests affected. Both the Commission of Conservation and the Mines Branch of the Department of Mines are co-operating in the investigation, the latter having assisted materially by making a number of analyses of samples of coal from the mines in question.

Right-of-way Clearing

It is fully recognized that the condition of the right-of-way is a very important factor in determining the extent of railway fire hazard. The best evidence indicates that, of locomotive sparks capable of setting fire, a large percentage—though by no means all—fall within a distance of fifty feet from the track, and will thus be within the average railway right-of-way. In many cases where fires burn over lands adjacent to railway rights-of-way, the fires originate in the first place upon the right-of-way, that is, at a distance of fifty feet or less from the track. Dry grass and weeds, bark peelings, or other inflammable matter, if allowed to accumulate upon the right-of-way, enable even very small sparks to start a blaze, which may readily communicate to lands adjacent to the right-of-way containing timber or other property liable to damage or destruction by fire. Fires resulting from cigars and cigarettes thrown from trains, or dropped by pedestrians, as well as fires due to the carelessness of sectionmen, almost invariably start upon the right-of-way.

The importance of rendering the right-of-way as nearly fireproof as practicable thus becomes obvious, not only from the point of view of public policy, but also from a purely selfish interest of the railways themselves, if there be reasonable consideration of potential earnings from passenger and freight traffic, as also of the expense incurred in the litigation and settlement of damage claims.

To maintain the right-of-way reasonably free from inflammable matter, constant attention on the part of railway employees is required. On some railways, or portions of railways, this matter has not received sufficient attention in the past, in part due to the limited staff of sectionmen being fully occupied in keeping the track in order and attending to other duties of an imperative character. In some cases, usually due to crippled financial condition, the debris resulting from the original clearing of right-of-way has never been disposed of. In other cases, provision has been regularly made for the adequate handling of

this work, including disposal of the annual accumulation of dry grass, weeds, etc. Experience has, however, shown that in the case of many railways, a close inspection by the Board assists materially in securing an efficient handling of this work by railway companies. Much attention has accordingly been paid to this matter by the fire inspection department, and probably more progress was made in right-of-way clearing work during 1914 than in any previous year.

Clearing Outside Rights-of-way The problem of railway fire protection through forest sections can never be solved satisfactorily until adequate provision is made for the disposal of inflammable debris on lands immediately adjacent to railway rights-of-way. In most cases the removal of inflammable debris from a strip of even 50 feet outside the right-of-way would decrease the fire hazard materially, though 100 feet would be much preferable.

In no part of Canada thus far has there been an adequate handling of this matter, through both legislative and administrative action. As in other matters of forest protection, however, the situation is most favourable in British Columbia. In that province, under the Forest Act, and the provisions of the new form of license in effect since 1912, much progress has been made in securing the disposal of recent slash along railway lines under construction. The adjacent timber lands are very generally Crown lands, and the cutting operations are, for the most part, by contractors, in connection with securing material for ties and other construction purposes. Here, as also in the case of timber licenses recently issued, there is provision for enforced brush disposal, and the policy has been adopted of safeguarding, so far as practicable, a strip of limited width on both sides of the right-of-way. The situation is very different, however, as to lines constructed before 1912. The timber licenses along these lines of railway are of older standing and they do not contain the effective brush disposal provisions of those issued during the past three years. As a rule, timber lands along these railway lines were cut over years ago, they being naturally among the most accessible. No provision for brush disposal was made, either by the operators or by the provincial government. In most cases, these operations were carried on before the question of brush disposal on lumbering operations was seriously raised in either Canada or the United States. The result is a serious fire hazard, in the form of highly inflammable lumbering debris, as well as dry grass and weeds, immediately adjacent to a very considerable railway mileage. While the percentage of live sparks liable to fall outside the right-of-way is small, still some fires do result, and the severity of these fires, and the difficulty of controlling them, are greatly



KETTLE VALLEY RAILWAY RIGHT-OF-WAY
After piling and burning of debris. Vernon District, B. C.



BRUSH PILING ALONG TOTE ROAD
Incident to Grand Trunk Pacific Railway construction. Tête Jaune District, B. C.

increased by this inflammable debris. Small fires starting on the right-of-way also spread quickly to this debris, so that bad fires result before the patrolmen or section crews can reach the scene. If the inflammable matter could be disposed of, by burning, at a safe time, a strip of 50 to 100 feet in width outside the right-of-way, the situation would be tremendously improved, since fewer fires would start, and there would be a much better chance to reach these before they got beyond control.

There is a provision in the Forest Act of British Columbia (Sec 123) which provides that the Minister of Lands or the Provincial Forest Board shall have the power to declare any inflammable material which endangers life or property a public nuisance, and to require the land owner or occupier, or the operator, to dispose of same.

Another section (124) provides that, when the safety of any forest, or woodland, or cut timber is endangered by the debris caused by any lumbering or other industrial operations, the Minister or the Forest Board may require the person or corporation conducting such operations, or the owner or occupier of the land on which such debris exists, to cut down dead debris or stubs within such area, and to establish a safe fire line around the area or areas covered by such debris; said fire line to be cleared of inflammable material, and to be of a width and character satisfactory to the Minister or to the Provincial Forest Board.

However, advantage has not been generally taken of these provisions to require a clean-up of slashings on old cuttings, along railway lines, where the hazard to settlements is not severe. The cost of carrying out such work is necessarily a serious obstacle to its rapid and general completion. On the other hand, a small beginning has been made in some places, by the Forest Branch, in persuading land owners to voluntarily clean up dangerous slashings along railway lines. The existence, in the Forest Act, of the provisions above referred to, has undoubtedly aided materially in enabling the Forest Branch to secure such co-operation. The voluntary action of the timber land owners alone will not, however, prove adequate in securing the handling of this problem generally, in British Columbia or elsewhere. The situation in British Columbia will no doubt steadily improve, through gradual application of the strong provisions of the Forest Act.

In all the provinces of Eastern Canada this situation is very much less satisfactory than in British Columbia, since, so far as known, there is no legislation applicable, nor, with few exceptions, do any material results appear to have been accomplished, by co-operation between the agencies concerned. In many sections, the lands adjacent

to railway lines have been so frequently and so completely burned over that the slashings have been consumed, and the problem has been changed from one of brush disposal as a preventive measure, to one of general fire protection, in order to permit the re-establishment of a young forest growth.

The governments of Ontario and Quebec have, however, given some consideration to the matter of legislation somewhat similar to the provisions of the British Columbia Forest Act above referred to, with a view of making it possible to enforce the disposal of inflammable debris where the same is a menace to life or property.

The Forest Fires Prevention Act of Ontario has been amended (Bill No. 110, third reading, April 27, 1914,) by providing that the municipal council of any city, town or township, may file a statement with the Minister of Lands, Forests and Mines, where it appears that the condition of any land within the limits of the municipality or adjacent thereto is, by reason of unfinished clearing, a source of danger from fire to property within the municipality. The Minister is authorized, after investigation, to require the owner to properly clean up the land, to such an extent as may be necessary to remove the source of danger from fire. Since this amendment apparently requires the initiative to be taken in each case by the municipal council, it seems doubtful whether it will prove as effective as would be the case could the initiative be taken by any interested party, or by the Minister direct. This section is not applicable to ordinary lumbering slash on non-agricultural lands under license from the provincial governments, but only to lands located, purchased, assigned or occupied for agricultural purposes. It is, therefore, not sufficient to meet the general situation above described.

It is believed that, so far as existing slash is concerned, the adequate solution of this problem demands the enactment, in each of the eastern provinces, of an act similar to that in British Columbia, authorizing some executive officer, for instance, the Minister having jurisdiction over the Crown lands of the province, to issue an order requiring the owner or lessee of forest lands adjacent to railway lines to make satisfactory disposal of inflammable debris on a strip of specified width adjacent to railway rights-of-way, where, in the judgment of such officer, this action is necessary in the public interest, as a matter of fire protection. In the case of Crown timber lands under license, the question would, of course, have to be considered whether the licensee should bear the whole cost of this work, or a portion should be borne by the provincial government. In the case of Crown lands not under license, the whole cost must obviously fall upon the

province, unless the co-operation of the railway concerned in each case, or of limit-holders threatened by the slashing, could be secured. As to Alberta, Saskatchewan and Manitoba, the provision would apparently be through action by the Dominion Government, since a very large percentage of the timber lands along railway lines in these provinces is held under Dominion timber license.

Legislation should also be enacted, to provide against the accumulation of inflammable debris from future cutting operations on lands immediately adjacent to railway rights-of-way. Such legislation should be made applicable to settlers' clearings as well as to lumbering operations. Laws which include provisions for the disposal of slashings along railway lines are in effect in Minnesota, Oregon, New York and New Jersey, and are advocated in Massachusetts, New Hampshire, Maine, and several other states. It will thus be seen that the necessity for action of this kind is becoming recognized to a constantly increasing extent.

Pending such legislation, there is unquestionably a wide field for either individual or co-operative action by the various interests concerned. Of these interests, the chief are the provincial governments, the railways, and the owners or licensees of timber lands along railway lines. Varying degrees of co-operation would be justified, according to the circumstances surrounding each case. While the provincial governments and the limit-holders, and, in some cases, the municipalities, should undoubtedly either co-operate or take individual action in this matter, the railways are also directly interested, and are fully justified in many cases in incurring expense, either alone or on a co-operative basis, for eliminating fire hazards of this character.

As an example of the policy adopted by one of the most progressive railways in matters of fire protection, the following statement, by Mr. E. A. Ryder, Commissioner, Department of Fire Claims, Boston and Maine railroad, is quoted:

"We burn over our right-of-way each spring and autumn, but, under certain conditions, sparks from locomotives will fall outside thereof, and we naturally felt that something should be done to avoid fires on property contiguous to our right-of-way. We have, therefore, asked the owners to clear back or burn the inflammable material, such as slash, dry grass, etc., and, if for any reason they have been unable to do it, we have asked their permission to let us do the work at our expense. Last year [1913] we cleared 75 such places. We believe it is a good investment. We know it has been the means of preventing many fires, and we also know that it is a good example to a large number of land owners contiguous to our property as well as others. We figure that our moral obligation extends at least to the limit we can get protection. The added expense is not very great, because we

try to have our men do such work on rainy days, when there is no track work they can do. While there are laws in the states of Massachusetts and New Hampshire regarding the removal of slash, we are glad to state that the people are gradually growing more willing to allow strips of their property alongside the railroad to be burned or cleared for fire protection purposes. We are trying to make people see that, while preventing fire claims is a large factor, we also have a great interest in conserving our forests, because they mean lumber, and lumber means freight, and freight means revenue; and further, New England, being the vacation grounds of this country (so we think, at least), we must do everything to maintain its picturesqueness, which, to a large extent, is due to its woods, so that we may secure the passenger revenue therefrom."

Although it should not be necessary for railways to incur expense for the disposal of inflammable debris outside rights-of-way in forest sections, and such action can not be expected except under the most unusual circumstances, nevertheless some excellent results have been secured during 1914 through co-operation between railways and governmental as well as private agencies. In a few cases, particularly along the Grand Trunk and Canadian Pacific (eastern lines) railways, there was co-operation between the railway company and the owners of adjacent lands, resulting in the disposal of inflammable debris on a narrow strip adjacent to the right-of-way. The best example of this occurred in Algonquin Park, Ont., where the provincial Department of Lands, Forests and Mines employed a gang of men and cleared up the inflammable debris along a portion of the Grand Trunk right-of-way and lands immediately adjacent thereto, the Grand Trunk management bearing one-half the cost. It is expected that this arrangement will be continued in 1915, until the line through the park shall have been covered.

Along the Canadian Pacific line, through the Shawanaga and Nipissing Indian reserves in Ontario, the Department of Indian Affairs disposed of inflammable debris on a strip adjacent to the railway, the company having cleared up the right-of-way independently.

In each of the above cases, the Department concerned is entitled to much credit for its progressive action.

Fire-Guard Construction

The question of fire-guard requirements in the Prairie provinces has received most thorough consideration by the Board's fire inspection department since its inception, in the spring of 1912. The requirements for that year (see *Forest Protection in Canada, 1912*, p. 34) were necessarily substantially those which had been in effect under the

previous requirements of the Board, embraced in Orders No. 3,245 and 15,995. In other words, sixteen feet of ploughing was required, at a distance of 300 feet from the track, without reference to the character of the land in question, except where a showing should be made by the company that such ploughing was unnecessary or impracticable.

As outlined at page 36 of *Forest Protection in Canada, 1912*, the matter of revising the fire-guard requirements for 1913 was exhaustively taken up in the fall of 1912, by circulars, which were sent to hundreds of representative farmers throughout the prairie provinces, as well as to provincial government officials, and representatives of all the railways concerned. A heavy correspondence followed the receipt of the answers to the questions contained in the circular. After most careful consideration of the many opinions expressed, including the preliminary submission, for criticism, of tentative drafts of requirements to railway officials and representatives of the Grain Growers' associations of Manitoba, Saskatchewan and Alberta, as well as to provincial government representatives, a final draft of requirements was prepared and issued to railways concerned, as follows:

BOARD OF RAILWAY COMMISSIONERS FOR CANADA

FIRE INSPECTION DEPARTMENT, OTTAWA

May 24, 1913

To The Canadian Pacific Railway Company, The Canadian Northern Railway Company, The Grand Trunk Pacific Railway Company, The Great Northern Railway Company:

Subsection 4 of Section 298 of the Railway Act provides that "The Board may order, upon such terms and conditions as it deems expedient, that fire-guards be established and maintained by the company along the route of its railway and upon any lands, of His Majesty or of any person, lying along such route, and, subject to the terms and conditions of any such order, the company may at all times enter into and upon such lands for the purpose of establishing and maintaining such fire-guards thereon, and freeing, from dead or dry grass, weeds and other unnecessary inflammable matter, the land between such fire-guards and the line of railway."

Regulation 9 of Order 16,570, provides that "every such railway company shall establish and maintain fire-guards along the route of its railway as the Chief Fire Inspector may prescribe."

You are accordingly required to establish and maintain fire-guards on both sides of the right-of-way, along the route of your railway, in the Provinces of Alberta, Saskatchewan and Manitoba, as follows:

Cultivated Lands—On lands under cultivation, fire-guards shall be constructed in the form of a ploughed strip not less than eight feet in width, not less than 100 feet from the centre of the track. All dead or

dry grass and other unnecessary combustible matter shall be burned or otherwise removed from the right-of-way. Where the right-of-way is 200 feet in width, the fire-guard may be ploughed at the outer edge of the right-of-way immediately inside the fence.

The construction of fire-guards is not required where, on account of recent ploughing, or the presence of non-combustible crop, there is no danger of fire spreading and doing damage.

The construction of fire-guards in standing grain or other similar crops is not required, but fire-guards shall be constructed as above prescribed immediately following the cutting or harvesting of such crops.

Your attention is called to the requirement of Order No. 16,570, that "No such railway company shall permit its employees, agents, or contractors to enter upon land under cultivation, to construct fire-guards, without the consent of the owner or occupant of such lands," and that "Wherever the owner or occupant of such land objects to the construction of fire-guards, on the ground that said construction would involve unreasonable loss or damage to property, the Company shall *at once* refer the matter to the Board, giving full particulars thereof, and shall in the meantime refrain from proceeding with the work." Said order also provides that "No agent, employe or contractor of any such railway company shall permit gates to be left open or to cut or leave fences down, whereby stock or crops may be injured, or do any other unnecessary damage to property, in the construction of fire-guards."

Where the owner or owners of cultivated lands have refused the company permission to plough fire-guards on such lands, and where, on account of weather conditions or other reasons, the dead or dry grass and other unnecessary combustible matter on the right-of-way has not been burned off or otherwise removed, the company shall construct a fire-guard along the outer edge of the right-of-way in the form of a ploughed strip not less than eight feet in width. Such ploughing along the outer edge of the right-of-way shall be done either before or immediately following such cutting or harvesting of crops on the adjacent cultivated lands.

Fenced Grazing Lands—On fenced, uncultivated lands, fire-guards shall be constructed and maintained in the form of a ploughed strip not less than 16 feet in width, not less than 200 feet from the centre of the track. All dead or dry grass and other unnecessary combustible matter shall be burned or otherwise removed from the right-of-way.

Open Prairie—On unfenced, uncultivated lands, fire-guards shall be constructed and maintained in the form of a ploughed strip not less than 16 feet in width, not less than 300 feet from the centre of the track. All dead or dry grass and other unnecessary combustible matter between such ploughed strip and the track shall be burned or otherwise removed from such strip.

Aspen or Poplar Lands—In sections where fire-guards are necessary and, on account of aspen or poplar growth it is impracticable to plough, the fire-guard may be constructed by clearing away such trees and undergrowth and removing all combustible material on the ground,

so as to expose the mineral soil, for a width of 16 feet, at a distance of approximately 200 feet from the centre of the track.

Additional Provisions—Where there are alternating bodies of cultivated, fenced, grazing, open prairie, or poplar lands, the ends of the fire-guards above prescribed shall, so far as possible, be so connected as to make an unbroken, continuous fire-guard.

Wherever, for any reason, it is not practicable to construct a continuous fire-guard as above specified, the ends of the constructed portions of the fire-guard shall be turned in to the right-of-way, and special care shall be taken to connect such ends, either by ploughing a strip eight feet wide along the outer edge of the right-of-way, or by burning or otherwise removing the combustible matter along such right-of-way, in such a manner as to provide good and efficient protection against the spread of fire to lands which have been properly fire guarded.

The construction of fire-guards shall be completed, as above specified, not later than the first day of August, 1913, except as to cultivated lands, where the requirements as to time of construction, above specified under that heading, shall be observed. Between the date of construction and the 15th day of May, 1914, said fire-guards shall be maintained in a good and efficient manner, and dead or dry grass and other unnecessary combustible matter shall be burned or otherwise disposed of, on lands or portions of lands between such fire-guards and the track, in accordance with the above requirements.

Where a fire-guard has been ploughed within two years, in accordance with the above specifications, the operation of discing and harrowing will be acceptable instead of reploughing, provided that all weeds and other inflammable material are disced and harrowed under the furrow, so as to make a good and efficient fire-guard. Otherwise, reploughing is required.

The provisions of this order shall apply to the portions of the line under construction, in the three provinces named, the same as to portions under operation. In other words, fire-guards shall be constructed at the time grading is done on each new portion of the line.

The foregoing requirements shall apply to all lines of the company in the three provinces named, except where the company shall be specifically exempted from such requirements on the basis of a showing by the company that such construction and maintenance of fire-guards is either unnecessary or impracticable. The list of such specific exemptions will accompany another letter, at a later date, after a field inspection by this department on the basis of the showing made or to be made by the company in this connection. In the meantime, the company must proceed upon the basis of constructing and maintaining fire-guards as above specified, except where such action is clearly impracticable or unnecessary.

The company shall submit to the Chief Fire Inspector for the Board, at Ottawa, not later than November 1st, 1913, a report in triplicate, in the form of a graphic chart, showing by mileages, subdivisions, and provinces the portions of the line in the three provinces named where fire-guards shall have been constructed or exemptions granted, and

where and for what reason there shall have been failure to comply with the requirements of this order. Said report shall account fully in the above respects for all lines of the company in the said provinces, including lines under construction.

In every case where the owner or occupant of cultivated land objects to the construction of fire-guards, the name and address of such owner or occupant, together with the description of the land in question, both by legal subdivision and railway mileage, shall be immediately submitted to the Board, as provided in Regulation 9 of Order 16,570, above referred to. This information shall also be shown upon the graphic chart constituting the annual report. Exemption by the Chief Fire Inspector is not necessary in such cases, since Order 16,570 specifically prescribes the procedure.

Very truly yours

(Signed) CLYDE LEAVITT

Chief Fire Inspector, B.R.C.

**Synopsis of
Variations**

The principal points in which the above requirements differ from those issued in 1912 are as follows:

(1) A specific classification of lands, with separate treatment prescribed for each.

(2) Eight feet of ploughing, instead of sixteen, in the case of cultivated lands; only the right-of-way to be burned off. Distance from track, 100 feet instead of 300.

(3) In fenced grazing lands, ploughing to be at a distance of 200 feet from the track, instead of 300 feet. Requirement for burning off grass between guard and track reduced to cover burning off of right-of-way only; this to decrease loss of pasturage.

It will be noted that this order made it necessary for railway companies to handle the fire-guarding of cultivated lands in substantially the same way as open prairie and fenced grazing lands, viz., by the contract system. In practice, however, great difficulty was found in securing permission of land owners or occupants to enter for the purpose of fire-guarding. Much time was lost by the necessity for repeated visits, by railway representatives, in order to find the owner or occupant. Unnecessary expense was in some sections incurred in ploughing fire-guards in grain stubble where the climatic conditions did not render such action necessary. Farmers were subject to annoyance by railway employees, in connection with the granting or refusal of permission to enter upon cultivated land, and also through the danger of fences being cut and gates left open in connection with fire-guarding operations. It was also found very difficult, if not impracticable, to handle the fire-guarding of grain stubble lands efficiently under the contract system applicable to open prairie and fenced grazing lands, on account of the



TIE SLASH IN CONNECTION WITH GRAND TRUNK PACIFIC RAILWAY CONSTRUCTION
A fire under these circumstances would mean the practically complete destruction of the forest. Under present regulations, such debris must be piled and burned in order to reduce fire hazard. Northern British Columbia.



RAILWAY RIGHT-OF-WAY AFTER THE CUTTING OF GRASS
In accordance with section 297 of the Railway Act. Fire danger greatly reduced Ontario.

difference in the time at which the work must be done. In the case of open prairie and fenced grazing land, the requirement called for the completion of construction by August 15. Obviously, fire danger in growing grain crops being negligible as a rule, fire-guarding should not take place until immediately after the cutting of the grain. It must, however, be done immediately after that operation, or the fire hazard will, in many sections, be great. The problem was further complicated by the materially different times at which cutting of grain takes place in the same sections of the country. Thus, in order to secure efficient results in stubble fire-guarding, the railway company must not only provide for the handling of this work at a later date than that prescribed for open prairie and fenced grazing land, but must also provide for the separate handling of the work in each grain stubble field.

**Stubble Fire
Guarding**

These difficulties were obvious, and had been considered to some extent previous to the issuance of circular of May 24, 1913, without, however, the development of any practicable method of obviating them up to that time. During the early summer, however, the matter was further taken up, principally by personal investigation in the field. The result was a joint conference at Winnipeg, on August 6, 1913, at which were present representatives of the three railways most concerned, and of the Grain Growers' associations of the three prairie provinces, as well as the Chief Fire Inspector of the Board. Following this conference, the following circular was issued:

BOARD OF RAILWAY COMMISSIONERS FOR CANADA

FIRE INSPECTION DEPARTMENT

Winnipeg, Manitoba, Aug. 8, 1913

To The Canadian Pacific Railway Company, The Canadian Northern Railway Company, The Grand Trunk Pacific Railway Company, The Great Northern Railway Company:

Reference is made to my letter of May 24, 1913, containing requirements for the construction of fire-guards along railway lines in the provinces of Alberta, Saskatchewan and Manitoba.

As a result of a conference held at Winnipeg, August 6, 1913, with representatives of the C.P.R., C.N.R., G.T.P.R., United Farmers of Alberta, Grain Growers' Association of Saskatchewan, and Grain Growers' Association of Manitoba, the following modifications are hereby made in the requirements prescribed in said letter of May 24, 1913:

FENCED GRAZING LANDS—No change in requirements.
OPEN PRAIRIE—No change in requirements.

ASPEN OR POPLAR LANDS—No change in requirements. It is, however, suggested that fire-guarding of this class of land is generally unnecessary, and that exemptions may properly be requested in such cases, as provided in letter of May 24, 1913. Especial care must, however, be taken to construct fire-guards, where practicable, along lines running through or near forest reserves.

CULTIVATED LANDS—All grass, brush, weeds and other unnecessary combustible matter shall be burned or otherwise removed, between the track and the edge of the cultivated land, provided that this requirement shall not extend more than ten feet outside the right-of-way on private land. Every effort must be made to have this work completed in an efficient manner at the earliest practicable date this autumn. Where mowing is necessary to secure a clean burn, this action must be taken.

It is generally agreed that if the right-of-way and adjacent narrow uncultivated strip are freed from combustible material, in accordance with the above requirements, the greatest source of fire danger in cultivated sections will have been removed, and that, while in some sections and under some conditions the ploughing of fire-guards through cultivated land will still be necessary, in other sections and under other conditions such action is not essential to a reasonable degree of safety. It is also agreed that in general the best judge of the necessity for ploughing fire-guards through cultivated lands is the owner or occupant of the land himself, and that, where such action is necessary, some degree of co-operation on the part of the land owner or occupant may reasonably be expected.

You are accordingly required, in addition to the measures above prescribed, to plough either four-foot or eight-foot fire-guards through cultivated lands adjacent to your lines in the provinces of Alberta, Saskatchewan and Manitoba, wherever such action is necessary in the judgment of the owner or occupant of such land, and where such owner or occupant will undertake to plough, immediately following the harvest, either a four-foot or an eight-foot fire-guard, as he may consider necessary, at a distance of approximately 100 feet from the track, for a remuneration of \$1.75 per lineal mile of four-foot fire-guard, or \$3.00 per lineal mile of eight-foot fire-guard, such amount to be promptly paid by the company, it being understood that the minimum amount to be paid in any case shall be one dollar.

Where the owner or occupant of such cultivated land is unwilling to undertake the construction of fire-guards in accordance with the above, the company will exercise its discretion as to whether it will make other arrangements for the ploughing of fire-guards or leave such lands unguarded. In case the owner or occupant will neither contract for the construction of such fire-guards nor permit such work to be done by an agent of the company, the company may either drop the matter of fire-guarding or make application to the Board for authority to enter upon such land for the purpose of fire-guard construction, over the protest of such owner or occupant. Such refusal must, however, be reported to the Board, as required by General Order 107 and by letter of May 24, 1913.

The construction of fire-guards is not required where, on account of recent ploughing or the presence of a non-combustible crop, there is no danger of fire spreading and doing damage.

It is clearly understood that nothing contained in this letter shall be construed as in the slightest degree affecting the statutory responsibility of the company for the payment of damage claims on account of fires.

It is also understood that the above modifications of the requirements contained in letter of May 24, 1913, are experimental, and that requirements as to fire-guard construction for the season of 1914 will depend upon the showing made in connection with the requirements for the current season.

The forms to be used in presenting the above matter for the signature of land owners or occupants shall be subject to the approval of the Chief Fire Inspector. Such forms, after signature, shall be available for examination by any authorized officer of the Board.

The graphic chart, in triplicate, comprising the annual report, required by letter of May 24, 1913, to be submitted not later than November 1, 1913, shall, as to cultivated lands, indicate lands fire-guarded, lands on which fire-guarding is stated by the owner or occupant to be unnecessary, lands on which permission to construct fire-guards has been refused by owner or occupant, lands exempted because fire-guard ploughing is unnecessary on account of recent ploughing, the presence of non-combustible crop, climatic conditions, or other reason, if any, why fire-guards have not been ploughed.

Your attention is directed to the fact that a strict enforcement by the company of Regulation 13 of General Order 107, with regard to the reporting and extinguishing of fire by all employees, is desirable in the prairie sections, and would undoubtedly not only reduce damage claims, but also make possible some relaxation of the requirements as to the ploughing of fire-guards.

The issuance and posting of full instructions to employees, in printed form, as required by Regulation 14 of General Order 107, is necessary in this connection. This action has not yet been generally taken in the prairie section, by the companies concerned.

In view of the above modifications, supplementary requests for exemption from fire-guard construction may be submitted at any time prior to October 1, 1913.

Yours very truly

(Signed)

CLYDE LEAVITT

Chief Fire Inspector, B.R.C.

The above arrangement worked out satisfactorily during the autumn of 1913, and very much more work was done in connection with the fire-guarding of grain stubble lands adjacent to railway lines than had ever been the case in previous years. No complaints regarding the arrangement were received from any source, thus proving the justice of the assumption that the requirement for the fire-guarding of grain

stubble lands by railway companies may reasonably be limited to cases where the land owner or occupant considers such action necessary, and is also willing to co-operate to the extent of ploughing the guard for the fixed reasonable compensation specified above. It will be noted that for the first time provision is made above for materially reducing the fire hazard through grain stubble lands, by the requirement that railway companies shall dispose of dry grass and other combustible matter between the right-of-way and the edge of cultivation. This is important, since, as a general rule, fires burning over grain stubble lands seldom start in the stubble itself, but in the dry grass or weeds on the right-of-way, or in the narrow uncultivated strip immediately between the stubble and the right-of-way fence. The requirements above specified have greatly reduced both these sources of fire danger, so far as grain stubble lands are concerned.

**Fire Guarding,
Season of 1914**

As in previous years, the details of fire-guard requirements for 1914 were fully discussed, in advance, with the railway companies and with representatives of the Grain Growers' associations. The result was the issuance of the following circular.

BOARD OF RAILWAY COMMISSIONERS FOR CANADA
FIRE INSPECTION DEPARTMENT

Ottawa, Monday, the 11th day of May, 1914

FIRE GUARD REQUIREMENTS

To The Canadian Pacific Railway Company, The Canadian Northern Railway Company, The Grand Trunk Pacific Railway Company, The Great Northern Railway Company:

Subsection 4 of Section 298 of the Railway Act provides that "The Board may order, upon such terms and conditions as it deems expedient, that fire-guards be established and maintained by the Company along the route of its railway and upon any lands of His Majesty or of any person, lying along such route, and, subject to the terms and conditions of any such order, the Company may at all times enter into and upon such lands for the purpose of establishing and maintaining such fire-guards thereon and freeing, from dead or dry grass, weeds and other unnecessary inflammable matter, the land between such fire-guards and the line of railway."

Regulation 8 of General Order No. 107 provides that "Every such railway company shall establish and maintain fire-guards along the route of its railway as the Chief Fire Inspector may prescribe."

You are accordingly required to establish and maintain fire-guards on both sides of the right-of-way, along the route of your railway, in the provinces of Alberta, Saskatchewan and Manitoba, as follows:—

(A). GRAIN STUBBLE LANDS—1. Section 297 of the Railway Act requires that "The Company shall at all times maintain and keep its right-of-way free from dead or dry grass, weeds and other unnecessary combustible matter." As to portions of lines where the right-of-way adjoins lands devoted to grain crops, this requirement is hereby extended to include the strip between the right-of-way and the edge of cultivation, provided that this requirement shall not apply more than ten feet outside the right-of-way on private land.

2. It is generally agreed that if the right-of-way and adjacent narrow, uncultivated strip are freed from combustible material, in accordance with the above requirements, the greatest source of fire danger in cultivated sections will have been removed, and that, while in some sections and under some conditions the ploughing of fire-guards through grain stubble lands will still be necessary, in other sections and under other conditions such action is not essential to a reasonable degree of safety. It is also agreed that, in general, the best judge of the necessity of ploughing fire-guards through grain stubble lands is the owner or occupant of the land himself, and that, where such action is necessary, some degree of co-operation on the part of the land owner or occupant may reasonably be expected.

3. You are accordingly required to provide for the ploughing of fire-guards through grain stubble lands adjacent to your lines in the provinces of Alberta, Saskatchewan and Manitoba, wherever such action is necessary in the judgment of the owner or occupant of such land; and where such owner or occupant after notice by the railway company as hereinafter prescribed, shall take the initiative and plough, immediately following the cutting of the grain, such fire-guard, four feet in width at a distance of approximately one hundred feet from the main track for a remuneration of \$1.75 per lineal mile of four-foot ploughed fire-guard, such amount to be paid by the company within forty days after the submission by the land owner or occupant of written statement of account to the railway company, it being understood that the minimum amount to be paid in any case shall be one dollar.

4. The railway company shall notify land owners and occupants as to the above requirement, by posting printed notices at all stations and all public road crossings through cultivated sections within the provinces of Alberta, Saskatchewan, and Manitoba. Notices at stations shall be posted in a conspicuous place, readily accessible to the general public. Two copies of such notice shall be posted on the railway crossing sign pole in a substantial manner at each public road crossing, these notices to be on the opposite sides of pole, one copy facing the railway track. Such notices shall be posted not later than July 15, 1914.

5. In notices to land owners and occupants, railway companies may insert a clause stating that the above arrangement relative to the construction of and payment for the fire-guarding of grain stubble lands will remain in effect during 1914 and successive years, until changed by public notices to be posted in a manner similar to that above pre-

scribed. In other words, the above arrangement will remain in effect without further notice, unless and until said arrangement shall be changed by public notice under instructions issued by the Chief Fire Inspector of the Board.

6. Notices under the above requirements shall be issued over the signature of a responsible official of the railway company, and the form of such notices shall be subject to the approval of the Chief Fire Inspector of the Board. Provision shall be made in the notice that the ploughing of these fire-guards shall be done in a workmanlike and efficient manner, and that where such guards do not connect with similar fire-guards on adjacent lands, the ends shall be turned in to the railway right-of-way.

7. Your attention is called to the requirement of General Order No. 107, that "No such railway company shall permit its employees, agents, or contractors to enter upon land under cultivation, to construct fire-guards, without the consent of the owner or occupant of such lands," and that "Wherever the owner or occupant of such land objects to the construction of fire-guards, on the ground that the said construction would involve unreasonable loss or damage to property, the company shall at once refer the matter to the Board, giving full particulars thereof, and shall in the meantime refrain from proceeding with the work." Said Order also provides that "No agent, employee or contractor of any such railway company shall permit gates to be left open or to cut or leave fences down, whereby stock or crops may be injured, or do any other unnecessary damage to property, in the construction of fire-guards."

8. Where the owner or occupant of grain stubble land is unwilling to undertake the construction of fire-guards in accordance with the above, the company will exercise its discretion as to whether it will make other arrangements for the ploughing of fire-guards or leave such lands unguarded. In case the owner or occupant will neither construct such fire-guards under the above requirement, nor permit such work to be done by an agent of the Company, the Company may either drop the matter of fire-guarding or make application to the Board for authority to enter upon such lands for the purpose of fire-guard construction over the protest of such owner or occupant.

9. The construction of fire-guards is not required where, on account of recent ploughing or the presence of a non-combustible crop, there is no danger of fire spreading and doing damage. Fire-guards are not required in standing grain crops.

10. It is clearly understood that nothing contained in this letter, nor any action to be taken under it, shall be construed as in the slightest degree affecting the statutory responsibility of the Company for the payment of damage claims on account of fires.

(B). FENCED GRAZING LAND—1. This classification shall include fenced, uncultivated lands, which are occupied by owner or tenant or which are used for the purpose of grazing. Meadows and hay lands generally shall be construed as coming under this classification.

2. On such lands fire-guards shall be constructed or maintained in the form of a ploughed strip not less than sixteen feet in width. Where such fire-guards have been constructed in the past at a distance of from 150 to 250 feet from the track, they shall be maintained in the same location, in order to minimize the weed nuisance. Otherwise, construction shall be at a distance of approximately 200 feet from the main track or as close a distance to 200 feet as the nature of the country will permit.

3. All dead or dry grass and other unnecessary combustible matter shall be burned or otherwise removed from the right-of-way, Burning outside the right-of-way is not required under this classification.

4. Wherever the owner or occupant of land under this classification objects to the construction or maintenance of fire-guards as above prescribed, the Company shall refrain from doing such work, but shall immediately report the matter to the Board, stating name and address of such owner or occupant, the description of the land by legal subdivision and railway mileage, and whether the Company desires the permission of the Board to enter on such land for the purpose of constructing or maintaining such fire-guards notwithstanding such refusal by owner or occupant.

(C). OPEN PRAIRIE.—1. This classification shall include unfenced, uncultivated lands, and fenced lands which are uncultivated, unoccupied by owner or tenant, and not used for purposes of grazing.

2. On such lands fire-guards shall be constructed or maintained in the form of a ploughed strip not less than sixteen feet in width. Where such fire-guards have been constructed in the past at a distance of from 200 to 400 feet from the track, they shall be maintained in the same location, in order to minimize the weed nuisance. Otherwise, construction shall be at a distance of approximately 200 feet from the main track or as close a distance to 200 feet as the nature of the country will permit.

3. All dead or dry grass and other unnecessary combustible matter shall be burned or otherwise removed, between the fire-guard and the track. Where the ploughing of fire-guards is impracticable on account of ground being too stony or rocky, or too hilly or broken to plough, the dead or dry grass and other unnecessary combustible matter shall be burned off on a strip extending 200 feet from the track.

4. Under the provisions of the Railway Act and of the Board's Order, the consent of the owner of private land coming under this classification is not essential in connection with either the ploughing of fire-guards or the burning off of grass between the fire-guard and the main track as above prescribed.

(D). ASPEN OR POPLAR LANDS—1. In sections where fire-guards are necessary and, on account of aspen or poplar growth it is impracticable to plough, the fire-guard may be constructed by clearing away the undergrowth and removing all combustible material on the ground, so as to expose the mineral soil, for a width of sixteen feet, at a dis-

tance of approximately 200 feet from the track. Where the land is sufficiently open so that ploughing is practicable, fire-guards shall be constructed as above prescribed for fenced grazing lands or open prairie, according to the status of the particular tract in question.

2. It is understood that fire-guarding of this class of land is generally unnecessary, and that exemptions may properly be requested in such cases. Especial care must, however, be taken to construct fire-guards where practicable along lines running through forest reserves.

3. All dead or dry grass and other unnecessary combustible matter shall be burned or otherwise removed from the right-of-way.

(E). ADDITIONAL PROVISIONS—1. Where there are alternating bodies of grain stubble, fenced grazing, open prairie, or poplar lands, the ends of the fire-guards above prescribed shall so far as possible be so connected as to make an unbroken, continuous fire-guard.

2. Wherever, for any reason, it is not practicable to construct a continuous fire-guard as above specified, the ends of the constructed portions of the fire-guard shall be turned in to the right-of-way, and special care shall be taken to connect such ends, either by ploughing a strip eight feet wide along the outer edge of the right-of-way, or by burning or otherwise removing the combustible matter along such right-of-way, in such a manner as to provide good and efficient protection against the spread of fire to lands which have been properly fire-guarded.

3. The construction of fire-guards shall be completed, as above specified, not later than the 15th day of August, 1914, except as to grain stubble lands, where the requirements as to time of construction, above specified under that heading, shall be observed. Between the date of construction and the 15th day of May, 1915, said fire-guards shall be maintained in a good and efficient manner, and dead or dry grass and other unnecessary combustible matter shall be burned or otherwise disposed of, on lands or portions of lands between such fire-guards and the track, in accordance with the above requirements.

4. Where a fire-guard has been ploughed within two years in accordance with the above specifications, the operation of discing and harrowing will be acceptable instead of reploughing, provided that all weeds and other inflammable material are disced and harrowed under the furrow, so as to make a good and efficient fire-guard. Such discing and harrowing shall be completed before the weeds on the fire-guard shall have gone to seed. Where more than one operation of discing and harrowing is necessary in order to keep down the weeds on a particular fire-guard, such action shall be taken.

5. The provisions of this Order shall apply to the portions of the line under construction, in the three provinces named, the same as to portions under operation. In other words, fire-guards shall be constructed at the time grading is done on each new portion of the line. However, in case the laying of the track is to be delayed for a period of one year or more, temporary exemption from this requirement will

be granted, upon a showing to that effect, to be made to the Board by the company.

6. The foregoing requirements shall apply to all lines of the company in the three provinces named, except where the company shall be specifically exempted from such requirements on the basis of a showing by the company that such construction and maintenance of fire guards is either unnecessary or impracticable. Such showing shall be made at the earliest practicable date but in any event not later than June 10, 1914, in the form of two blue print copies from right-of-way plan. Such plan shall indicate railway mileages and shall show in each case why fire-guard construction is considered unnecessary or impracticable. Pending action by the Chief Fire Inspector upon such request for exemption, the company shall proceed upon the basis of constructing or maintaining fire-guards as above specified, except where such action is clearly impracticable or unnecessary.

7. The following reasons will be considered in connection with requests for fire-guard exemptions: ground too stony or rocky, or too hilly or broken to plough (exemption here, as to open prairie, will apply to ploughing but not to burning, see paragraph 3 under heading "Open Prairie"); timber or scrub; swamp, muskeg or sloughs (where permanently wet and too large to plough around); cities and villages (only where ploughing is impracticable); and the following where width and location are such as to constitute an efficient fire-guard, thus making ploughing unnecessary:—irrigation canals, ditches, rivers, lakes, creeks, graded roadways or other railway grades parallel to the company's tracks.

8. The company shall submit to the Chief Fire Inspector for the Board at Ottawa, in duplicate, not later than December 31, 1914, annual graphic charts and an annual fire-guard statistical report, in accordance with the accompanying forms. Such charts shall indicate by mileages, subdivisions and provinces, the portions of the lines in the three provinces named, where fire-guards shall have been constructed or maintained, and where and for what reason there shall not have been such construction or maintenance. All portions of the lines in the said provinces, including those under construction, shall be fully accounted for in the above respects.

Very truly yours

CLYDE LEAVITT

Chief Fire Inspector

Points in which Requirements Varied The principal new points included in the 1914 requirements are as follows:

(1) The use of the term "grain stubble" instead of "cultivated land" as one of the classifications. This is merely a change in form.

(2) Farmers to be informed of the arrangements for the fire-guarding of grain stubble lands, through public notices posted at all

stations and public road crossings in cultivated sections in the prairie provinces, instead of by personal visits of railway representatives, as in 1913.

(3) Four-foot fire-guards made standard in grain stubble lands, instead of leaving it to the individual land owner or occupant to determine whether the guard should be four feet or eight feet in width.

(4) Two hundred feet made the standard distance from the track for the ploughing of fire-guards in open prairie, instead of 300 feet, except that, where guards have been previously ploughed at a distance of from 200 to 400 feet from the track, they shall be maintained in the same location. This change was considered desirable, on account of previous confusion where doubt arose as to whether a particular piece of land should be regarded as fenced grazing or open prairie land, thus raising the question as to whether the fire-guard should be ploughed at a distance of 200 feet or 300 feet from the track. Also, in many cases, what is open prairie one year becomes fenced grazing land the next, thus necessitating the ploughing of a new fire-guard and the abandoning of the old, with consequent possible increase in the number of noxious weeds, which thrive on old fire-guards. Both these difficulties are overcome in the 1914 requirements.

(5) Inclusion of requirement that where the ploughing of fire-guards in open prairie is impracticable on account of ground being too stony or rocky, or too hilly or broken to plough, the dead or dry grass and other unnecessary combustible matter shall be burned off on a strip extending 200 feet from the track. This provision is obviously necessary in order to reduce the danger of fires spreading in open prairie lands where guards cannot be ploughed, but where the dry grass would otherwise accumulate year after year until the occurrence of an accidental fire, which, under such circumstances, might assume serious proportions.

Results On the whole, the 1914 requirements worked very
Have Proven satisfactorily and seemed generally acceptable, aside
Satisfactory from the feeling of the railways that they should have the right of unrestricted entrance upon fenced grazing lands for the purpose of ploughing fire-guards, instead of being compelled to follow the procedure prescribed in the requirements. A few other points have been raised, concerning which it was not possible to completely meet the sometimes conflicting points of view of the railways, but these are of a minor character and do not modify the general statement that, on the whole, the requirements have given very general satisfaction.

During 1914, specific complaints were received as follows: Damage by fire: Canadian Pacific, 4; Canadian Northern, 12; Grand Trunk Pacific, 2; total, 18. In each case the complainant was advised that



FIRE HAZARD IN ALGONQUIN PARK, ONTARIO

Reduced through the disposal of inflammable material along Grand Trunk railway right-of-way and land immediately adjacent. This work was done through co-operation between the railway company and the Provincial Department of Lands and Forests.



FIRE HAZARD ALONG PROVINCIAL GOVERNMENT WAGON ROAD

Due to failure of construction gang to pile and burn debris when building road. This condition is now being gradually corrected. Southern British Columbia.

the Board has no jurisdiction in connection with damage claims and that recourse should be had through the courts, in case of failure to reach a settlement with the railway concerned.

Failure to construct fire-guards, or construction unsatisfactory: Canadian Pacific, 3; Canadian Northern, 5; Grand Trunk Pacific, 1; total, 9.

Report by railway company that land owner refuses to permit construction of fire-guards in fenced grazing lands: Canadian Pacific, 11; Grand Trunk Pacific, 22; total, 33. In twelve of these cases, the Grand Trunk Pacific requested authority to enter upon the lands in question for the purpose of constructing fire-guards, notwithstanding such refusal of the owner. In three of these cases, orders were issued by the Board, granting authority for such entrance and construction, as requested.

The following tables show fire-guard statistics for 1913 and 1914:

Summary of Fire-guard Construction by Railways in the Provinces of Alberta, Saskatchewan and Manitoba, 1913 and 1914

	Great Northern		Grand Trunk Pacific		Canadian Northern		Canadian Pacific	
	1913	1914	1913	1914	1913	1914	1913	1914
Length in track miles.....	162.38	162.38	1,795.1	2,152.8	4,011.8	4,541.20	5,960.9	6,313.13
Length in fire-guard miles (1).....	324.76	324.76	3,590.2	4,305.6	8,023.6	9,082.40	11,921.8	12,626.26
Fire-guards constructed (shown in fire-guard miles)								
Open prairie	81.75	.50		1,240.80		2,346.60	7,878.7	3,970.90
Fenced grazing lands.....	37.75	171.50	1,903.7	404.85	3,708.05	387.50	1,374.41	1,374.41
Grain stubble lands.....	153.00	80.25		400.60		314.10	144.1	2,107.18
Total constructed	272.50	252.25	1,903.7	2,046.25	3,708.05	3,048.20	8,022.8	7,452.49
Fire-guards not constructed (shown in fire-guard miles) (2)								
Exemptions	52.26	53.76	743.00	1,442.00	2,633.10	3,368.00	1,684.6	2,276.30
Owner refuses entrance (3).....			46.30	9.30	45.45	*	80.8	23.00
Land already ploughed (4).....				156.90	28.8	*	3.4	1,410.10
Grain stubble, not fire-guarded by owner (5).....								
Miscellaneous other reasons		6.00		547.59	212.0	1,118.50		272.48
Total not constructed	52.26	10.25	897.00	103.56	1,396.2	*	2,130.2	1,191.89
		72.54	1,676.50	2,259.35	4,315.55	6,034.20	3,889.0	5,173.77

*Total of these items amounts to 1,547.70.

- (1) Fire-guard mileage is double the track mileage since the construction of fire-guards is required on both sides of the track.
- (2) Company exempted from fire-guard construction, as to portions of line where showing made that such construction is unnecessary or impracticable.
- (3) Employees of railway company refused permission by owner to enter upon land for purpose of constructing fire-guards.
- (4) Fire-guarding unnecessary, because fields already ploughed.
- (5) Fire-guarding in cultivated-land required only where the land-owner or occupant would undertake to plough guard at the reasonable price specified by the Board.

Fire Protection in Ontario, Quebec and New Brunswick along the Canadian Pacific Railway, Season of 1914

By *B. M. Winegar, Forest Inspector, C. P. Ry.*

In spite of the long, dry season and the droughts in May, July, and August, comparatively few very serious fires occurred on timber lands immediately adjoining the eastern lines of this railway. A great amount of damage was, however, done in various sections by fires which had their origin a long distance from our railway lines. Timber in the Laurentian mountains and on the upper Ottawa suffered severely,

New Brunswick Logging operations along this company's lines are not
Fairly Satis- being carried on, except perhaps to a limited extent,
factory and new settlement is not as marked as in some of the more western provinces.

Reproduction, which is very satisfactory generally, amply repays the cost of necessary protection. A total of 43 fires occurred on or within five miles of the company's lines during the fire season of 1914. Fourteen of these occurred within the 300-foot limit; of this number five were proved to be of foreign origin. Nine occurred immediately on the right-of-way, but the agency is not definitely known. The 29 other fires referred to occurred on cut-over timber lands, on farms, newly settled areas, etc. There was no damage from fires starting on right-of-way, nor did any fires on neighbouring land cause any timber losses. The fire situation in New Brunswick is fairly satisfactory.

Slash along highways, parallel to the company's rights-of-way, has been pretty well cleared up, and outside of a few deserted mill properties there seems little danger of a heavy loss.

Quebec has In the old settled and thickly populated districts there
Difficult is only a small portion of the area covered by forest
Conditions growth. These are used principally for wood-lots, but, here and there, some local timber industries thrive. Protection in such districts is comparatively simple, and very few losses are recorded each year. Fires rarely get away from the average farmer in the older districts, who is careful in doing his clearing.

Along the Laurentian and Maniwaki subdivisions, in the Laurentian mountains, a variety of conditions make difficult a satisfactory system of fire protection. Settlement is going on all the time, right after logging operations. The settler follows the lumberman, and the

debris and slash accumulation make the reduction of the fire risk most difficult. The average new settler is extremely careless, and added to this is the lack of passable highways. Several very important factors militate against the conservation of the merchantable timber and young growth. It has been shown that the most dangerous zone for fires lies between the railway line and the virgin forest, because here the settler is clearing up. This strip may be two miles wide, and, in some places, it is five miles in width.

Local organizations are needed in the villages and settlements to handle all fires. Equipment for fighting fire could be kept in an accessible spot, under the care of the local police officer, who could be named "fire warden." Telephone lines and lookout stations could be constructed at a comparatively small cost. The value of the two last mentioned improvements is indisputable, especially where topographical conditions such as exist in the Laurentian mountains permit.

Two protective associations, which are made up of lumbermen and pulp-wood limit-holders, are doing most efficient work along fire protection lines. One of these associations gives permits to burn during the fire season. This idea has proved very valuable, as it educates the settler not only to use care in handling his slash, but his contact with the local fire officer tends to ensure a more amicable relation between the settler and the lumberman.

In the Timiskaming country, the question of fire protection ought to be comparatively simple. Waterways allow the use of motor boats and a mobile equipment, and easy access could be gained to fires occurring near the lakes and rivers. Telephone lines and trails are badly needed in this area.

Ontario The lack of organization for handling fires, the
Conditions Very absence of cleared highways in the timber districts,
Unsatisfactory and the non-existence of the permit system for burn-
 ing on settlers' lands have resulted in a very dangerous and unsatisfac-
 tory condition. Especially is this so between Muskoka and Sudbury,
 and between Chalk River and Chapleau.

The system of fire protection which has been in force in Ontario looks only to the conservation of merchantable timber, and seemingly disregards reproduction, which is so essential.

Can. Pac. Ry. To reduce the fire loss to forest properties a fire pro-
Fire Protection tection system has been developed by this company,
 and the co-operation of all operating employees is
 given. A fire inspection force gathered data of all fires on or within
 five miles of the company's lines. Reports on the efficiency of the

patrols furnished, under orders of the Board of Railway Commissioners, were made by fire inspectors.

Circular No. 8, copy of which is attached, together with supplementary letter, outlines the plan for the elimination and extinguishing of fires which occur along the company's lines.

Under the order of the Board a number of special patrolmen were kept patrolling through the forest regions. During extremely dry seasons additional patrolmen were put on; and besides these, section-men constantly patrolled their sections.

The results proved satisfactory this past year, and little damage was done to timber by fires of known company origin.

CANADIAN PACIFIC RAILWAY

(Eastern Lines)

OFFICE OF THE GENERAL MANAGER

Montreal, April 3rd, 1914

To General Superintendents.

Dear Sir:—

Referring to my circular No. 8, dated February 25th, covering the prevention and extinguishing of fires on or in the vicinity of our right of way.

Your attention is drawn to the fact that sub-section (*e*) of section 13, General Order No. 107, of the Board of Railway Commissioners, specifies that the company's zone of responsibility is within 300 feet of the track. However, the company is interested in the preservation of all natural resources, and, therefore, whenever an employee discovers a fire outside of the 300 foot zone, he should immediately advise his superintendent, who will in turn telegraph the nearest provincial forest officer, notifying him that a fire has been discovered in such and such a place, outside of the company's zone; this, of course, so that the provincial authorities may have an opportunity to promptly extinguish the fire.

(Sgd.) A. D. MAC TIER

General Manager

CANADIAN PACIFIC RAILWAY COMPANY
(Eastern Lines)

OFFICE OF THE GENERAL MANAGER

Montreal, February 25th, 1914

Circular No. 8

To all Officers and Employees:

Instructions Covering Prevention and Extinguishing of Fires on or in the Vicinity of Right-of-Way.

In carrying out this Order, it will be the duty of all officers and employees generally, to take precautions to prevent fires on or along the railway of the Company, to promptly extinguish and prevent the spread of fires outside the right-of-way, and to investigate and report fires and probable cause thereof.

When fire is noticed by any train or engine crew, on or in the vicinity of right-of-way, they must notify first section gang after observing fire by giving three short whistles repeated twice.

Sectionmen, as well as such other employees of the Company as are available, must proceed at once to the fire, and take all possible and immediate steps to prevent its spreading, and, if possible, to extinguish it.

Conductor must send to Superintendent, by telegraph, from the first telegraph office, full report of any fire discovered by himself or of which he receives notice, giving the exact situation of the fire, its extent, and any other information which may be of value, particularly as to the means required to cope with it; and, when a fire threatens to be of any magnitude, copy of this report must immediately be telegraphed by the Superintendent to the Local Fire Inspector of the Board of Railway Commissioners.

If fire is of such an extent that sectionmen, or other local force available, cannot control it unaided, Superintendent, or, in his absence, his representative, must immediately arrange for the despatch of the Roadmaster, or other competent officer, with the necessary additional men, who can be drawn from those available in any department, and all necessary fire-fighting appliances, to the scene of the fire, and must so arrange the train service that they will get to the fire with the least possible delay, in order that no time may be lost in getting it under control.

The officer in charge must also arrange to obtain promptly complete statements from all witnesses so that origin of and responsibility for the fire can be accurately determined.

Employees must not do or cause damage or injury to any of the fire-protective appliances on any engine. The back dampers of engines must not be opened while running ahead, or the front dampers while running tender first, except when there is snow on the ground, and it is necessary to take such action in order to have engines steam properly.

Fire, live coals, or hot ashes must not be deposited upon the tracks or right-of-way, unless they are extinguished immediately thereafter, except in pits provided for the purpose. On no account shall ash pans be dumped, or ashes from cars or cabooses be thrown out on the right-of-way while running. Burning or smouldering waste taken from hot boxes shall be covered with earth, or otherwise completely extinguished.

Fires must not be started upon or near the right-of-way for the clearing of rubbish or dried grass from the right-of-way, between the first day of April and the first day of November, unless specially authorized by the Roadmaster or his superior officer. Officers of the Board of Railway Commissioners may at any time require that no burning be done along specified portions of the right-of-way, and employees must observe such instructions.

General Order No. 107 of the Board of Railway Commissioners provides as follows:

“If any employee or other person included in the said regulations fails or neglects to obey the same, or any of them, he shall, in addition to any other liability which he may have incurred, be subject to a penalty of twenty-five dollars for every such offence.”

A copy of this Circular must be posted at all Stations and Tool-houses, as well as in Bulletin Books.

(Sgd.) A. D. MACTIER

General Manager

PART II

Reports of the Committee on Forests of the Commission of Conservation

BY

CLYDE LEAVITT

Chief Forester, Commission of Conservation

REPORT FOR 1913

THE report of the Committee on Forests for the year 1913 is, for the most part, one of progress.

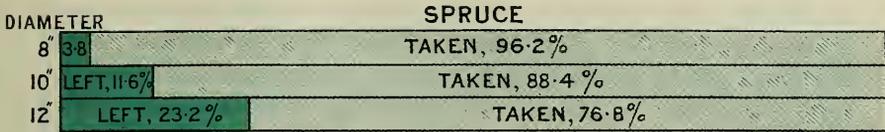
THE RAILWAY FIRE SITUATION

At the instance, largely, of the Commission of Conservation, the Board of Railway Commissioners on May 22, 1912, issued its well-known order, No. 16,570, with respect to forest fires along the lines of railway that are subject to its jurisdiction. The unique feature of this order was that it placed on the railway companies, under the jurisdiction of the Board, the responsibility of taking all the precautions reasonably necessary in order to prevent forest fires due to railway operation. For the purpose of administering the order, the Chief Forester of the Commission also holds the position of Chief Fire Inspector of the Board of Railway Commissioners, in pursuance of a co-operative arrangement between Hon. Mr. Sifton and the late Chief Commissioner Mabee. Thus, this Commission has every reason to take a particular interest in the railway fire protection work, although the actual administration of the work itself is necessarily under the sole jurisdiction of the Railway Commission, to the members of which the fullest credit must be given for the splendid support they have afforded the new department.

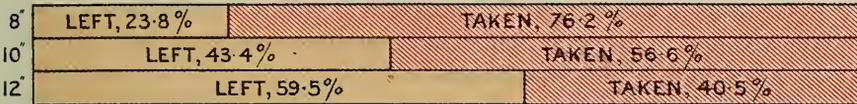
Railway Fire Protection Work

As was announced at the last annual meeting, the railway fire protection work was organized only in western Canada during 1912. In 1913, the organization was extended as far as possible in the eastern provinces. The plan of building up an inspection staff, through co-operation with the existing fire-protective organizations of the Dominion and Provincial

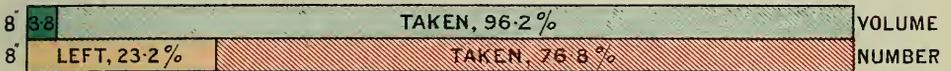
APPLIED FORESTRY



QUANTITY OF MATERIAL — CUTTING TO VARIOUS DIAMETERS



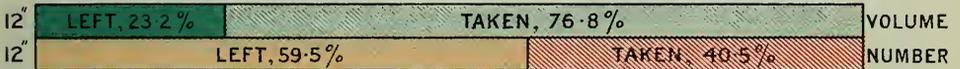
NUMBER OF TREES — CUTTING TO VARIOUS DIAMETERS



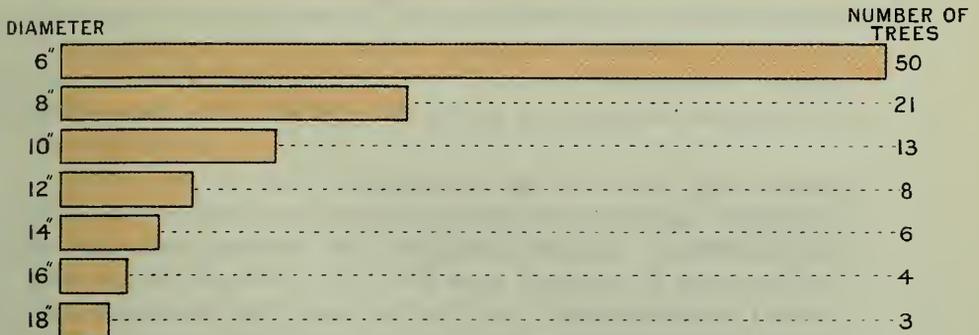
RATIO, NUMBER OF TREES TO VOLUME — CUTTING TO 8"



RATIO, NUMBER OF TREES TO VOLUME — CUTTING TO 10"



RATIO, NUMBER OF TREES TO VOLUME — CUTTING TO 12"



NUMBER OF TREES OF VARIOUS SIZES
REQUIRED TO MAKE 1000 FEET OF LUMBER

governments, within the territory already covered by the jurisdiction and organization of each, has been consistently followed throughout. As a result, a considerable number of the officials of the Dominion Parks Branch, Dominion Forestry Branch, British Columbia Forest Branch, Department of Lands, Forests and Mines of Ontario, Forest Protection Branch of Quebec, and the Department of Crown Lands of New Brunswick have been appointed officers of the Fire Inspection Department of the Railway Commission. The principal work of these officials has been in connection with enforcing the requirements respecting patrol work and right-of-way clearing by the railways, as well as co-operating with the Operating Department of the Board in the inspection of fire-protective appliances in use on locomotives. Thus, the fire-protective work of the Board is carried on in full accord with existing fire-protective organizations of the Dominion and Provincial governments, and all unnecessary duplication is avoided.

**Fire-Guards
in Prairie
Provinces**

In the Prairie provinces, fire-guard inspection has been carried on under the direction of the Chief Fire Guardian of Alberta and the Fire Commissioner of Saskatchewan, who have been appointed officers of the Railway Commission. It is hoped that a similar arrangement may be made in Manitoba, negotiations being under way for co-operation with the Fire Commissioner of that province.

Almost without exception, the results of the co-operative handling of the railway fire protection work have been highly satisfactory. Not only has the number of fires been reduced, but most of the fires that have occurred were prevented from spreading. It is worthy of note that the efficiency of the work is in direct ratio to the sufficiency and efficiency of the inspection staff made available by the various co-operating agencies. In the western provinces, especially, very little criticism can be made of the work. However, certain minor changes will be made with a view to still further increasing the usefulness of the organization.

In the east, the work of organization has been much slower, owing to the more conservative attitude taken by the authorities, resulting in an inadequate inspection staff being made available. Assurances have been received, however, which will mean a very much more satisfactory organization in the east during 1914. Such extension is particularly needed in Ontario at the present time. In Nova Scotia, too, the proposed plan of co-operation has not yet been put into effect, pending the appointment of a provincial forester. This appointment was provided for in a law passed last spring, following the report made by Dr. Fernow, on forest conditions in that province. It is proposed,

under this law, to give the forester, when appointed, supervision of forest protection work in general, including that of railway fire inspection.

The railways have, for the most part, shown a uniformly friendly attitude toward the work, and have made honest efforts to meet the various requirements. There is every reason to believe that henceforth the railways will be found near the foot instead of at or near the head, in the list of agencies responsible for forest fires, providing the amount of damage rather than number of fires be considered.

**Railways not
Subject to the
Commission** Before this condition shall be fully reached, however, it is urgently necessary that further action be taken as to two classes of railways which are not subject to the jurisdiction of the Railway Commission. These are the various railways operating under provincial charters, and the Government railways, consisting of the Intercolonial, Prince Edward Island, and National Transcontinental.

In regard to the first class, action in the form of new legislation, or, in some cases, a more complete enforcement of existing legislation, is required in the provinces of Nova Scotia, New Brunswick, Ontario and Alberta. The governments of these provinces have already been approached in this matter, and it is hoped that steps will be taken to improve conditions as to fire protection on provincially-chartered railways. The one great essential, which has all too generally been lacking, is the provision of an adequate inspection staff for this line of work.

During the past year, marked improvement has been shown in the matter of fire protection on Government railways. In the spring of 1913, following representations made by this Commission and by the government of New Brunswick, a system of special fire patrols was established along the line of the National Transcontinental railway between Edmundston and Moncton, N.B., and special instructions were issued to all employees relative to reporting and extinguishing fires occurring along the railway line. There is still much to be done, however, before the fire protection afforded on Government railways will be as efficient as on the lines now subject to the Railway Commission. Much still remains to be done in the matter of removing inflammable material from the rights-of-way of the Transcontinental and the Intercolonial. The former is in an especially dangerous condition, and measures should be adopted to destroy the debris at the earliest possible moment. Patrols should be established and regulations applied similar to those in force on the New Brunswick division. More attention should also be paid to the fire-protective appliances in use on

locomotives running on portions of the Transcontinental not yet opened to traffic.

It is believed, also, that the best results would be secured in the long run by making the Government railways subject to the same fire regulations as are prescribed by the Board of Railway Commissioners for lines under its jurisdiction. This action is accordingly recommended.

INVESTIGATION OF FOREST RESOURCES

Considerable progress may also be reported in connection with matters other than railway fire protection. A beginning has been made toward the collection of information relative to the forest resources and forest conditions of the Dominion. The value and importance of this work may be realized when it is considered that there is at the present time no sufficient basis for anything like a reliable estimate of the forest resources of the Dominion as a whole. It is, however, known, in a general way, that these resources have been vastly over-estimated, and that, instead of being able to supply the United States after her timber shall have been exhausted, Canada has, as a matter of fact, probably not more than one-fifth to one-fourth as much saw-timber as has the United States.

Inventory of Forest Resources Commenced The work of collecting this information was commenced during 1913 in two provinces. In British Columbia Dr. H. N. Whitford has gathered information relative to the territory south of the railway belt. In this work, the co-operation of the British Columbia Forest Branch and the Forestry Branch of the Canadian Pacific railway has been of the very greatest value. Limit-holders have also been of very material assistance, by furnishing information as to the quantities of timber in various specific sections of the province. At the same time, Mr. J. C. Blumer has been engaged in similar work in the district west of Prince Albert in Saskatchewan. Here the co-operation of the Forestry Branch of the Department of the Interior has been most helpful. As in British Columbia, the limit-holders have provided much valuable information. It is considered exceedingly important that this work be continued until the two provinces have been covered. This is the first attempt at a comprehensive study of this kind in Canada, and the results will undoubtedly be of great interest and value.

It now seems, however, that, unless the existing appropriation can be increased, not only will it be impossible to extend this work so that the final result for the whole Dominion may be secured within a reasonable number of years, but it may even be necessary to cut down the amount of work now being done in British Columbia and Saskatche-

wan, so that the results in these two provinces may be seriously delayed. It is believed that this work should be handled on such a scale that the data for British Columbia and Saskatchewan may be gathered within the next eighteen months, and for the whole Dominion within five years.

There are also various other investigations for which it is exceedingly important that provision be made. One of these is a study of forest reproduction and rate of growth, with a careful check estimate of the amount of standing timber on representative portions of the Crown timber lands of New Brunswick. There has already been tentative discussion with the Government of New Brunswick relative to a co-operative handling of this project. It is believed that the execution of such work as this, not only in New Brunswick but in other provinces as well, together with the collection, on an adequate scale, of data relative to the forest resources of the Dominion, will amply justify a request for an increased appropriation for the work of the Commission.

A detailed statement of the financial situation as to forestry work during the current year is as follows:

Cost of investigation of forestry conditions on the public domain, by J. H. White, approximately....	\$1,700
Cost of detailed study of forest reproduction on Trent watershed, by Dr. C. D. Howe, approximately....	1,600
Study of forest resources and forest conditions in Saskatchewan, by J. C. Blumer.....	1,000
Study of forest resources and forest conditions in British Columbia, by Dr. H. N. Whitford, to date	1,600
Necessary, for balance of fiscal year.....	1,100

The total approximate cost of conducting all the above field work, exclusive of travelling expenses of the Chief Forester, is thus approximately \$7,000. The projects of Messrs. White and Howe were conducted only during the summer, approximately four months. Messrs. Whitford and Blumer were not employed until late in the summer.

Dr. Whitford is still on duty, and the above estimate (\$2,700) covers a period of approximately seven months. The estimate for Mr. Blumer's work (\$1,000) covers approximately four months' work, and it is impossible to continue the project at the present time on account of lack of funds. Both these projects will require to be prosecuted during the whole of the coming year, and longer, unless the benefit of the work already done is to be largely sacrificed. In addition, provision should be made for one man to work with Dr. Whitford, in order that the report on the entire province of British Columbia may be completed within the next eighteen months. Provision should also be made for a detailed study of forest reproduction under various con-

ditions, on burns and cut-over lands in British Columbia, to supplement the information relative to the stand of timber, etc., being collected by Dr. Whitford.

A detailed summary of the needs for the ensuing fiscal year is as follows :

For continuation of work of Dr. H. N. Whitford, study of forest resources of British Columbia....	\$4,500
For additional man to co-operate with Dr. Whitford in British Columbia	4,500
For continuation of work of J. C. Blumer, study of forest resources of Saskatchewan.....	4,000
Study of forest reproduction in British Columbia.....	2,000
Co-operative forest investigation in New Brunswick..	2,000
	\$17,000
Total.....	\$17,000

The total needed is thus \$17,000, or \$10,000 additional to the sum made available during the present year. If the Commission desires to retain the services of Dr. Whitford and Mr. Blumer, continuous employment must be provided, otherwise new men must be found when the work can again be taken up, thus losing the benefit of the personal experience gained by the men, and delaying the work so greatly that its value will be largely lost before the final results can be secured.

DOMINION FOREST RESERVE EXTENSION

Each year, for some years past, the Forestry Branch of the Department of the Interior has had six or seven parties in the field examining the lands in the western provinces which are under Dominion jurisdiction. The purpose of this work has been to determine the lands that control watersheds or are absolute forest lands and which should, therefore, be set apart for timber production. In addition to the area of 35,805 square miles already set apart for forest purposes by Act of Parliament, the surveys show that there is an additional area of 20,980 square miles which is best suited for timber growth.

Protection of Forested Watersheds These areas are of two characters. There are, first, the large forested watersheds in the northern portions of the provinces of Manitoba, Saskatchewan, and Alberta, such as the Porcupine hills, the Pasquia hills, the Swan hills and others. These form the main watershed between the Mackenzie and Churchill River systems and the Saskatchewan and Red River systems, and should, in addition to protecting the water supply, form the great source of timber for domestic and manufacturing purposes for the great prairie regions to the south.

The second class of reserves are smaller or larger areas of light sandy lands, scattered through the prairie, which are of absolutely no agricultural value and which, although now generally denuded of tree

growth, may, by an active policy of reforestation, be made of great value to the surrounding prairies.

In the Railway Belt, in the province of British Columbia, there are also large tracts of mountain country which are suitable only for forest lands, and which, after examination, have been recommended for addition to forest reserves. The Commission of Conservation should use its influence to secure these additions to the forest reserves.

A detailed statement of the results of the Forestry Branch examinations is as follows:

*Approximate Areas of Additions to the Dominion Forest Reserves,
Recommended by the Forestry Branch, Department of the Interior*

BRITISH COLUMBIA (RAILWAY BELT)		
New Reserves		Square miles
Shuswap Lake	1,097	
Hope.....	1,044	
Nahatlatch.....	935	
Joss Mountain	802	
Petee	747	
Coast.....	1,200	
	5,825	
Additions to Existing Reserves		
Hat Creek	178	
Larch.....	30	
	208	
Total for British Columbia.....		6,033
ALBERTA		
Lac la Biche (new reserves)	4,248	
Lesser Slave (addition).....	1,496	
	5,744	
Total for Alberta.....		5,744
SASKATCHEWAN		
New Reserves		Square miles
Dundurn.....	63	
Sheep Creek	7	
Stench Lake	27	
Keppel.....	25	
Steward.....	31	
Eagle Hills	34	
Good Spirit Lake.....	6	
Manitou Lake.....	180	
Sturgeon River.....	560	
Pasquia Hills.....	2,592	
Big River.....	1,250	
Battleford.....	951	
Elbow.....	115	
	5,841	

Additions to Existing Reserves		
Cypress Hills.....	26	
Porcupine.....	2,559	
	2,585	
Total for Saskatchewan.....		8,426

MANITOBA

	Square miles	
Lake Winnipeg (new reserve).....	546	
Eastern Manitoba (new reserve).....	231	
	777	
Total for Manitoba.....		777

Total for British Columbia (Railway Belt), Alberta, Saskatchewan and Manitoba, 20,980 square miles.

TRENT WATERSHED SURVEY

There is now in process of publication a report on the Trent Watershed Survey, by Dr. C. D. Howe and Mr. J. H. White. This report was prepared under the direction of Dr. B. E. Fernow, and shows very clearly the serious consequences which have followed the agricultural settlement of a section of old Ontario, which for the most part is essentially non-agricultural in character. The soil having quickly become impoverished from cultivation, the people who remained on the poorer lands are living under undesirable economic conditions. The merchantable timber has been largely removed, and protection from fire on such lands, having ceased to be worth the while of the limit-holders, has therefore practically not been given. Neither has such protection been considered practicable or worth while on the part of the Provincial Government itself. The result is that the repeated fires have destroyed a young growth of timber having a potential stumpage value of millions of dollars, besides impoverishing the soil, facilitating erosion, and so changing the composition of the forest that its possible future value is greatly decreased.

Watershed of Trent Canal This is a matter of serious import to the Dominion Government, since the area in question comprises a large portion of the watershed of the Trent canal, the partial construction of which has already involved the expenditure of something like ten millions of dollars. It is thoroughly established that a forest cover exercises a very beneficial influence in preventing extremes of low-water and high-water stages. The maintenance of a forest upon the slopes is, therefore, of the greatest importance, in order to supplement and protect the necessary system of dams for water storage. To this end, it is essential that an adequate system of fire-

protection be established. Even during the past summer, fires burned over not less than 190,000 acres, largely covered with young growth, causing an enormous present and prospective loss. The interest and responsibility of the Provincial Government is great, since it still controls approximately one-third of the area in question. Probably the most practicable arrangement would be for the Provincial Government to take the initiative, the Dominion Government making a cash contribution to cover a portion of the cost of protection, in consideration of its very great interest in the matter. Co-operation on the part of the municipalities and private owners is also suggested in the report. It is believed that this matter is of sufficient importance to justify a conference between representatives of the Dominion and Provincial governments, looking toward the adoption of a definite co-operative plan for the solution of the problem.

It should be understood that the situation in the Trent watershed is not an isolated case, but is merely one example of a situation which exists to an alarming extent in other portions of the Dominion.

FOREST STAFF UNDER CIVIL SERVICE COMMISSION

In accordance with recommendations made at the last annual meeting, representations were made to the Federal and to the several Provincial governments urging the extension of the merit system of appointment for forestry and fire-protection work. So far as the Dominion Government is concerned, this matter is covered in a general way in the report of Sir George Murray, which is now under consideration by the Dominion Government. The elimination of political influence in matters of personnel is believed to be absolutely essential before satisfactory results can be hoped for in fire-protective organization. The extension of the jurisdiction of the Civil Service Commission to the field staff of the Dominion Forestry Branch would go further in increasing the efficiency of the fire-protective work of that organization than perhaps any other step that could be taken. This matter should again be strongly urged upon the Dominion Government.

FORESTRY ON DOMINION TIMBER BERTHS

During the past summer, a study has been made for the Commission of forest conditions on the public domain in Alberta, Saskatchewan and Manitoba and the Railway Belt of British Columbia. In this study, which was conducted by Mr. J. H. White, particular attention was paid to the matter of fire prevention through brush disposal, and to the question of securing a natural reproduction of the forest through control of the methods of cutting. In addition to certain technical

features, the question of organization is raised, and the fact is brought out that in matters affecting the timberlands of the Dominion Government, jurisdiction is divided between three separate branches of the Department of the Interior.

As to the timber berths, which comprise a very large percentage of the accessible merchantable timber on the public domain, both inside and outside the forest reserves and Dominion parks, responsibility rests upon the Timber and Grazing Branch of the Department of the Interior, which is, to a large extent, in practice, a fiscal organization, charged with the collection of revenue, the prevention of trespass, the administration of grazing leases, etc. This is due to the fact that, legally, the licensed timber berths are not a part of the forest reserves or parks, even though included within their exterior boundaries. The jurisdiction of the Forestry and Parks branches in the enforcement of timber regulations extends only to the lands in the forest reserves and Dominion parks not included in licensed timber berths. However, in the matter of establishing and maintaining fire patrols, the whole forested portion of the public domain is covered by the organization of the Forestry and Parks branches.

Brush Disposal as Fire Preventive The question of brush disposal as a fire preventive measure, and of so controlling the methods of cutting as to ensure the perpetuation of the forest, are the principal technical features of present-day forestry practice, and provision for these matters is made in the licenses covering all timber berths.

Both the Forestry and Parks branches have field organizations actually on the ground, sufficient to handle the work which falls within their respective jurisdictions. The Timber and Grazing Branch, which has jurisdiction over the licensed timber berths, is, however, not so fortunately situated in this respect, since it has only a limited field staff. The Crown timber agents and their office staffs are obviously unable to devote any material personal attention to these technical matters in the field. The inspectors under the Crown timber agents are the only men upon whom this work can fall under the present plan of organization. Of these, one is at New Westminster, one at Kamloops, one at Calgary, six at Edmonton, four at Prince Albert, and five at Winnipeg. The time of these men has previously been fully occupied with the duties regularly incident to their positions, and it would be hopeless to expect that anything like adequate results can be accomplished by trying to place upon these already fully occupied men the responsibility for the enforcement of the technical forestry provisions of the licenses. These provisions have not been enforced in

the past on the licensed timber berths, nor can they by any possibility be enforced under present conditions of organization.

**Lack of
Technical
Supervision** From a forestry and fire-preventive point of view, we thus have the anomalous situation of a total lack of the essential features of technical supervision of logging operations upon lands containing the vast majority of the accessible merchantable timber which is now the property of the Dominion Government. Until this situation is remedied in some way, the Dominion Government can have very little cause for self-congratulation so far as the practice of forestry is concerned. The particular way in which this problem of organization should be worked out is, of course, strictly a departmental matter. The main consideration is that the results ought to be accomplished in some way.

It goes without saying that, whatever the solution, it must involve the assignment to this work of men who are fully qualified by training and experience to enforce the technical provisions of the timber licenses with due regard at the same time to the future of the forest and the interest of the lumbermen concerned. Efficient results at a minimum of cost to the operator must be the aim. This work can most certainly not be handled by men without special qualifications in the way of training and experience.

The above is not intended, and should not be considered as, a criticism of the Timber and Grazing Branch. The situation simply appears to be that the Dominion Government has made no provision for the administration of forestry regulations upon the licensed timber berths of the public domain. As a result, the protection and perpetuation of the forest upon the best timbered areas, both within and outside the forest reserves and parks, is most seriously endangered. The correction of this omission is of the most pressing importance, and will amply justify the submission of strong representations by this Commission to the Dominion Government.

RECOMMENDATIONS OF COMMITTEE ON FORESTS, 1913

The Committee on Forests finds that, since the last annual meeting, the situation, to which its recommendations at that time referred, has changed but little, and that it can repeat with propriety most of the propositions then formulated—with some additions.

1. The protection from forest fires, in which decided progress has been made, still requires assiduous effort to make it effective in all directions.

2. The matter of fire protection along Government railways should be further taken up with the Dominion Government, and such rail-

ways should be made subject to the fire regulations prescribed by the Board of Railway Commissioners for lines subject to its jurisdiction.

3. Representations should be made to the governments of Nova Scotia, New Brunswick, Ontario and Alberta, urging that both legislative and administrative provision be made for requiring provincially chartered railways to take adequate steps to safeguard the adjacent country from fires due to railway causes.

4. The ascertainment or inventory of timber supplies has been properly begun in British Columbia, in co-operation with the Provincial Forest Branch and with the Forestry Branch of the Canadian Pacific railway, and in Saskatchewan in co-operation with the Dominion Forestry Branch. This work should be persistently continued. Co-operation of the Provincial Government of New Brunswick for the same purpose should be encouraged, and the governments of Ontario and Quebec invited to pursue a similar course.

5. The attention of the Dominion and Provincial governments should be again drawn to the vital necessity of withholding from settlement all lands which cannot properly be classed as agricultural, and of setting such lands apart for the permanent production of timber supplies. The importance should be especially accentuated of reserving and protecting from fire the vast areas of young forest growth, in order that they may reach merchantable size and form a future source of local revenue and industry.

6. The governments of Ontario and Quebec should be urged to undertake a systematic classification of land in the "clay belt" in advance of settlement, in order to have settlement properly directed.

7. A strong effort should be made to secure co-operation between the Dominion Government and that of the Province of Ontario, to solve the problem of protection and recuperation of the Trent watershed.

8. The extension of forest reservations in the public lands of the west should be forwarded, as the surveys by the Dominion Forestry Branch develop their desirability.

9. The organization of forestry branches should be urged on the two forest provinces, New Brunswick and Nova Scotia, which are still without such an agency.

10. The Commission reiterates its opinion that, in the forest services of the Dominion and Provincial governments, more than in any other service, the appointments should be based on capability and experience, such as may be secured by civil service examinations.

11. Representations should be made to the Dominion Government looking toward the adoption of some plan, whereby adequate pro-

vision may be made for the enforcement of the technical provisions affecting lumbering operations on the licensed timber berths.

12. The immediate establishment of a game preserve in the southern portion of the Rocky mountains, in Alberta and British Columbia, adjacent to the Glacier National Park of Montana, should be urged upon the Dominion Government and the Government of British Columbia. Immediately favorable action upon this recommendation is imperative in the interests of game preservation.

13. In the opinion of the Committee, an expenditure of \$25,000 per annum for the next four years is urgently needed, to furnish the basis for formulating and forwarding a forest policy for the Dominion.

14. In view of the importance, for water-power development, of the forest cover on the upper waters of the Winnipeg river, and especially on the watershed of the lake of the Woods, steps should be taken to segregate as a forest reserve the area drained by this river.

REPORT FOR 1914

In the matter of forest protection, the general aspects of the situations have not changed materially since the last meeting, though there have been improvements in some respects.

The fire season of 1914 was the worst since 1910, and the aggregate of loss will be heavy. Fire-protective organizations throughout the Dominion were severely taxed, and, in most cases, the results have shown that these organizations need strengthening in one or more respects, in order to provide really adequate protection. In practically all cases, larger appropriations are needed, especially for the protection of young forest growth. This action, wherever at all practicable under present conditions, is fully justifiable on the basis that fire protection must be regarded, not as an expense, but as an investment, necessary in the public interest, that will pay high dividends in the future.

INVENTORY OF FOREST RESOURCES

The inventory of forest resources, begun in British Columbia and Saskatchewan in 1913, has been continued during the past year. The financial situation has, however, made it necessary to cut down expenses, and the work in Saskatchewan, under J. C. Blumer, has been discontinued, with apparently no prospect of its being again taken up during the coming season. The work in British Columbia is being continued under Dr. H. N. Whitford and Roland D. Craig.

As indicated last year, there is strong reason for the belief that the forest resources of Canada have been much over-estimated in the past, and the necessity for a general stock-taking is obvious, in order

to provide the basis for a comprehensive plan for the intelligent conservation of this most important resource.

The Work in British Columbia In British Columbia, during 1913 and 1914, figures and other data have been collected covering over 200,000 square miles, at an average cost of about six cents per square mile. The explanation of this low cost lies in the fact that a very large amount of detailed information had been previously collected at great cost by the British Columbia Forest Branch, the Dominion Forestry Branch, the Canadian Pacific Forestry Branch, and a great many limit-holders. Practically all this information has been placed at the disposal of our investigators, and has been supplemented to a limited extent by further data collected by them at first hand, on the ground. Without the admirable co-operation of all these agencies the results which are being secured would be impossible except at a cost that would be prohibitive to the Commission. It is hoped that with one more year's work, the report on the timber resources of British Columbia will have been completed. In addition to the descriptive text, this report will include maps showing land classification, forest regions, silvicultural types, and range of the principal tree species.

Progress in Saskatchewan. In Saskatchewan, the work, to date, has covered some 60,000 square miles, but the information collected on a part of this area is incomplete, as financial considerations made it necessary to discontinue the investigation. At least another year should be devoted to completing the work in Saskatchewan, but it does not seem possible to carry it forward during 1915. The investigations already made show that the total amount of spruce in the timber limit belt of Saskatchewan is discouragingly small, especially in proportion to the vast area over which this timber is scattered. Fire has been largely responsible for this situation, and the need is emphasized for more adequate fire protection.

From this uncompleted investigation, the indications are that, of spruce saw-timber, there are in the portion of the province of Saskatchewan accessible by present logging methods, some 2,100 million feet, board measure. This area comprises 27,000 square miles, and includes all the timber limits, for which specific estimates have been secured from most of the limit-holders. Between this timber-limit belt and the Churchill river is another area of 33,000 square miles, with no timber limits, and for which the incomplete data available indicate a total stand of 1,200 million feet of spruce saw-timber, generally inaccessible under present conditions. North of the Churchill river is another vast area of 88,000 square miles, on

which the timber is generally poor and scattering. Assuming this vast inaccessible area to contain 200 million feet of spruce saw-timber, we have, roughly, for the whole of Saskatchewan a total of only 3,500 million feet of spruce of saw-timber size, of which not quite two-thirds is accessible at present.

Estimate for Manitoba and Alberta. While no detailed study has been made in Manitoba and Alberta, a very rough indication may perhaps be secured by applying the averages found in Saskatchewan. If this be done, we would have for Manitoba about 2,500 million feet of spruce, and for Alberta, some 6,000 million feet, making a rough total for the Prairie provinces of 12,000 million feet of spruce saw-timber.

While these figures are for the most part only rough approximations, they indicate clearly the depleted condition of these forests, and, before the advent of the white man, which has so generally been followed by large and destructive fires, they, undoubtedly, contained many times their present stand of timber. With adequate protection from future fires, these great areas would gradually re-establish their former productivity of timber wealth.

REPRODUCTION STUDY IN BRITISH COLUMBIA

During the past summer, an investigation was made by the Commission, to determine the conditions under which the reproduction of commercial tree species is occurring most advantageously in the coastal region of British Columbia. Particular attention was paid to the effect of fire upon the reproduction of Douglas fir, which is the most valuable and most widely distributed species in the province. The study was conducted by Dr. C. D. Howe, of the Faculty of Forestry, University of Toronto. In this work the British Columbia Forest Branch co-operated by assigning a forest assistant to work with Dr. Howe, and by furnishing a considerable amount of information available from the head office in Victoria. The report is now being put in shape for publication.

The report emphasizes the fact that the popular assumption that nature alone will provide satisfactorily for the replacement of valuable commercial forests on cut-over and burned-over lands is only partially true. Nature is oftentimes wasteful in her methods, and needs to be aided by man in order to secure the best results. This is particularly true with regard to forest resources. The detailed investigations made by Dr. Howe, in British Columbia, show, in the first place, that the burning of logging slash, at selected times and under

proper supervision, not only greatly reduces the fire hazard, but favors the reproduction of Douglas fir by exposing the mineral soil. However, repeated fires, and fires occurring during dry periods, not only destroy the young growth, but the seed trees as well, thus preventing or greatly retarding the establishment of a stand of commercial species.

**Repeated Fires
Destroy Valuable
Species.**

As a general rule, a sufficient number of seed trees is left after logging, so that one fire leaves enough for seeding purposes. Each fire thereafter, however, reduces them in proportionately larger quantities. Thus, through the diminution of seed trees, each fire makes it increasingly difficult to re-establish, by natural means, the forest on the successively burned areas. On this account, in many sections, reproduction of valuable species is wholly inadequate in amount, or is entirely lacking, since each successive fire diminishes the earning capacity of the area, from the point of view of timber production, unless artificial planting be resorted to; and this is impracticable at the present time, on any large scale, on account of the great expense involved. The same results can, however, be secured at relatively slight expense, by providing more adequate protection from fire on cut-over lands, especially those bearing young forest growth at the present time. In a sense, protection of young growth is more essential than that of mature timber, since the effect of fire is so much more disastrous, a single fire entirely destroying the young trees, while the old timber on the Pacific coast is very fire-resistant, being protected by a thick covering of bark. The additional protection needed naturally means the employment of a larger patrol force than has previously been practicable, on account of the limited funds available.

RAILWAY FIRE PROTECTION

Under the fire regulations of the Board of Railway Commissioners, the railway fire protection work has been continued along the lines of organization and policy established during 1912 and 1913. Steady improvement has taken place, and it is only fair to state that along hundreds of miles of railway lines, especially where there are no timber limits, the fire protective organizations of the railway companies have proved the most effective, and, in some cases, the only organized, agencies in those particular sections, for the extinguishing of fires. Some of the worst fires have been those which originated at a distance from the track and, in many such cases, the railways have been very effective in checking the spread of fires, for the origin of which they were in no wise responsible.

Co-operation in Fire Protection. The Board has established co-operation, in the handling of its railway fire inspection work, with governmental fire-protective organizations in all of the forest provinces with the single exception of Nova Scotia. In that province the situation reported a year ago still exists, and active co-operation is still pending, awaiting the appointment of a provincial forester, for which appointment provision has been made by law. Fire protection in general, and the railway situation in particular, would benefit greatly by the early appointment of a qualified man to this position.

At the past two annual meetings attention was called to the need for more adequate control of railway fire-protective work in a number of the provinces, along lines not subject to the Board of Railway Commissioners. This situation has, to a considerable extent, been cleared up during the past year.

Lines Brought Under Railway Board. Under the terms of the Canadian Northern Railway Guarantee Act, a number of provincially-chartered lines in the Canadian Northern system have been declared works for the general advantage of Canada, and thus come under the Board's jurisdiction. Of these, the most important are the Halifax and Southwestern, in Nova Scotia; the Quebec and Lake St. John, in Quebec; and the Irondale, Bancroft and Ottawa, in Ontario. Also, the Canadian Northern Pacific, comprising the British Columbia lines of the Canadian Northern system, will come under the Board when it is completed and opened for operation.

The International railway of New Brunswick, a provincially-chartered line, has been absorbed into the Government Railways system. The International runs through an almost solid forest, so that its acquisition by the Intercolonial serves to emphasize the need for the adoption of the same fire-protective measures upon Government lines as are required by the Government, through the Railway Commission, upon lines privately-owned. Upon the International, in particular, there is needed the establishment of special fire patrols and a thorough cleaning up of the right-of-way. Also, the special instructions to regular employees relative to reporting and extinguishing fires, issued during the past two summers, by the management of the Intercolonial, should be repeated prior to April 1, 1915, and each spring thereafter.

A year ago a resolution was adopted by the Commission, urging that Government railways should be made subject to the Railway Commission, so far as fire protection is concerned. However, this action has not yet been taken.

Reduction of Railway Fire Hazard Railway companies throughout Canada are seriously handicapped in their efforts at fire protection by the presence of large quantities of inflammable debris on Crown and private lands immediately adjoining railway rights-of-way. The prevention of fires through reduction of the hazard is a most essential feature of any campaign for better fire protection. All that the railways can reasonably be required to do under the regulations of the Railway Commission can never be more than partially effective so long as the lands adjoining their property are allowed to constitute the worst possible fire-traps. Further legislation, coupled with adequate enforcement, is necessary in order to provide satisfactorily for remedying the conditions on private lands and on Crown lands under license. As to Crown lands not under license, the remedy needed is not legislation, but provision for the expenditure of money, in order to gradually clean up the most dangerous sections. This, again, should be regarded, not as an expense, but as a dividend-paying investment. Work of this kind, especially along railway lines through parks and forest reserves, would be thoroughly suitable for alien enemies, for whom self-supporting employment must be furnished.

While the situation, as a whole, is still in urgent need of attention, distinct progress has been made along this line in some individual cases.

Burning of Slash Required During the year, the provincial authorities of British Columbia issued instructions requiring the burning of slash resulting from new public road construction, and also made provision for a beginning at cleaning up the old road slash, left from the work of previous years. Although only a relatively small beginning has been made as yet, the situation should now improve from year to year. The reduction of fire hazard in this way will materially benefit the general situation, and will be of particular value in the numerous cases in the mountains where public wagon roads necessarily parallel the railway lines closely.

In Ontario, provision appears to have been made for the satisfactory disposal of road slash on the very considerable amount of new construction, particularly in proximity to railway lines.

Co-operation Secures Good Results A particularly creditable piece of co-operation has been brought about between the Grand Trunk railway and the Department of Lands and Forests of Ontario, whereby an excellent beginning has been made in reducing the railway fire hazard through Algonquin park. This arrangement contemplates the careful and thorough disposal of inflammable debris on the Grand Trunk right-of-way and a strip of the Crown lands

adjoining on both sides, through the park, the cost to be shared equally between the railway company and the provincial government. It is understood that this work will be continued next summer, until the mileage through the park shall have been completed.

A further example, on a somewhat smaller scale, is the work done by the Department of Indian Affairs in disposing of old slashings along the Canadian Pacific line through the Shawanaga Indian Reserve, in the Muskoka district, Ontario. This work has been most efficiently done, and practically eliminates what was a serious railway fire hazard.

In these, and other individual cases, the railway companies have shown a thoroughly co-operative spirit, which has gone far toward inducing land owners to do their share and to meet the companies half-way. The continuation and extension of such co-operation will, in the course of years, reduce the railway fire hazard very materially.

DOMINION FOREST RESERVES

During the past year material additions have been made to the area of Dominion forest reserves in Saskatchewan, but there are still large areas of non-agricultural forest lands in all the western provinces which should likewise be included in permanent forest reserves. At the present time the total area of forest reserves and parks is as follows:

Manitoba.....	4,072.50	square miles
Saskatchewan.....	9,680.79	“ “
Alberta.....	26,270.90	“ “
British Columbia.....	3,777.56	“ “
Total	<u>43,801.75</u>	“ “

The net area of forest reserves alone is as follows:

Manitoba.....	4,072.50	square miles
Saskatchewan.....	9,680.79	“ “
Alberta.....	19,473.15	“ “
British Columbia.....	2,749.56	“ “
Total.....	<u>35,976.00</u>	“ “

Areas temporarily reserved, with a view to being, later, included in permanent forest reserves, are as follows:

Manitoba, approximately.....	700	square miles
Saskatchewan, approximately.....	3,200	“ “
Alberta, approximately.....	14,000	“ “
Total.....	<u>17,900</u>	“ “

This does not include areas which were examined during 1914, the temporary reservation of which has not yet been approved. The

Commission should exercise its influence to secure the early reservation of these additional areas of non-agricultural lands.

CIVIL SERVICE REFORM

The merit system of appointments is not yet in effect in the field service of the Dominion Forestry Branch. The passage of the proposed Civil Service Act would presumably lead to an order in council putting this very necessary reform into effect, together with others. However, there now seems to be some doubt as to whether this legislation will be enacted during the coming session of Parliament. All experience goes to show that a really efficient field service cannot be developed under the patronage system of appointment, and it is believed that, in the interests of forestry, the adoption of the merit system should be brought about at the earliest possible moment. The Canadian Forestry Association has also urged this reform for years, and it has been recommended by Sir George Murray in his report to the Dominion Government. It is understood that favourable assurances have been given by the Government. It appears, however, that the enactment of the new Civil Service Act is not essential to this action, but that it can be taken at any time by an order in council, under existing legislation, which action would still be necessary even under the proposed new Act. It is therefore believed that, whether the new Act is passed or not, at the coming session of Parliament, the Government should be strongly urged to issue an order in council placing the field force of the Dominion Forestry Branch in the inside service, and providing for the filling of all places by competitive examination. Many of the force, as at present constituted, are fully competent, but many others are not, and provision should be made for appointing qualified men. This is most urgently needed at the present time to place Dominion forestry on a satisfactory basis.

It should also not be overlooked that similar action is necessary as to the forestry and fire-protective services of the several provincial governments.

FORESTRY ON DOMINION LANDS

We are still faced with the anomalous situation of a practically complete divorce between the theory and practice of forestry on Dominion lands held under license to cut timber. This matter was discussed last year, on the basis of a report made for the Commission by J. H. White, of the Faculty of Forestry, Toronto. It was then shown that, while the Forestry Branch is well equipped with men technically trained in forestry and is administering the forest reserves, as well as affording fire-protection both within and outside these reserves, it has abso-

lutely no connection with the administration of cutting regulations on the licensed timber berths, although many of these berths are included within the boundaries of the reserves. This is because the timber berths are not legally a portion of the forest reserves. At the same time, the Timber and Grazing Branch, which is charged with the administration of the timber berths, has not, so far as known, even one man in its employ who has had any training in forestry whatever.

As stated last year, the principal technical features of present-day forestry practice are such control of the methods of cutting as shall ensure the perpetuation of the forest, and such measures of brush disposal, as a fire-preventive measure, as may be found practicable and desirable under the conditions of each individual case. The licensed timber berths naturally include the bulk of merchantable accessible timber on Crown lands, and it is obviously illogical and thoroughly undesirable in every way to permit the cutting of this timber without the most careful and intelligent enforcement of the existing regulations, which have for their object the perpetuation of the forest, by wise use. Such enforcement is, however, not now provided, and is impossible under existing conditions of organization.

FOREST RESERVES IN ONTARIO

The present area of forest reserves and parks in Ontario is 22,574 square miles, or 14,447,360 acres. This area, while large in itself, is not great in comparison with the 108,089,362 acres of provincial and township forest reserves and parks in Quebec; nor is it large in proportion to the total area of non-agricultural lands in Ontario which must always be chiefly valuable for the production of timber. There are many millions of acres of cut-over or burned-over forest lands in this province, belonging to the Crown, which are now practically without fire protection, but which contain a great deal of young growth and much timber at present below merchantable size. This timber, if protected from fire, would, however, ultimately become merchantable.

The present annual revenue from woods and forests in Ontario is in the neighbourhood of \$2,000,000. It is obvious that, if this revenue is to be maintained, new areas must be continually opened up for lumbering, and this, in turn, necessitates the protection of the non-merchantable areas and the young growth, in order that, when the time comes, they may contain merchantable timber ready for cutting. Any other policy means the sacrifice of a large future revenue to avoid much smaller present expenditures. Since the expense of protecting the large areas of young growth during the necessary period of many

years would in the aggregate be heavy, while there is, at the same time, a strong demand for the surplus revenues for purposes of general governmental administration, the problem is undoubtedly a difficult one. It seems probable that the situation could best be met by the adoption of a definite policy which would result in the reservation and placing under protection each year of a limited but definite area of young forest growth, found upon examination to be most suitable for this purpose. An excellent step in this direction was the addition last year of 2,000 square miles to the Mississagi forest reserve, and 811 square miles to the Algonquin park; but this constitutes only the beginning of what should be adopted as a definite and continuing policy.

Protection of Watersheds The necessity for further protection of important watersheds must also be considered. Water-power development is now a vital factor in the industrial life of the province, and this importance is bound to increase tremendously in the future. For the intelligent protection of this great interest, forest preservation is absolutely essential. A concrete example of this relationship was brought to the attention of the Commission at the annual meeting a year ago, by Mr. J. B. Challies, Superintendent of the Dominion Water Power Branch. As a result of the representations made by Mr. Challies, a resolution was adopted by the Commission, favouring the establishment of a forest reserve on the upper waters of the Winnipeg river, and especially on the watershed of the lake of the Woods. So far as known, however, no action has been taken by the Ontario Government.

TRENT WATERSHED

At the last two annual meetings of the Commission, there has been full discussion of the situation on the watershed of the Trent canal, and resolutions have been adopted and transmitted to the Ontario Government. However, so far as known, there has been no action taken, and the situation remains unchanged.

The land surface of this watershed comprises some 2,000 square miles, of which about one-third, or 725 square miles, still remains in the ownership of the Provincial Government. Of this, 450 square miles are still under license, while 275 square miles, or 176,000 acres, represent limits which have reverted to the Crown, after the licenses had lapsed or been abandoned. These Crown lands are practically all non-agricultural, and are chiefly valuable for forestry purposes.

It is understood that, on account of financial considerations, and the existence of very large areas of similar or better forest lands in the province, for which it is impracticable at the present time to pro-

vide adequate protection, there is little hope of the Provincial Government being able to provide the amount of protection urgently needed in the Trent watershed.

On the other hand, the Dominion Government is vitally interested in this situation, having already expended some ten million dollars upon works pertaining to the Trent canal. The protection of this watershed, and consequent regulation of waterflow, are essential to the full success of this undertaking. It is believed that, under these circumstances, the Dominion Government would be amply justified in incurring further reasonable expense for this purpose, in order to protect the investment already made, as well as the future expenditures which must be incurred in completing the project.

In the Dominion Forestry Branch, there is already in existence an organization admirably equipped to carry on this work. The Dominion Government has already been authorized by the provincial authorities to acquire Crown land in the Trent watershed at fifty cents per acre.

The Committee on Forests believes that the most practicable method of securing a beginning in the solution of this problem would be for the Dominion Government to proceed with the purchase of such portions of the 176,000 acres of unlicensed Crown lands as are fairly contiguous, and place the same under the Forestry Branch for protection and development; or else, considering the benefits which such action would confer upon the province, it may be possible to induce the province to place such areas, free of charge, under the care of the Dominion Government, under an arrangement by which, eventually, financial satisfaction might be secured for the province.

Undoubtedly, at least some plan of co-operation could be developed whereby a system of fire-protection would be established, covering the more important portions of the watershed outside as well as within this area. The cost of this work would not be great, in proportion to the benefits to be received.

**Value as
Demonstration**

In addition to the value of watershed protection, this work would have a very great indirect value as an experimental demonstration to all the provincial governments and owners of forest lands in eastern Canada, of what can be done in the way of restoring such waste lands to a productive condition. Educational work of this character is a thoroughly well-justified function of the Dominion Government, and is closely comparable to work which the Dominion Forestry Branch is already doing in the west, as well as to work in other lines which other departments of the government are conducting throughout the Dominion. It is also directly parallel to work which the United States Government is carry-

ing on in the eastern states, under the Weeks law. This law carries a large appropriation for the acquisition of non-agricultural forest lands on the watersheds of navigable streams.

The work in the Trent watershed could be taken up on this basis, by the Dominion Government, without any large expenditure, either for first cost or for annual charges. Also, entirely aside from the indirect benefits resulting from better watershed protection, the investment would, in the long run, undoubtedly be a paying one, from the sale of forest products in future years. In addition, these relatively barren lands would be made productive, and would thus add to the wealth of the country and afford an opportunity for labour on the part of the local population, for whom there is far too little remunerative employment under present conditions.

WIDER USE OF WESTERN COAL

During the past several years there has been some difficulty on account of excessive fire danger resulting from the use as locomotive fuel of certain western coals having poor coking qualities. This difficulty has interfered quite seriously with the use of some of these coals by railways during the summer season. In order to increase their summer market, the Canadian Coal and Coke Company has employed an expert to devise a spark arrester which shall so check the emission of live sparks from the stack, as to permit the reasonably safe use of such coals the year round. The Grand Trunk Pacific railway and the Operating and Fire Inspection Departments of the Railway Commission are co-operating with the Canadian Coal and Coke Company in the conduct of these experiments. The results already secured give considerable promise of success. Such an outcome is greatly to be desired, since the utilization of local coal supplies means the development of additional Canadian industries.

CO-OPERATIVE FIRE PROTECTION

A notable occurrence of the past year in eastern Canada was the organization last spring of the Lower Ottawa Forest Protective Association. The territory protected by this association comprises some 7,500,000 acres, on the watersheds of the Gatineau, Lievre, Rouge, Coulonge and Nation rivers, in the province of Quebec. The lines of organization are closely similar to those which had previously proved so successful in the case of the St. Maurice Forest Protective Association, whose territory lies just east of the territory embraced within the Lower Ottawa Association. The combined territory of these two associations now comprises approximately 15,000,000 acres

of forest lands. Both organizations co-operate closely with the Provincial Government of Quebec. In each case also, the association manager is an officer of the Fire Inspection Department of the Railway Commission, and secures co-operation in that capacity from the railways operating within the association boundaries.

Co-operative fire protection, having proved such a success in a portion of Quebec, as it had previously proved in many portions of the United States, there is every reason to hope that the movement will continue, and, in particular, that the plan at present under discussion of an association on the Upper Ottawa, shall be made effective.

GAME PRESERVATION

At the last two annual meetings of the Commission, resolutions have been adopted favouring the establishment of a game preserve in those portions of Alberta and British Columbia adjoining the Glacier National Park of Montana. Through the extension of the Waterton Lakes park, this action has now been taken so far as the Alberta portion is concerned, but no action has been taken in British Columbia. The provincial government very naturally objects to the establishment of a park in that section, which embraces a portion of the headwaters of the Flathead river, on account of interference with the further development of the natural resources, particularly coal. It should, however, be emphasized that the Commission has recommended only the establishment of a game preserve, and that this action could readily be taken without the withdrawal of either land or minerals from alienation, and thus would not at all retard the development of the natural resources of the section in question. All that is needed is the enactment of a law by the Provincial Legislature, or the passage of an order in council, closing an area of some 320 square miles to hunting, together with adequate provision for enforcement. Unless the Government of British Columbia can be persuaded to co-operate to this extent, it appears that there will be a serious limitation to the efficiency of the measures already taken by the United States Government in Glacier park, Montana, and by the Dominion Government in Waterton Lakes park, Alberta, looking toward the preservation of big game, particularly mountain sheep and mountain goats. This proposal has the cordial support of the Camp-Fire Club of America, which has continuously urged favourable action during the past several years.

SCIENTIFIC INVESTIGATIONS

While fire-protection is the first essential to any plan of forest administration, it does not by any means constitute all there is to

forestry, which is a well-developed science and profession in itself, even entirely aside from fire protection. The Dominion Forestry Branch, the British Columbia Forest Branch, and the Quebec Forest Service all have quite extensive organizations, and have done excellent work, while the Ontario Government is doing less and has only the nucleus of a forestry organization. New Brunswick and Nova Scotia have no forestry organizations at all. Past efforts have in all cases been directed primarily at protection and general administration, with very little attention to the carrying on of scientific investigations calculated to develop a permanent basis for Canadian forestry practice.

The Dominion Forestry Branch is now considering the extension of its organization to include a section of forest investigations, to be charged with the special conduct of fundamental scientific studies, the results of which shall, in the long run, guide the work of administration. This is a very necessary and exceedingly commendable project, and the Commission should urge its adoption, with adequate provision for making it effective.

RESOLUTIONS OF COMMITTEE ON FORESTS, 1914

1. The inventory of forest resources of British Columbia, now well under way, should be continued until completed. The similar work in Saskatchewan, now discontinued for lack of funds, should be resumed at the first opportunity. Similar studies should be commenced in other provinces as rapidly as funds will permit.

2. In connection with the investigation of forest resources of British Columbia, the Commission should recognize the exceedingly valuable co-operation afforded by the British Columbia Forest Branch, the Canadian Pacific railway, the Dominion Forestry Branch, and also of the large number of limit-holders and other individuals who have supplied detailed information. As to the work in Saskatchewan, the same acknowledgment should be made to the Dominion Forestry Branch and a large number of limit-holders and other individuals.

3. The Board of Railway Commissioners should be congratulated upon the beneficial results arising from its efforts toward better fire protection along railway lines.

4. The governments of Nova Scotia and New Brunswick should be urged to make early provision for the appointment of provincial foresters.

5. Further representations should be made to the Dominion Government concerning fire protection along the Government railways. Attention is particularly needed along the International railway of

New Brunswick, in connection with right-of-way clearing and the establishment of special patrols. The Government railways should be made subject to the fire-protection requirements of the Board of Railway Commissioners.

6. Representations should be made to the Dominion and Provincial governments, urging that a systematic beginning be made at reduction of the fire hazard along railway lines, by the removal of inflammable debris on a narrow strip adjacent to railway rights-of-way through forested sections. So far as lands in private ownership are concerned, legislation will be necessary in some cases, while, in others, the more thorough enforcement of existing provisions will be sufficient. The same is true as to Crown lands under license. To cover the situation on unlicensed Crown lands, the expenditure of money by the respective governments will be necessary. The more dangerous sections through forest reserves and parks should receive first attention.

7. The action already taken by the Dominion Government in the establishment and extension of forest reserves is to be commended. This policy should be continued as rapidly as the necessary land classification can be completed, and sufficient funds should be made available to provide for protection and administration.

8. The action most urgently needed at the present time, to increase the efficiency of the administration of Dominion forest reserves, is the extension of civil service regulations to include the field staff of the Forestry Branch, with provision for annual examinations of a thoroughly practical character, and the appointment of only those men found to be up to the required standard. Similar action is also urgently needed in the field services of the various provincial forestry and fire protective organizations.

9. The attention of the Dominion Government should again be called to the urgent need for such a change in organization as will result in the adequate enforcement of cutting regulations on licensed timber berths, with a view to securing better forest reproduction and a greater reduction of the fire hazard.

10. The Ontario Government should be urged to make further extensions of the forest reserve area, with a view to placing under protection and administration the better classes of forest growth on non-agricultural lands, not at present included in forest reserves and parks. Such action as to the best stands of young growth is particularly desirable.

11. A further attempt should be made to interest the Dominion Government and the provincial authorities of Ontario in the adoption of some co-operative arrangement looking toward the protection and

restoration of the Crown lands on the Trent watershed. It is suggested that these lands be turned over to the Dominion Forestry Branch for this purpose, under some arrangement acceptable to the Ontario Government.

12. Further representations should be made to the Government of British Columbia, favouring the establishment of a game preserve on the headwaters of the Flathead river, adjoining the Glacier National park in Montana and the Waterton Lakes park in Alberta.

13. The Dominion Government should be urged to make suitable provision for the establishment of a section of forest investigations in the Dominion Forestry Branch, such section to be charged with the conduct of scientific studies in the field calculated to furnish a permanent basis for Canadian forestry practice.

PART III

Forest Fires and the Brush Disposal Problem

Introduction by Clyde Leavitt, Chief Forester, Commission of Conservation

THE relation between forest fires and the brush disposal problem was fully discussed in *Forest Protection in Canada, 1912*. Up to that time, however, the question of brush disposal had received relatively little consideration in Canada; therefore, the discussion in the 1912 report was, for the most part, based upon conditions and results of investigations in the United States. The attempt was made in that report to draw some conclusions applicable to eastern Canada from experience under the operation of the state law of New York, which requires the lopping of tops of coniferous trees, in connection with logging operations on privately-owned lands in the Adirondack mountains. For western Canada the conclusions were based principally upon the results secured by the United States Forest Service, which has for years required some form of brush disposal as a condition of sales of government timber on the national forests.

Now, however, there is a considerable amount of information available, relative to the situation in Canada, and reports have been secured from the officials best qualified to state the facts and express opinions in the matter. Some further data are also added, showing later developments in certain portions of the United States.

There is no rule which can invariably be followed in this matter, unless it be one to the effect that the owner or operator should always consider what measures, if any, are both desirable and practicable, to reduce the fire hazard on the land in question. Undoubtedly, the establishment of an efficient patrol system, aided by the construction of telephone lines, trails, look-out towers, etc., must be placed ahead of brush-disposal in order of importance. With such a system established the disposal of logging slash will be found unnecessary in some cases, and, where advisable, the measures to be taken must depend on the surrounding conditions.

Since the Dominion and Provincial governments own a very large percentage of the timber-lands in Canada, this matter is primarily one



HEAVY LOGGING SLASH. DOUGLAS FIR COAST TYPE

Broadcast burning at a safe time is the only practicable method of reducing this fire hazard and preparing for a second forest crop.



INFLAMMABLE LOGGING DEBRIS IN NORTHERN COAST TYPE
Spruce, hemlock, cedar and balsam.

for their consideration rather than for the limit-holders or private owners. It is not to be expected that these latter, individually, will, to any material extent, be able to solve this problem, since the expense of brush disposal would add to logging costs, and thus place their product at a disadvantage, in comparison with their competitors, who do not incur this added expense. A government can, however, impose reasonable conditions for brush disposal upon all limit-holders alike, in connection with the renewal of licenses, and the added cost of this requirement should be taken into consideration in the readjustment of stumpage dues. Commercial conditions would thus be equalized in the long run, and no material additional hardship would be imposed on operators.

Under certain circumstances the disposal of logging slash is unquestionably necessary if large areas of non-agricultural lands are to continue to add to the wealth of the country by producing successive crops of timber. Vast areas of cut-over lands totally unsuitable for agriculture, have already been turned into barren deserts by fire, due to the extreme hazard caused by inflammable logging *debris*, and to the failure of the respective governmental agencies to provide adequate machinery for the detection and control of such fires.

The adoption of measures for the reduction of the fire hazard in connection with logging operations must be regarded as only a matter of time. This change must, however, be preceded by the dispelling of the apathy and inertia which exist only too generally on the part of both government officials and the general public. It is distinctly encouraging to note that a beginning at brush disposal on Crown lands has been made under the direction of the British Columbia Forest Branch and also of the Dominion Forestry Branch.

DISPOSAL OF LOGGING SLASH IN BRITISH COLUMBIA

By R. E. Benedict, Assistant Forester, British Columbia Forest Branch

The one factor which prevents, and which will continue to prevent for many years, the adoption and application of advanced or scientific methods of growing timber in the North American continent is the extremely small amount of the wood crop which can be used or marketed. Speaking generally, only stems sixteen feet long and at least eight inches in diameter, sound, straight and fairly free from large knots, can be profitably harvested.

This means that all tops and branches, most of the unsound stems and logs, all small trees, nearly all of the dead and down trees, and all undergrowth must be left on the ground. The amount of such

material varies, of course, with the character of the forest and the market, but even under the most favourable conditions it is considerable, and, in the dense forests of the Rocky mountains and Pacific coast, the quantity is enormous. In other words, the standard of merchantability is so high, as compared with the wood material produced under natural conditions, that the greater part of the crop must be left on the ground. Further, it prevents putting into effect the very measures (thinning and removal of weakened or undesirable trees) required to increase the quality of the crop, and at the same time to reduce the amount of waste or unusable material produced. It also materially lengthens the time necessary to produce high quality timbers, thus increasing the cost of production.

This condition can only be improved by the discovery of new uses for such material, the invention of new and cheaper methods of logging, and the opening up of new markets. Such changes can come about only very slowly, and, timber being largely controlled by private capital anxious for increased profits, no doubt advantage will be taken of every chance to utilize a larger proportion of the forest product.

In the meantime, however, timber owners, both private and governmental, are confronted with the many problems resulting from this condition. The most important of these problems are, first, the great increase in the fire hazard occasioned by large amounts of combustible material left on the ground and exposed to the sun; and, second, the unfavourable conditions for regeneration of the forest, the result of the soil being covered by the piles of slash, brush, tops and logs. The effect of the slash on the fire hazard and on regeneration varies with the character of the forest and with the nature of the logging operations; to understand the condition in British Columbia surrounding the problem of slash disposal, a brief description of the forest regions and methods of logging must be given.

Forest Regions of British Columbia The climatic conditions of British Columbia include a heavy rainfall and an extended growing season along the coast, and, in the interior, long winters, with consequent conservation of the snowfall, and moderate rainfall in the summer, in conjunction with a short but vigorous growing season. These conditions insure, throughout almost the whole of the province, a dense forest growth with rank undergrowth. Only at low altitudes, in the dry belt—which is the term applied to the section lying between the Cascade range and the foothills of the Gold and Cariboo mountain ranges—and in the lower portions of the Kettle, Columbia and Kootenay valleys, do long, hot summers and light rainfall restrict the forest growth to arid types or prevent it altogether.





Commission of Conservation

Canada

SIR CLYDE DIXON, K.C.M.G., CHAIRMAN

JAMES WHITE, ASSISTANT TO CHAIRMAN

FOREST REGION MAP OF SOUTHERN BRITISH COLUMBIA

BY R. E. BENEDICT

from information furnished by British Columbia Department of Lands, Forest Branch

MAN, W. F. RANK, ASSISTANT

H. B. MacMillan, Chief Forester

Scale



The northern limit of Region also includes the Queen Charlotte Islands which include the bulk of the map.

UNITED STATES

Using climatic factors as the basis of forest classification, seven broad regions may be distinguished as follows.*

Douglas Fir Coast Region An annual precipitation of over 50 inches, a mean temperature of 45 degrees, with an absence of extremes, a humid atmosphere and long growing season, which characterize the climate of the southern coast and the greater portion of Vancouver Island, produce a coniferous forest which is only equalled for density, rapidity of growth, yield and individual tree development, in the coast regions of Oregon and Washington, where the same climatic conditions prevail.

The typical stand in this region is of even-age origin, dating from a fire, and is made up of varying proportions of Douglas fir, hemlock and cedar, with occasional admixture of spruce, white fir, lovely fir, and white pine. Where this typical stand escapes fire for a period of 400 years, the Douglas fir drops out, and, thereafter, the forest continues as an uneven-aged stand, the blanks being filled by reproduction of hemlock, cedar and lovely fir. Pure stands of hemlock are of frequent occurrence, and, occasionally, nearly pure stands of cedar are found.

The forest is everywhere very dense, regardless of age, with a very rank undergrowth of shrubs and hemlock seedlings, and a heavy deposit of dead leaves, branches and down trees, all covered with a thick layer of moss. The mature stands bear from 10,000 to 100,000 feet, board measure, per acre, with an average of 20,000 feet.

Commercially, Douglas fir is the most important forest type in British Columbia, furnishing at the present time over 1,000,000,000 board feet annually, or two-thirds of the lumber cut of the province.

Owing to the density of the stand, the great size of the individual trees, the heavy undergrowth, the large amount of dead vegetable material on the ground, the destructiveness of the methods of logging (donkey engines and wire cable being used almost exclusively), and the high standard of merchantability, the amount of *debris* left on the ground is really stupendous, and the damage to the remaining trees is generally so great as to destroy their further usefulness.

The heavy deposits of *debris*, besides rendering the conditions extremely unfavorable to re-seeding, constitutes a fire hazard so great that any attempt to use the remnants of the stand as a basis for a second crop would be altogether impracticable. Again, Douglas fir is undoubtedly the most rapidly growing and commercially valuable species, and, unless the *debris* is removed, this tree will form only a very small proportion of the new stand, hemlock becoming the predominant species.

* For situation of regions see accompanying map.

All the facts therefore point to the uneven-aged Douglas fir stand as the most suitable forest for this region; this means that the *debris* must be disposed of to allow the fir to reseed, and the extreme fire hazard, created by the *debris*, to be thus removed.

**Northern
Coast
Region** Rainfall, averaging more than one hundred inches annually, an average annual temperature under 45 degrees, severer winters with heavy snowfall, a shorter growing season and an absence of sunshine, with its important influence in assisting decomposition of vegetable matter, and the creation of healthful soil conditions, occurring in conjunction with a rugged and rocky topography devoid of soil deposits, produce a forest along the northern coast of British Columbia very different from that in the Douglas fir coast region.

Hemlock is a universal constituent of the stand, mixed with cedar and spruce, and occasionally with yellow cedar. The forest is dense, although the trees, except in the best situations, are short and extremely defective, the hemlock rarely being of a merchantable character. The undergrowth consists almost wholly of hemlock and cedar brush, and is fairly dense. The most characteristic feature of this forest region is the deep accumulation of vegetable material, consisting of down trees, branches, leaves, moss, roots, etc. This layer, which is often many feet deep, is saturated with water practically throughout the year and consequently assumes the nature of a muskeg.

In the interior, the rainfall becomes less, and the summer temperature higher, while on the watersheds of streams like the Bella Coola, Dean, Skeena and Nass rivers, which cut through the Coast range, the conditions as regards climate and soil are so much different from those of the coast and coastal islands, as to produce a marked improvement in the forest. On the Bella Coola and Dean rivers the Douglas fir coast type reappears, and, on the Skeena and Nass, there are extensive areas of merchantable forest in which spruce is the dominant species. On the map, the forest on the Bella Coola and on Dean channel is properly classed with the Douglas fir coast type, but the dense spruce and hemlock forests of the Nass and Skeena watersheds can be considered only as a variation of the northern coast type.

In this region also belong the forests of Queen Charlotte islands, although here the better soil results in an increase in the proportion of spruce and in a better development of the trees. Everywhere in the region, however, there are found very marked accumulations of undecomposed vegetable material which, as has been said, can be considered a distinguishing feature of the region.

From a merchantable standpoint, the forests covering the rugged islands which dot the coast and the western slopes of the coastal mountains are not of great present value, the merchantable stands being limited to isolated tracts where soil conditions are favourable. On the northern end of Vancouver Island, on the mainland opposite, and on Queen Charlotte islands, the necessary soil conditions are present and, here, there are extensive areas of hemlock, cedar and spruce fit for lumber. Speaking generally, however, a large portion of the stand in this section is not suitable for manufacture into lumber, although probably large areas will be used for pulp. This is also true of the dense spruce and hemlock forests of the Nass and Skeena watersheds. The spruce here, however, is suitable for lumber and will be used for this purpose to an extent sufficient to supply the small local market.

It is evident that under the conditions,—a dense stand of low-grade timber and an excessive accumulation of undecomposed vegetable material,—little can be done to assist regeneration and promote the rate of growth, where only saw-timber is removed. Fortunately, the fire hazard, though present for short periods in July and August, is not high, consequently the fire danger may, for the present at least, be neglected. The only places where the removal of *debris* might be justified are those where logging has totally destroyed the stand and where the soil is of sufficient depth to insure an immediate new growth. Where rock underlies the layer of dead vegetable material, efforts at disposal of logging *debris* will not be advisable.

In the spruce and hemlock forests on the Nass, Skeena and other rivers, where there is a deposit of soil, destructive logging methods will be indulged in, and an excessive amount of *debris* produced. The trees remaining after logging will consist of undesirable species, and regeneration will be impossible without the removal of the slash and layer of dead material. Undoubtedly, however, there will be large areas on the upper slopes on which the conditions will be similar to those on the coast, and consequently it will be inadvisable to attempt to dispose of the *debris*.

Summarizing, it may be said that, in the northern coast region, there will be extensive areas of forest in which, on account of absence of real soil, removal of the slash and dead vegetable material should not be attempted. The forest on these areas, however, is of small merchantable value at present, and logging operations in it will be very restricted. The merchantable forests of the region, which are situated in the north end of Vancouver Island, on the mainland opposite, on the upper reaches of the rivers which cut through the coastal mountains, and on Queen Charlotte islands, are everywhere very dense, with

a heavy accumulation of dead vegetable material, and, to insure prompt re-stocking of the most suitable species and to promote the rate of growth, the slash resulting from logging and the dead vegetable material must first be removed.

**Interior
Wet Belt
Region** Paralleling the Coast range, at a distance of about a hundred miles, and separated from it by a broken or rolling plateau averaging 3,000 to 4,000 feet in altitude, though intersected by several deep valleys, the Gold and Cariboo mountain ranges rise to a height of 5,000 to 8,000 feet, and maintain this altitude for a length of 350 miles north of the International boundary. The Gold range is paralleled again for a length of 250 miles—at a distance of 80 miles further east—by the Selkirk range, the deep valley of the Columbia lying between the two ranges. Northward of the termination of the Selkirk range, the Rocky mountains continue in the same direction as the Gold and Cariboo ranges for a distance of 200 miles, and separated from them by the deep valleys of the Canoe and Fraser rivers. This region of parallel mountain ranges and their many peaks, all separated by deep valleys, is characterized by a climate which partakes somewhat of the nature of those of both the coast and dry belts.

The annual precipitation amounts to between 30 and 40 inches, the average annual temperature is in the neighbourhood of 40 degrees, with warm summers, and winters which, though cold, are free from long periods of extreme low temperatures. The growing season is long, considering the latitude and altitude, with a comparatively humid atmosphere. The heavy snowfall insures plenty of moisture in the beginning of the growing season and, generally, there is sufficient rainfall in July and August to maintain most favourable growing conditions throughout the summer. Locally, this region is known as the second, or interior, wet belt, and the term has been applied to the very distinctive forest which the favourable climatic and soil conditions produce.

While many sub-forest types are found in the region, the forest generally is characterized by great density, rapid growth, a large yield and excellent individual tree development, although, of course, it does not equal that found in the Douglas fir coast region.

Cedar, hemlock, Douglas fir, lodgepole pine and spruce are found over nearly the whole region, while western white pine is a constituent of the stand on the Columbia and North Thompson watersheds. Larch is found on the slopes surrounding the Arrow and Kootenay lakes, and yellow pine in a narrow fringe along the Columbia, Pend d'Oreille and Kootenay rivers, Lower Arrow lake and the south arm of Kootenay lake. Northward, on the Clearwater river, on Quesnel lake and along the main stream of the Fraser river, hemlock, cedar and Douglas

fir, while they still occur, form a less important component of the merchantable stand, which consists largely of spruce.

Probably no equally extensive forest region on the continent has suffered so severely from fire as has this district, it being estimated that 75 per cent of the forest has been burned over at least once during the last 50 years, destroying 100,000,000,000 feet of timber. The burns, however, all promptly re-stocked, showing that fire, by the removal of the dead, vegetable covering, creates the conditions necessary to regeneration.

The forest of this region differs but little from the Douglas fir coast region, so far as conditions resulting from logging are concerned, and the only possible method of ensuring a good second growth of the most desirable species, is by destructive, clean logging, and disposal of the resultant slash and layer of dead vegetable material. Areas do occur, however, in which the amount of merchantable material consists of scattered trees, and here it will pay to make use of the remaining trees as a basis for a second crop.

Commercially, this region is second in importance only to the coast fir region, yielding about 300,000,000 feet in 1913. In the possibilities of future production, it probably excels the coast fir region, owing to its greater area of productive land, most of which is covered with an excellent young growth.

Yellow Pine Region Between the Coast range and the Gold and Cariboo mountain ranges lies a plateau, having a general elevation of 3,000 to 4,000 feet, cut through by the deep valleys of the Fraser, North Thompson, Okanagan, Nicola and Similkameen rivers, over which semi-arid conditions prevail. Similar conditions are found along the International boundary in the low valleys of the Kettle, Columbia and Pend d'Oreille rivers, and the two valleys of the Kootenay.

These valleys and the lower portions of the plateau possess a long growing season and very hot summers, which, with the limited precipitation (10 to 20 inches annually) effectually prevent the formation of denser forest types and restrict individual development.

On the valley floors and benches and lower slopes, in these districts, occur the only timberless lands in the province below timber line, not due to excessive moisture. These lands bear a good growth of nutritious grasses and a small amount of sage brush. They are not, however, extensive in area. On moist, bottom lands, on poor-soiled benches, and on the slopes, they yield an open to fairly dense stand of yellow pine, Douglas fir, tamarack and lodgepole pine, with a ground

cover of grass and weeds. There is a general absence of brush and thickets of second growth.

The greater portion of this forest region is, at present, of little commercial value, owing to the scrubby nature of the trees. The only considerable tracts of merchantable timber occur in the Kettle and east and west Kootenay valleys. Here the forest is fairly dense and is composed of a mixture of yellow pine, Douglas fir and larch, and logging operations are being carried on at a number of points. Although more of the timber in these stands is being utilized than is the case in any other type, and although there is an almost entire absence of down timber or other dead material, the slash resulting from logging is still considerable and the fire hazard great, owing to the dryness and hot weather. However, the mature and young growth trees remaining after logging are all needed for seeding purposes and protection of the moisture supply, so that, in many places, the slash would prove of benefit if it could be left without increasing the fire risk.

Altogether, the situation as regards the disposal of the slash in this type of forest is complicated by a number of opposing factors. It may be said, however, that, if the fire hazard can be overcome in some other way—as, for instance, by the construction of effective fire breaks—the slash should be allowed to remain on the ground.

Rocky Mountain and Plateau Region As previously stated, semi-arid conditions prevail on the uneven plateau which lies between the Coast range and the Gold and Cariboo ranges. The general altitude of this plateau is between 3,000 and 4,000 feet, but, towards its northern limits, at the foot of the Babine mountains, and, of course, where streams have cut into it, elevations of 2,500 feet, and even lower, are to be found.

The climate is typical of the eastern slope of the Coast range throughout its length, and also of the Rocky Mountain region in the states of Montana, Idaho, Wyoming and Colorado. A precipitation ranging from 10 inches to 20 inches, long, cold winters and warm, dry summers, with cool nights, do not constitute conditions favourable to tree growth, and forest growth would not be possible, were it not for the accumulation of the snowfall in winter, the melting of which leaves the ground saturated at the beginning of the growing season. On good soil, and on protected slopes, however, the available moisture is conserved, and permits the formation of dense though slow-growing forests.

The same climatic conditions are found on the western slope of the Rocky mountains, from the International boundary to Yellowhead pass, and, since the forest is of identical character, the whole region is included. The distinguishing species throughout the immense

interior plateau and the long though narrow slope of the Rockies, is lodgepole pine. Over extensive areas, it forms practically pure forests, especially on the higher elevations with poor soil conditions. The stand is everywhere dense and the timber small, the trees rarely being of sawlog size. Practically the only use now made of lodgepole pine is for railway ties, but it is probable that it will be utilized for pulp-wood in the near future. Spruce is common along all the streams and on most good soils. On good sites at high elevations it frequently forms almost pure stands, balsam being the only other component. Douglas fir occurs at elevations below 2,500 feet throughout all but the north-western portion of the plateau region and over the whole length of the Rockies to Yellowhead pass. In the southern portion of the region it is found as high up as 4,000 feet. Along the Fraser and the North Thompson it is found in almost pure stands on limited areas. Generally, however, it occurs in mixture with lodgepole pine. The timber, though rough and often defective, will make rough lumber and railway ties. In the aggregate, considerable quantities are available and will, eventually, be used. Up to the present, however, only a few portable mills are using it. Yellow pine creeps into the type south of Bridge river and the North Thompson, but has no commercial significance.

Like the wet belt region, this forest region has, both in the plateau and Rocky mountain sections, suffered severely from fires. Scarcely any considerable areas are without traces of old fires, and vast tracts have been almost completely denuded. Regeneration, however, follows quickly and most of the severely burned lands are covered with a dense second growth. After a fire, poplar is a universal component of the stand, but is of commercial importance only on moist soils at low altitudes. Here, it attains a diameter of six inches to twelve inches and a height of 50 feet. Until the pulpwood industry can make use of it, its only value will be for cordwood, fences, etc.

Throughout the forest of this immense region there is a considerable accumulation of dead, fallen timber, branches, leaves, moss and other vegetable material, which adds greatly to the fire risk and interferes with regeneration. The timber also is small, with a relatively large crown, and logging operations will result in a large amount of slash. Owing to poor soil fertility and the small supply of moisture which exists in this region, and the resultant slow rate of growth, any practical plan for management must include measures to preserve and improve these most important factors of growth. Since the logging slash and dead material are also an obstacle to regeneration, a cautious policy must be adopted as regards the removal of the *debris*. Apparently, no general rule can be followed, each case requiring measures to

fit the conditions. Where removal of the *debris* is undertaken, however, it must be carefully done, the so-called broadcast method of burning usually being out of the question.

Fraser Basin Region That portion of the great interior plateau, which takes in the secondary drainage system of the Fraser river, between Alexandria and Prince George, those of the Nechako below Fort Fraser, Stuart river below Tacla lake, and the entire drainage basin of the Fraser between Prince George and the Bear river, has, generally, a lower elevation than the western and southern portion of the plateau, and possesses also better soil conditions and a heavier precipitation. These conditions also extend over the upper portion of Babine lake and the drainage basin of the Parsnip river, above and including the Nation river. While there are drainage divides and isolated hills, having an elevation of over 3,000 feet, the general elevation of these basins is less than 3,000.

While dependable records are not available, it is believed that the annual precipitation is everywhere over 20 inches and, in places, reaches 30 inches. The winters are long and cold, and the snowfall heavy, but the long days of this northern latitude apparently make the growing season as favourable to forest growth as the climates of more southern latitudes. The favourable climatic conditions, taken in connection with the deep soil, result in the formation of a very dense forest with a remarkable yield, considering the latitude. As in all the dense forests of the province, there is a very heavy accumulation of dead vegetable material, which effectually prevents regeneration of the most desirable species.

The forest of the region is made up of a number of sub-types. Spruce occurs everywhere in admixture, and frequently in nearly pure stands, the only other species appearing with it being balsam. On good areas these spruce stands run as high as 20,000 feet per acre, 10,000 feet being common. Lodgepole pine is found over the entire region, either in pure stands or in admixture with spruce, balsam and fir. Its presence, however, on all but the drier soils is due to fire, since it reseeds immediately and forms a reserve crop for the spruce.

Douglas fir is, or once was, a constituent of the stand on all well drained lands below an elevation of 2,500 feet, but fires have removed it from all but the drier sites. The individual development of all species is excellent, spruce and Douglas fir frequently reaching 30 inches diameter and 100 feet in height. Stands of 10,000 and 20,000 feet per acre are not rare, and, as an annual yield of 100 feet per acre can be expected on the good soiled lands below 2,500 feet altitude, the region is an important and valuable one for the production of timber.

Probably 75 per cent of the area has been burned over since the advent of the white man, about 1860, the timber destroyed amounting to approximately 50,000,000,000 board feet. Except in a very limited way, logging has not yet commenced in the region, but it is evident that, owing to the density of the forest and high percentage of merchantable timber in the stand, the great amount of slash produced will constitute a highly dangerous fire hazard and a serious obstacle to regeneration. In this forest, the removal of the slash and of the deposit of old material is therefore plainly necessary.

Northern Interior Region The portion of the province north of the Fraser drainage basin is essentially mountainous, with narrow, separating valleys. This is true of at least that portion included within the Peace, Skeena and Nass watersheds. The only considerable areas of level land in this great region are found on the Peace river within the "Peace River Block" and in the valleys of the Finlay, Parsnip and Bulkley rivers.

The climatic conditions include a precipitation of over 20 inches, mostly in the form of snow, long cold winters, and a short growing season with frequent summer frosts. These conditions permit the growth of only sub-alpine species, and the forest of the region contains only spruce, lodgepole pine and balsam.

The mature forest is everywhere dense, its composition ranging from nearly pure stands of either of the three species to varying admixtures of the three. In the valley lands, good merchantable stands of spruce occur, which will be utilized for both lumber and pulp on the completion of projected railways.

The forest floor is covered with the same heavy deposit of undecomposed vegetable material which marks nearly all the forests of the province, and the removal of this material and of the large amount of slash which will result from logging operations, will be necessary to prevent devastating fires and to prepare favourable conditions for regeneration.

Summary of Timber Areas The area of the different forest regions described within the portion of the province under administration, estimated at 160,000,000 acres, is, after allowing for barren areas, approximately 120,000,000 acres, divided as follows:

	Acres
Douglas Fir Coast region.....	18,000,000
Northern Coast region.....	20,000,000
Interior Wet Belt region.....	22,000,000
Yellow Pine region.....	5,000,000
Plateau and Rocky Mountain region.....	26,000,000
Fraser Basin region.....	14,000,000
Northern Interior region.....	15,000,000

Total 120,000,000

Eliminating the land capable of agricultural development, which is estimated at 15,000,000 acres, there are left 105,000,000 acres of land whose only value to the province (outside of the grazing value of 20,000,000 acres) is its adaptability to the production of timber. The province is truly a forest country, and, with agricultural land occupying less than 10 per cent of its area, it is evident that its future is inseparably bound up with the crop of timber which can be grown on this 105,000,000 acres. The climatic and soil conditions are, for the most part, excellent, and it is believed that the annual cut, which already amounts to nearly 2,000,000,000 board feet and makes the lumber industry the leading one of the province, can be increased by four times without overtaxing the productivity of the forest growth. But, to accomplish this, measures must be adopted to ensure prompt regeneration of the forest, to afford the most favourable conditions for rapid growth, and to protect the growing crop from destruction by fire. The chief obstacle to the attainment of all these conditions is the presence, in the most valuable and productive forest areas, of a heavy layer of undecomposed vegetable material, made up of leaves, twigs, branches, fallen trees, grass and weeds, which accumulate in the 100 years or more during which the forest is growing to maturity, as well as the immense amount of slash, consisting of the crowns of cut trees, and of unusable trees, young growth and brush, which is produced in removing the merchantable material. Undoubtedly, as the value of timber increases and as new uses are found for wood, the amount of slash will be lessened to some extent, but no material improvement in conditions will take place for many years.

**Most Important
Forest Problem**

The removal of the deposit of old vegetable material and the slash resulting from logging becomes then the most important forest problem of the province, and one which demands and will repay the most careful investigation into conditions, methods and results.

Considering the problem broadly in connection with the conditions found in the regions described, it may be said that, on the 5,000,000 acres covered by the yellow pine region, the removal of the slash resulting from logging (the deposit of old vegetable material being absent, or very slight) is not a silvicultural requirement; on the contrary, leaving it on the ground will improve soil conditions. The removal of the slash in this region, therefore, is purely a fire protective measure, and should be carried out only where the excessive risk demands it. In most cases, the only action necessary would be measures to insure rapid decomposition, such as lopping the tops, so that the larger pieces could be in contact with the ground.

Much the same conditions exist on extensive areas of the plateau and Rocky Mountain regions, wherever warm, bright, growing seasons and a light rainfall create conditions favourable to decomposition, though not for rapid growth. It is believed that such conditions prevail on one-half of this type, or on an area of 13,000,000 acres. Here, as in the yellow pine region, disposal of logging *debris* should be treated solely as a fire protective measure, and, if the fire hazard is not great, the only action necessary is such disposition of the slash as will result in rapid decomposition.

On about 10,000,000 acres of the northern coast region the soil consists almost entirely of partially decomposed vegetable material, the accumulation of centuries of growth, lying on a rock surface. The destruction of this layer, besides being practically impossible on account of its saturation with water, would prevent further forest growth. As the forest growth on this area is not commercially valuable, it need not be considered. Altogether, then, the area of forest land from which the removal of the logging slash is either not necessary or not possible as a silvicultural measure, amounts to approximately 28,000,000 acres. On the remaining 77,000,000 acres—which includes practically all the valuable timber-producing lands, and by far the most productive forest lands—the accumulation of dead vegetable material during a single rotation is so great as to materially reduce the fertility and productivity of the soil, prevent or hinder the regeneration of desirable species and greatly increase the fire hazard. When to this layer is added the immense amount of slash resulting from logging the heavy stands of timber which characterize these lands, a condition is produced which effectually prevents the regeneration of the forest and the utilization of the full productivity of the soil, and creates a fire hazard which it is hopeless to attempt to overcome. Further profitable use of the land for the production of timber is therefore necessarily contingent on the removal of the layer of undecomposed vegetable material and the slash resulting from logging.

The removal of *debris* can, of course, only be accomplished by the use of fire, and, owing to the danger of its escaping to surrounding timber, destroying seed trees and injuring the soil, burning must be undertaken only under conditions which make its control certain. To do this is often expensive, the cost ranging from a fraction of a cent, in the case of broadcast burning under the most favourable conditions, up to as high as fifty cents and one dollar per thousand feet of timber removed. This constitutes a serious tax on an industry subject to such severely competitive conditions as is the logging and lumber industry, and its universal application can only be obtained gradually.

As has been said, however, the success of forest management in British Columbia is absolutely dependent on the removal of *debris* from cut-over lands, and the government must work consistently toward this end.

Government Forest Policy Since the establishment of a Forest Branch in the Lands Department of the Government of British Columbia, and the incorporation in its statutes of a comprehensive Forest Act, a material advance in the matter of disposal of *debris* has been made, although some of the larger aspects of the problem still remain to be worked out.

Among the first of the steps taken by the Forest Branch was the removal of *debris* caused by road and railway construction; this, of course, constitutes merely a fire protective measure and has no relation to the larger problem.

The rights-of-way of 1,800 miles of railway constructed in the province during the last three seasons have been satisfactorily cleared of *debris*, as a result of the supervision given by the Forest Branch, under the authority of both the Provincial and Dominion Statutes.

In the clearing of slash, caused by the building of public roads, less progress has been made, owing to the tremendous demand made on the province for new roads, due to the rapid settlement of the country. However, the burning of the slash is an established policy of the government, and, where the heavy expense and popular pressure for rapid extension of roads prevents the destruction of the *debris* at the time of construction, the work will be undertaken later and, within ten years or less, it is thought that all the dangerous slash will be disposed of.

Timber Sales and Railway Permits Complete power is held by the government in the fixing of conditions for timber sales and permits to railway companies to cut timber free of charge for construction purposes, and the disposal of slash has been made a condition of purchase or grant of every timber sale and railway permit. In all, 59 timber sales, covering 22,775 acres, which have been advertised for sale, have included stipulations requiring the disposal of *debris*, and, on the fifteen sales on which operations are being conducted, the regulations are being carried out.

Ninety railway permits, covering an area of 138,376 acres, have been granted during the last two years, and timber has been cut on approximately 50,000 acres of this area. Disposal of the *debris*, by burning or by piling the brush, has been required on all portions of these lands except those occupied by the yellow pine type, or where the trees cut were scattered and the slash inconsiderable.



BRUSH PILED ON TIMBER SALE

Under direction of B. C. Forest Branch. Lillooet district. Douglas fir.



TIE PILES AND SLASH RESULTING FROM TIE-CUTTING OPERATIONS

Grand Trunk Pacific Railway. Tête Jaune district. Cutting area later under the direction of the B. C. Forest Branch.

Slash Disposal on Timber Leases and Licenses The disposal of slash resulting from logging on timber leases and licenses is not made a special requirement in the fire protection section of the Forest Act, but authority to do so is provided under sections 13 and 26 pertaining to the renewal of leases and licenses by means of orders in council.

Owing to the unsatisfactory condition of the lumber industry during the last year or two, it has not been thought advisable to adopt compulsory measures for the disposal of slash. Another reason is the fact that sufficient information in regard to the best methods of disposal, on which to base regulations covering the whole province, is not yet at hand. Therefore, it has been necessary to make a careful study of the methods and cost of slash disposal in the various forest types and to determine whether or not the cost can be borne by the industry without injury. It must be remembered that the lumber industry of British Columbia has to meet the competition of Washington, Oregon, Idaho and Montana mills, which have the advantage of a generally higher quality of timber and cheaper labour and machinery. The seriousness of this competition is evidenced by the fact that, in 1912, these mills shipped nearly 300,000,000 feet of lumber into Alberta and Saskatchewan, which is the chief market for British Columbia forest products. Investigation of the problem is being carried on and action will be promptly taken on the results shown.

In the meantime, however, the fire hazard created by logging slash is so serious that operators in the coast fir type are generally convinced of the advisability of burning their slash, and such action has been encouraged in every way possible.

The following letter, sent to all the operators on the coast, has induced some of them to burn their slash. Data in regard to the actual area burned over are lacking, but it is thought to have amounted to nearly 10,000 acres. With the larger field force which will be put on duty on the coast in the spring of 1914, and, with the accumulation of experience as to the best seasons and methods of burning, it is confidently expected that, in a few years, the slash on the area cut over in this type will be burned each year.

*The Government of the Province of British Columbia, Forest Branch
(Lands Dept.), May 1st, 1913*

Dear Sir:—I wish to request, for the Forest Branch, your earnest co-operation in an effort to solve the problem of the disposal of the slash resulting from logging operations.

Owing to the great density of the timber stands on the coast and in portions of the interior of British Columbia, to the conditions surrounding the lumber industry, which permit of the removal from

the woods of only a very small proportion of the stand, and to the methods of logging, the amount of slash remaining after logging is excessive. Generally, also, the timber remaining after logging is without further value, and, since the slash effectually prevents the growth of a valuable second crop, slash must be removed first if the land is to be utilized in producing another crop of timber.

I need not point out that by far the greater portion of the land in British Columbia is, owing to its roughness and lack of soil, unsuited for agriculture, and the only possible way it can be made a steady source of wealth is by the growing of timber. Besides its effect in preventing the production of a second crop of timber, slash is universally recognized as the most serious of all fire hazards, and that it is only a question of time before every slash-area will be set on fire. This being the case, the evident thing to do is to burn the slash at such a time and under such conditions as will, so far as is humanly possible to determine, render it certain that the fire does not spread to adjoining timber.

The Forest Act of British Columbia does not make the burning of slash compulsory, although in the States of Oregon and Washington, where the conditions are identical, such laws are in effect. The Forest Act does, however, empower the Minister of Lands or the Forest Board to require owners to construct a safe fire-break about any area of slash, and where necessary to protect valuable timber, this provision of the Act will be enforced.

To be at all safe or effective against July or August fires, fire-breaks must consist of a strip, five to ten feet wide, cleared to mineral earth, and a strip ten to thirty feet wide cleared of brush, inside which all dead snags standing within a distance of 100 feet must be felled.

As long as the slash remains, however, the danger from fire is serious, and it is felt that it would be far better to burn the slash itself than to construct such fire-breaks, the cost of which is as much or more than that of slash-burning.

A number of loggers in British Columbia have already adopted the practice of burning their slash every year, either in the spring or in the fall, and I hope that you will decide to apply the plan to your operations and take up the matter immediately with your superintendent. The present spring is backward, and, except in high winds, slash burning may be safely carried on until the first or second week in June. During April no permit to burn is required, and after May 1, permits can be obtained from the local forest officers. While it is impossible to specify the conditions as to weather when burning can be safely done, or the methods by which the burning can be most effectively accomplished, these matters being best determined by your superintendent, the following general rules may be of assistance:

(1) Always construct a trail or a light fire-break around the slashed area before starting fires. This will serve to confine the fire and also permit men to get around the fire quickly.

(2) Be sure to have enough men on hand when you start a fire to control the fire if it threatens to spread beyond the slash.

(3) Never start a fire in the **morning** unless you feel certain a strong wind will not arise. The best time to start a fire is after 4 o'clock in the afternoon on a calm day; if the weather is warm and the slash dry, all the better.

(4) If the slash-area is surrounded by timber, start fire first on the leeward side if there is a breeze, or on the uphill side if on a slope. When the danger of fire spreading beyond the area to be burned is past, set fire on the windward side or at the base of the slope; also, whenever possible, take advantage of a breeze blowing away from green timber.

(5) Burn over the area as quickly as possible. This can be done by starting fires in a large number of places.

(6) Keep a watchman on the area burned until all fires are out. Cut down any snags which may be burning. All fires should be completely out before June 15.

Experience has shown that slash can be burned safely at the cost of five to twenty cents an acre, and that this expense is fully repaid by the resulting added safety of the camps, equipment, and surrounding timber.

The cost can be materially reduced if the policy of annual burning is definitely adopted, since by a little forethought the superintendent and foreman can arrange to have drag and skid roads serve as fire-breaks. When it is known where the boundary of an area to be burned will lie, it is also a material help to have the trees felled away from the green timber.

Yours very truly,

H. R. MACMILLAN

Chief Forester.

REMOVAL OF SLASH TO REDUCE FIRE HAZARD

The Forest Act provides authority for disposing of slash where it creates a dangerous hazard, and, since these provisions have a general bearing on the subject of slash disposal, the instructions governing their enforcement issued by the Forest Branch to the field force will probably be of interest. These instructions also include the regulations governing the hazard caused by the use of fire in industrial operations.

Section 123 of the Forest Act provides that:—The Minister or the Provincial Forest Board shall have power to declare any inflammable material, which endangers life or property, a public nuisance, and upon receipt of notice to this effect the owner or occupier of, or the person conducting any operations for the cutting and removal of forest material from the land upon which any such nuisance exists, shall immediately remove or abate such nuisance to the satisfaction of the Minister or the Provincial Forest Board.

**Reports on
Fire Dangers.**

Paragraph 1 of section 124 provides that:—When the safety of any forest or woodland or cut timber is endangered by the *debris* caused by any lumbering or other industrial operation, the Minister or the Provincial Forest Board may require the person or corporation conducting such operations, or the owner or occupier of the land on which such *debris* exists, to cut down dead trees and stubs within such area, and to establish a safe fire line around the area or areas covered by such *debris*. Said fire line to be cleared of inflammable material and to be of a width and character satisfactory to the Minister or to the Provincial Forest Board.

Paragraph 3 provides that:—Every person, persons or corporation clearing rights-of-way for any road, trail, telephone, telegraph, power or pipe line, tote road, ditch, or flume shall pile and burn on such right-of-way all refuse, timber, slashings, choppings and brush cut thereon as rapidly as the clearing or cutting progresses, and the weather conditions permit, or at such times as the Provincial Forest Board may direct.

Paragraph 4 provides that:—No one slashing brush or burning timber for the purpose of clearing land, or in the conduct of any lumbering operation, or in the cutting of any road or right-of-way, shall fell or permit to be felled trees or brush in such a manner that said trees or brush shall fall and remain on land not owned by the one felling or permitting the felling of such trees or brush.

Paragraph 5 provides that:—Any person who, within 200 feet of the right-of-way of any railway, causes any accumulation of inflammable *debris* shall immediately pile, and, subject to the requirements of this Act covering permits, burn the same.

The above extracts from the Forest Act relate to slashings and accumulations of inflammable material which constitute a dangerous fire hazard. The following relate to the unsafe use of fire in industrial operations:

Fire in Industrial Operations. Section 120:—During the close season a watchman shall be maintained at the point where any stationary or portable engine is located in or near any forest or woodland for at least two hours following any time when said engine shall have ceased operation, to prevent the escape of fire therefrom.

Section 121 provides that:—(1) During the close season in each year it shall be unlawful for any person or corporation

(a) To use or operate any locomotive, logging engine, portable engine, traction engine, or stationary engine, using fuel other than oil, within a quarter of a mile of any forest slashings or brush land, which is not provided with a practical and efficient device for arresting sparks, together with an adequate device for preventing the escape of



LOGGING SLASH BEFORE BURNING
Crownsnest district, B. C. Fire danger extreme. McInnes limit.



A PORTION OF THE SAME TRACT AFTER BROADCAST SLASH-BURNING
All small debris completely consumed and fire hazard greatly reduced

fire or live coals from all ash-pans and fire-boxes, and which does not comply in every respect with any regulations for the time being made and in force under and by virtue of the provisions of this Act;

(b) To operate any river steamboat using fuel other than oil on any of the rivers or lakes within the province of British Columbia which is not provided with a safe and suitable device for the arrest of sparks from the smoke-stack thereof, complying in all respects with any regulations for the time being made and in force under and by virtue of the provisions of this Act;

(c) To destroy any wood-waste material by fire within any burner or destructor operated at or near any mill or manufactory, or to operate any power-producing plant using in connection therewith any smoke-stack, chimney, or other spark-emitting outlet, without installing and maintaining on such burner or destroyer or on such smoke-stack, chimney, or other spark-emitting outlet, a safe and suitable device for arresting sparks, complying in all respects with any regulations for the time being made and in force under and by virtue of the provisions of this Act;

(d) Being engaged in the manufacture of lumber, or shingles, or other forest products, to destroy wood-waste material by burning the same at or near any mill without properly confining the place of said burning, and without further safeguarding the surrounding property against danger from said burning by such additional devices as may be requisite in order to comply in every respect with any regulations for the time being made and in force under and by virtue of the provisions of this Act.

Paragraph 2 provides that:—It shall be the duty of every person or corporation operating any engine referred to in this section to provide equipment in the way of tools, hose, and other fire-fighting appliances in accordance with any regulations for the time being made and in force under and by virtue of the provisions of this Act.

Paragraph 3 provides that:—During the close season no deposit of fire or live coals shall be made from any locomotive or engine within one-quarter of a mile of any forest, woodland, or hay land upon any railway right-of-way outside of yard limits, unless said deposit be immediately extinguished.

Paragraph 2 of section 124 provides that:—Every camp, mine, sawmill, portable or stationary engine, using any fuel other than oil, and located within a quarter of a mile of any forest or woodland, shall, by person in charge thereof, have such space surrounding said camp, mine, sawmill, or engine, cleared of inflammable material as the Minister or the Provincial Forest Board may direct. Any person neglecting or refusing to perform and fulfil any duty imposed upon

him by or pursuant to the provisions of this section shall be guilty of an offence against this Act.

Inspections by District Foresters. One of the important duties of district foresters will be the collection of complete information about dangerous *debris* and sources of fire, so that the provisions of the Forest Act may be enforced. This work will, so far as possible, be done by the members of the permanent force, but forest guards who are known to be competent for such work, may also be assigned by the district forester to make inspections.

The district forester will be held responsible for seeing that all cases of dangerous *debris* and dangerous industrial uses of fire in his district are reported on as early as possible in the season.

Procedure—The above reports must be made on the forms provided in duplicate. All information called for by the instructions in the form must be supplied. In all cases of dangerous *debris*, and, wherever necessary in cases of dangerous uses of fire, a sketch should be made on the back of the form.

The following should be the standard descriptions, and a legend describing the symbols used should be placed on the border of the map sheet:—

1. Grass, weeds or brush not over two feet or three feet high.
2. Bare ground, cliffs, rocks, etc.
3. Water. Show all ponds, streams, or other body of water.
4. Cultivated lands. Show whether garden, field or grain crop, pasture, hayland, or orchard.
5. Swamp, muskeg, or peaty land.
6. Cut-over land, slash on which has not been burned.
7. Cut-over land, slash on which has been burned.
8. Second growth from four feet to five feet high to tie size.
9. Merchantable forest, whether or not fire has run through it.
10. Land covered with timber, which is unmerchantable on account of poor quality, injury by fire, or difficulty of logging.

All surveyed lines, buildings, roads, trails, and other works should be shown as well as the topography.

Scale should not be less than two inches to the mile, nor greater than one inch to 100 feet.

Every effort should be made to examine slash or fire-using structure in company with the owner, and the matter should be thoroughly discussed with him. If the conditions are such that immediate action is necessary to reduce the fire risk, the way in which the slash can be

got rid of should be discussed with the owner; a plan of fire-breaks, brush piling, time of burning, or the installation of protective devices and measures agreed upon; and a promise obtained from the owner, if possible, to carry out the work. If necessary a forest officer should be present to supervise the work.

On receipt of a report on a dangerous slash or dangerous use of fire the district forester will forward the original to the chief forester with his recommendations, retaining the duplicate for his files.

The following statements by District Foresters Gilmour, Andrews, Caverhill and MacFayden contain detailed information relative to the results secured in their respective districts:

CRANBROOK DISTRICT

By J. D. Gilmour, District Forester, British Columbia Forest Branch

It has been demonstrated that the burning of slash is practicable, from the standpoint of cost as well as of safety. It has been proven a good form of insurance, protecting the future of the logging operation until the timber is all logged, as well as equipment, camps and men employed in logging.

To obtain some practical experience in costs and methods in the interior, and also to safeguard a large body of timber in which the government has a considerable financial interest, the Provincial Forest Branch undertook, late in the spring of 1913, to demonstrate the cheapness and safeness of slash burning in the heavily timbered valleys of British Columbia. The area selected for slash burning comprised 300 acres of the limits of the McInnes Lumber Company, eight miles from Crowsnest station, on the North fork of Michel river.

Logging had been carried on for several years, with the result that several hundred acres of heavy slash constituted a menace throughout each summer. It seemed likely that a little carelessness on the part of someone would, one day, start a fire which might wipe out all the timber remaining in the valley, estimated at several hundred million feet.

The type was spruce-jack pine, the stand running from twelve to twenty thousand feet per acre on the best timbered portions close to the river. The stand was thrifty and mature at the time of logging, the understory consisting of suppressed spruce. The resultant slash was, therefore, very heavy for the interior, lying from three to six feet deep. The trees left after logging, being suppressed, shallow-rooted spruce, were not windfirm, so that after everything merchantable was removed, the balance in a short time blew down, adding to

the already dangerous *debris*. No care was therefore taken to prevent destruction of the standing small trees, and, indeed, in such a heavy slash, to do so would render the cost prohibitive; also, brush piling was not necessary to insure a clean burn.

The area has an elevation of about 4,800 feet, and consists of a flat valley some half mile wide along the river, with steep slopes running up to beyond timber line. Due to the configuration of the country, there is almost constantly a wind blowing up or down the valley, increasing the danger of disastrous fire.

Owing to the elevation the snowfall is heavy, and, in the timber, it remains late in the spring. The snow is gone from the open logged-off area a couple of weeks before it is gone from the standing timber. It was therefore a question only of awaiting an opportunity when the melting snow will protect the standing timber, but has gone from the slashed area. The melting snow also drains toward the river, and the duff under the slash contains so much water that no danger to the soil cover was to be feared. The spring of 1913 was wet and backward, so that the conditions for slash-burning were not favourable until about June 1st. The fire was started on the evening of June 9th, about a week later than it should have been to obtain the cheapest results. However, it was soon found that fire would not run in standing timber, although a very fierce fire resulted in the slash. The method employed was backfiring along the edge of standing timber, and along cross roads. After backfiring, all parts along the edge were lit as soon as possible, so that fires ran towards each other and met in the middle of the slash away from green timber.

A gang of river drivers was available when required. About twenty men were employed on June 11 to work around the edges, putting out all fires, as it was too late in the season to allow any fire to remain in stumps and rotting logs. The total cost was therefore somewhat increased, compared to what it would have been about a week earlier.

The cost was \$132.00. Area burned, 300 acres. Cost per acre, 44 cents. The cost, reckoned on a per thousand basis for timber estimated to have been cut from this area, was less than three cents per thousand feet.

All the most dangerous slash, caused by several years' operations, was disposed of practically in one day. No damage was done to merchantable timber, nor was the duff burned off the ground. A clean burn was made at a cost by no means excessive, when the amount of timber and logging equipment protected by it are considered. There should follow on the burned area a full stand of jack pine and a considerable percentage of spruce. Spruce may naturally be

expected to form a noticeable part of the reproduction, on account of the forest soil cover being preserved; also, the burned strip is not too wide for seeding from the edges and from spruce seed trees remaining along the river inside the burn.

It was demonstrated that slash burning may be undertaken with safety if advantage is taken of a favourable opportunity. It would seem that, between the time when slash will not burn because it is too wet and the season in which it is too dry to attempt burning it, there must be a period when fires can easily be controlled, when a sufficiently clean burn can be made, and when the soil cover will not be injured. Especially when spruce reproduction is desired, the soil cover should be preserved. When fir and yellow pine comprise the type, probably a more severe ground fire would be beneficial if sufficient seed trees could be protected. Broadcast burning would appear to be indicated in heavy stands, where small timber remaining after logging is of little use; but, in more open stands, characteristic in other parts of the interior, the young timber is worth preserving. In order to obtain a clean burn and to protect such small timber, rough piling would be necessary before burning.

VERNON DISTRICT

By L. R. Andrews, District Forester, British Columbia Forest Branch

Construction of the Kettle Valley railway across the Hydraulic summit in the Vernon forest district was commenced in late autumn and early winter of 1912 and 1913. The grade at this point is at an elevation of about 4,000 feet above sea level. It traverses the watershed and within a few miles of the source of the tributaries of Mission creek, and close to the catchment areas and reservoirs of two large irrigation projects which supply much needed water to about 10,000 acres of irrigated land under fruit in the Kelowna district.

Owing to the highly inflammable nature of the watershed, which is largely covered by dense second growth pine and down timber, with patchy stands of fir, tamarack and spruce, an acute fire hazard was created. Large amounts of slash and other *debris* were left on the ground. This hazard was greatly intensified by the usual carelessness of labourers and travellers with camp fires, cigarettes, pipes, etc., as well as by the danger of sparks from stationary engines.

The situation was keenly felt by the irrigation interests and the Forest Branch, as well as by the contractors, who had some \$50,000 worth of equipment at stake. Spring burning of the *debris*, therefore, recommended itself as essential, to get rid of the slashings early, and thus reduce to a great extent the danger during the fire season.

The problem was attacked in the spring so soon as conditions permitted, and most of the work was finished before the surrounding vegetation had become excessively dry. In three instances fires were started as a result of the brush-burning operations, but, in each case, the fire was controlled before any damage was done.

The slash resulting from the cutting of roads and right-of-way had been banked in continuous windrows along both edges and presented a fine trap for catching sparks, matches or cigarettes dropped along the edge. On the tie permit, close to the grade, the slash had been left scattered over about 400 acres.

In order to complete the burning in the shortest possible time, a special force of ten men was organized by the contractor, under a competent foreman. The work was directed by the two forest officers on patrol work, who also rendered assistance in the burning.

Work was commenced by spreading the men along the road and right-of-way, about 40 to 50 yards apart, according to the amount of slash along the edges to be burned. Each man then pulled the slash in towards the centre of the road or right-of-way, clear of the timber, cutting it roughly into lengths of less than 16 feet. It was stacked into compact piles, three to four feet high and ten to fifteen feet apart. These piles were fired, each man tending from ten to twenty small fires, and piling on the slash as it burned, until all had been removed from the edge of the timber. Ten men therefore watched and tended ninety to one hundred small fires burning at the same time, and kept the fires going until the slash was consumed. According to the amount of brush and the difficulty of handling, from one-half to two miles of right-of-way was cleared per day. As soon as the slash was burned at one place, the men were moved ahead to start fresh piles. The foreman and fire patrolman kept things going, and care was taken to keep the fires small and continuous and watch that they did not spread.

The essentials of this method, which proved efficient, are good axemen and an experienced foreman, with the supervision of at least one man for each half mile of burning. The advantages are: That it is quick, efficient and cheap. The small fires are always under control, and do not create enough heat to necessitate moving the slash more than a short distance from the edge of the road or right-of-way. Scorching of the standing timber is avoided, and handling of the slash, which is the big item in cost, is reduced to a minimum. The fires are fed continuously and burn themselves out quickly, and, therefore, do not have to be watched at night. No piles were fired later than an hour before quitting time, and all fires were practically out by dusk. Freighting along the roads was held up for only short

periods, as it was possible to get past the small fires. On the grade, no work was interfered with in any way.

On the tie permit area, close to the grade, fir trees had been felled and ties hewn in considerable confusion on the snow. The slashings here presented a more difficult proposition, as only the smaller fir had been taken, leaving the larger trees standing. Thick masses of tops, limbs, butt logs and chips were left on ten to thirty acre patches throughout the area. The slash was piled in larger piles, as far as possible out of range of the standing timber, so as not to injure it. All tops were lopped, and the limbs and *debris* piled. Butt logs and large tops were not burned, as the disposal of only the highly inflammable material was considered necessary. These piles were made six to eight feet high, and ten to twelve feet in diameter. Two men tended from eight to ten piles, gathering and throwing the slash continuously on the burning piles. The force of ten men averaged about fifteen acres per day in this way. A little over twelve days was required to clean up the whole area.

The total cost of cleaning up the slashings along twenty-seven miles of roads and fifteen miles of right-of-way across the Hydraulic summit was approximately \$1,200. On the 400 acres of logged-over tie permit, the cost of burning slash was \$520.00; worked out on a mileage basis, the above shows: Roads, \$25.00 per mile; right-of-way, \$35.00 per mile; tie slashings, \$1.25 per acre, or 2.7 cents per tie for 18,000 ties.

The above figures are approximately correct, and might be considered a basis for other work of a similar nature. In this instance, where there was no room for doubt as to the necessity of the undertaking, it was shown that such work can be handled at a cost which is in fair proportion to the benefits derived in the form of reduced fire hazard.

KAMLOOPS DISTRICT

By P. Z. Caverhill, District Forester, British Columbia Forest Branch

Broadcast burning was tried on an area of slash, comprising 350 acres, situated on a gentle southern slope on the North Thompson river. The slash extended along the slope for three and one-half miles, and was from 650 to 1,000 feet wide. The stand was open fir, with little or no underbrush. The soil cover was mostly grass, with a very thin coat of humus, and the soil was gravelly. The stand would average 3,500 feet board measure per acre, the trees being ten to fourteen inches in diameter and sixty to seventy feet high. Patches of volunteer fir reproduction were common among the older trees. Logging opera-

tions had been carried on during the winter, the cut being 210,209 feet board measure and 31,913 ties.

The snow disappeared from the area late in March and early in April. While the crew was waiting for driving the men were set at burning, and about twenty men were employed for three days. The work was done by setting out fires at the lower edge of the slope and allowing it to run up the hill to the public road, which formed an effective fire-break. Where the cutting had crossed the road the burning was carried on under a careful guard. The *debris* was comparatively heavy, owing to the small size of the timber and the heavy, open tops.

A detailed record of the cost was not kept by the company, but twenty men were employed for three days. The total cost was thus approximately \$210.00, amounting to sixty cents per acre or seventeen cents per thousand feet, for both saw-timber and ties.

Burning was also done on an area of about 500 acres on the Barrier river. This slashing lay approximately one mile along the slope and was three-quarters of a mile wide. The stand was open fir similar to the above. Logging operations had been carried on during the previous winter, approximately 634,000 feet being cut.

Fire was started accidentally on May 31, but, as the operator had intended burning at least part of the brush, this fire was allowed to do the work. Eighteen men were detailed for three days to hold the fire in check and to light piles not fired by the general conflagration. Later, two men were detailed to watch it for a couple of days till the fire was out.

The total cost was approximately \$160.00, but no detailed record was kept. This is approximately thirty-two cents per acre or twenty-five cents per thousand feet.

From a protective standpoint the result was excellent. Small *debris* and limbs up to one and one-half inches in diameter were consumed and the danger from future fire was reduced to a negligible amount. Much of the volunteer growth was, however, destroyed. The fire had little effect on trees six inches and over in diameter, but all reproduction ten feet high and under was destroyed, while larger poles up to six inches diameter were often so burned that they died later.

It seems, therefore, that broadcast burning would be satisfactory on agricultural land and where the volunteer crop need not be considered in connection with the future crop; but, where planting cannot be resorted to, and where the volunteer crop is composed of the desired species, piling and burning for the protection of the young growth is to be preferred, where financial considerations will permit.



SLASH BURNING BY SETTLERS UNDER PERMIT, IMMEDIATELY FOLLOWING A RAIN.
KAMLOOPS DISTRICT



THE BURNING OF PILES OF BRUSH RESULTING FROM WAGON ROAD CONSTRUCTION.
VERNON DISTRICT

On another area of about 500 acres, on an easterly slope, the brush was piled but not burned. Here the stand was of dense young Douglas fir, running 150 to 200 trees to the acre, ranging from six to twelve inches in diameter. The soil was gravelly clay, and the cover mostly grass, with little underbrush. Logging operations were carried on during the winter of 1912 and 1913 for ties, 43,564 ties and 27,000 feet of saw-timber being cut.

The brush was piled the following October, having been on the ground during the summer, so that, in many cases, it became matted down with a rank growth of weeds and grass.

The trees had been felled with the tops more or less in clusters. The limbs were lopped off up to a diameter of about four inches, where the top was again cut off and all loose limbs piled on top as compactly as possible.

The company kept no special cost account for the operation, but gave \$700.00 as the probable total figure, or fifty cents per thousand feet. The cost was high because the brush had lain all summer and had become embedded in weeds and grass, and also because the labourers used were not accustomed to the work and consequently were not as efficient as if they had been employed at this class of work before.

While the piling without burning did not eliminate the fire hazard altogether, it greatly reduced it by making it much easier to control a fire should one occur accidentally.

TETE JAUNE DISTRICT

By C. MacFayden, District Forester, British Columbia Forest Branch

In connection with the construction of the Grand Trunk Pacific and Canadian Northern Pacific railways, the British Columbia government granted free permits for timber for ties and other purposes incident to railway construction. It was at first a condition in each of these timber permits that all the *debris* caused by logging operations should be piled in such a way that it could be burned without danger to the remaining timber. This was a complete innovation to the contractors who had always previously left their slash as they wished, and the requirement was consequently hard to enforce. At the outset, all contracts contained only the blanket cause, "Subject to the regulations of the Forest Branch." This was looked upon by the sub-contractors as a mere matter of form and not to be taken into consideration in arriving at prices, so that, later, when these regulations were enforced, they, without exception, claimed they could not possibly fulfil them at the prices they were getting from the company or the contractor above them, as the case happened to be. During the first winter's operation,

very few of the sub-contractors were making even wages, and, in many cases, were losing money; so that, rather than see the burden fall on the working man, leniency was shown in every case, thus leaving it hard to judge of the beneficial results of the regulations had they been carried out as originally intended.

In every case the contractor made the mistake of letting the piling lag behind his other work until a heavy snowfall made it impossible to do anything further with it until spring. He then experienced trouble in getting men to do the work, as the average "tie hack" considered it beneath his dignity to handle brush. These difficulties will be overcome, however, when the contract price given to men working by the piece includes the piling of the brush; they will then do it the cheapest way, which, it is agreed, is at the time of cutting. The contractors all agree that the additional price to be allowed should be between three and four cents per tie, or between fifty and seventy cents per thousand feet for saw-timber, depending on the size of the average tree in the stand. The rate per thousand feet for saw-timber would be below this where the operation is in a stand of large timber, since practically the same amount of brush has to be handled for a tree cutting out 600 feet as for one cutting 1,000 feet.

The work done during the first winter's operations showed that, where there is a lot of *debris* already on the ground, due to natural causes, the labour and expense of piling only the brush that results from logging operations is almost wholly lost. In many stands of spruce and cedar, an operator may faithfully pile all the *debris* caused by his operations, and yet the effect of this work may be lost entirely, owing to the large amount of *debris* previously on the ground, for which he is not responsible, and which he cannot reasonably be required to pile and burn. In the case of a jack pine stand, where the ground is absolutely clean, piling the brush will go a long way towards absolute fire protection and is a cheap form of insurance.

A case in point is a "tote" road cut south from Henningville by Palmer Bros. & Henning, largely through a jack pine stand. The brush from this cutting has been piled by these contractors in such a way that it creates absolutely no fire hazard. I believe these people can claim to have made the most satisfactory job of brush piling that has to date been done in the Dominion. In this last instance, the cost, as nearly as I can ascertain, was about \$50 per mile.

After noting the effect of a regulation requiring that only the brush caused by the logging operations be piled over the whole area, I decided it would be of more practical value to limit the piling to a 300-foot strip around the outside, but to require that all *debris*, whether due to natural causes or to the contractors' operations, be piled in the

same way. Where this was done, the result was a tolerably safe fire-guard. The best figures of cost I have on this work show an expense of \$14 per acre of fire guard. The cost, figured on the area afforded protection, would of course be very much smaller.

In conclusion, it is my opinion that, except in the case of clean-bottomed stands, piling only the brush caused by logging operations affords but little protection for the expenditure, and simply lopping the tops would give practically the same protection at less cost. Better than either of these is, I believe, a wide strip encircling the cut-over area and cleared of all *debris*. This seems the most practical method of doing away with the danger from old slashings, especially where the danger is limited to one or two sides of the cut-over area.

The following supplemental statement, by District Forester H. B. Murray, shows the further developments in the Tête Jaune district since the resignation of Mr. MacFayden:

"During the past year, 1914, the areas covered by permits which had been granted to the Canadian Northern Pacific and to the Grand Trunk Pacific railways were examined by the Forest Branch, and in any case where the amount of timber left standing warranted, a timber sale was made on such permit area. It is the intention of the Forest Branch to dispose of all timber left standing on the different permit areas in this manner, and then a slash fire can be run over the area at a safe time and the hazard removed. This course is absolutely necessary, owing to the proximity of the railways to the permit areas, and the constant danger of fire getting into the slashings during a dangerous fire period."

BRUSH DISPOSAL IN THE RAILWAY BELT OF BRITISH COLUMBIA

D. Roy Cameron, District Inspector of Forest Reserves, Dominion Forestry Branch, Railway Belt District

The slash menace on forest reserves in the railway belt of British Columbia, is, at the present time, a comparatively unimportant feature of the fire hazard, due to two factors. First, there has been practically no timber cut on forest reserves, in quantity sufficient to make any considerable area of slash; second, the merchantable timber on these forest reserves, as at present constituted, is of the dry belt type—scattered, open, park-like stands—so that the *debris* resulting from lumbering operations would be largely scattered in the natural process of logging.

The only cutting of timber since the inauguration of administration of the forest reserves has been under settlers' permits. These

permits have required in every case the piling of slash. Burning is carried on at convenient times by the forest officer. Satisfactory data as to the cost of piling per thousand can not be given, owing to the fact that each separate operation is of so small a character that figures obtained from them would be inaccurate as applied to an operation of any size. Settlers are, in most cases, willing to carry out any brush disposal regulations required.

The proposed extension of forest reserves in the railway belt, to include large areas within timbered regions, where logging operations of considerable size have been, and will be, carried on, will cause this question to assume much greater importance in the near future.

The *debris* resulting from lumbering or clearing operations outside the present forest reserves constitutes the greatest source of fire danger with which the Dominion fire protection service has to contend. It is safe to say that 90 per cent of all the fires which do damage have their origin in slash. The solution of this question is the greatest problem before the Forest Branch at the present time. The slash, besides being a source of great and ever increasing danger to adjoining timber or other property, is in most cases the greatest obstacle to regeneration, and must be removed before a second crop of timber can get a permanent start.

Until 1914, except in a few isolated cases, no consistent attempt was ever made in this district on the part of either the lumbermen or the Government to deal with this question. This negative attitude on the part of the lumbermen was the result of, first, exaggerated ideas as to the cost of burning; and, second, a natural aversion to taking the responsibility for carrying out burning operations, which might conceivably result in the spread of the fire beyond control, with resulting damage to timber and property for which the lumberman would be liable.

The inaction of the Government was due to lack of organization and lack of the necessary funds for the carrying out of such work; and also, to some extent, to lack of appreciation of the fact that any remedy was possible.

When the Dominion Forestry Branch administration in the railway belt of British Columbia was reorganized in 1912, the question of slash disposal was taken up and studied by various forest officers. The possibilities of action were discussed at ranger meetings and elsewhere, and the appointment of a special officer to deal with the question was urged upon the Government. The result of this was that during the spring of 1914 the Dominion Forestry Branch appointed one of the most experienced fire rangers in its employ to the position of slash burner for the railway belt. This officer made detailed studies of the

slash situation in the Fraser valley on the coast, and in the Columbia valley, in the vicinity of Revelstoke, in the interior, and drew up plans for the burning of certain typical slash areas. The intention was to burn these areas at Government expense as an experiment, to obtain reliable cost data which could be advanced to the lumbermen as proof that it would be good business for them, figured on an insurance basis, to take up the question of slash disposal during lumbering operations, and to charge the expenses incurred against the cost of logging.

If it could be proved to the lumbermen that burning could be done quite reasonably as regards cost, the question of responsibility of burning would be the only hindrance to slash disposal. The appointment of a slash burner was designed to take care of this part of the situation; this officer was also given authority to take over, on behalf of the Government, the responsibility of handling burning operations, provided the lumber companies would supply the necessary help and pay all legitimate expenses in connection therewith.

Unfortunately the fire season of 1914 set in early and very badly, so that, when plans for burning were completed, the fire hazard was prohibitive. During the summer, forest fires effectually cleaned up the type areas chosen, together with other large areas of both slash and timber.

During the autumn other areas were selected, but, again, natural obstacles intervened. This time, continual rains prevented the possibility of getting a fire started at all.

These unforeseen occurrences show that there is only from one to two weeks in spring and autumn when slash burning can be successfully undertaken, and emphasize the necessity of careful planning and organization beforehand in order to take the fullest advantage of natural conditions when they do prove favourable. Although no actual burning was done last season, it is certain that the work done was not wasted, because the studies made served to interest lumbermen, particularly in the coast district, in the importance to them of slash disposal. It is expected that the work will be pressed forward vigorously in the spring of 1915, and it is hoped that the experience gained this year will enable the Forestry Branch to carry experimental burnings to a successful conclusion.

In the dense forests which cover the areas in which lumbering operations are being carried on, brush piling is out of the question. The only possible method of brush disposal will be broadcast burning, which entails the construction of fire guards around the slash. The lands on which these conditions obtain are not, as above noted, included within forest reserves at the present time. Nor are the licensed timber

berths in any case legally a part of the forest reserves, even though included within their exterior boundaries.

It is probable, however, that a few minor changes in the methods of logging, such as attention to the location of skid roads, etc., and the felling of trees with their tops together, so far as possible, will greatly facilitate the ease and safety of broadcast burning.

It is impossible, at the present time, to give any authoritative data regarding the additional cost to operators on account of brush disposal. This is the main point towards which the work we propose to undertake will be directed. The advantages to the operator are self-evident, including reduced fire hazard, the elimination of property loss, and increased facilities in financing operations due to the greater safety of the raw product from destruction by fire.

The question of brush disposal on the right-of-way of roads constructed by the Public Works Department of the British Columbia government is also very important from a fire protection standpoint. Until the last year or two, absolutely no attention was paid to this point by them. There existed, therefore, the anomalous condition of one department of a government preaching the necessity of slash disposal and enforcing regulations against railways, and at the same time another department doing construction work of somewhat the same character and paying no heed to brush disposal at all. Within the last two years, however, strong representations have been made to the Provincial Department of Public Works by both the Provincial and Dominion Forestry Branches. As a result of these, the Minister of Public Works in the British Columbia government issued a general order to all road superintendents that the *debris* resulting from road construction was to be burned. Unfortunately, the strong pressure of public opinion for new roads and the limited funds at the disposal of road superintendents militated against the effectiveness of this order, and the present state of affairs, while showing some improvement, still leaves much to be desired. In many localities, roads are still being constructed without any attention to brush disposal.

ALBERTA

By W. N. Millar, District Inspector of Forest Reserves, Dominion Forestry Branch, Alberta District

It is possible for me to make only a brief and general statement in regard to slash disposal in the Alberta district, as the question has never been taken up on a very definite basis or with a well-defined policy in view. While the seriousness of the slash menace

in the future is recognized, its present importance is not unusually great, because of the comparatively small amount of cutting that is taking place within the reserves. Both for this reason and because there are many other more pressing and more immediately important problems on hand, the question of slash disposal has been dealt with in only a very cursory manner. Slash in the reserves in the Alberta district results from four classes of operations. These are: Settlers' permits, involving some 600 or 800 permits a year; Forestry Branch timber sales; railroad tie-cutting permits; and the operations on licensed berths within the reserves.

The settlers who obtain timber on permit are all required to dispose of their slash by piling and burning, but, in the reserve, where the majority of such permits are issued, the permits are confined almost exclusively to dead timber, which produces very little slash, and therefore does not constitute a menace nor give opportunity for securing figures that would be of any value in arriving at the cost of such brush disposal.

The bulk of the Forestry Branch timber sales, and all of the tie-cutting permits within the forest reserve, have operated so recently that no work of slash disposal has been undertaken as yet. A number of operators are due to burn their slash at the end of the present fire season, but a great deal of opposition to this action has developed and is based upon grounds that are hard to controvert.

No slash disposal of any kind is undertaken on the licensed berths within the reserves, where the bulk of the timber cutting in this district goes on. These berths, of course, are not under the control of the Forestry Branch, even though located within the reserves, so that, so far as this office is concerned, the largest and most serious slash disposal question is entirely beyond our control. The licensed timber, of course, includes the bulk of the merchantable timber and practically all of that which at the present time can be logged and manufactured at a profit.

So long as slash is left undisposed of on the licensed timber berths, the disposal of it at the expense of the operator on areas covered by Forestry Branch sales will be attended with many difficulties, if not rendered entirely impossible. The timber on these tracts is now sold at rates many times the price charged on licensed berths, and the operators object strenuously to increasing their logging costs by being required to dispose of slash while the berth holders, who are in some cases their competitors, escape this expense. They also point to the fact that the quantity of slash on the timber sale areas is so insignificant when compared to the vast amounts of slash being produced

and left on the licensed berths, often immediately adjacent to timber sale areas, that it seems unreasonable to compel an expenditure whose futility is only too evident. A more serious objection, however, and one which appeals not only to the smaller operators but also to the holders of berths, is a well-grounded doubt of the value of slash disposal as a fire protective measure. Although no one seriously denies the danger which accumulated coniferous slash gives rise to, and although it is generally agreed that a disproportionate number of fires occur in slash areas, and the cost of the control in such areas is unreasonably high, nevertheless, there are no figures available to support a claim that slash disposal is anything in the nature of a panacea for forest fires, and it is believed that before slash disposal of an effective kind, which necessarily means an increased logging cost, can be reasonably urged or enforced upon logging operators on Dominion lands, it will be necessary for the Dominion fire protective establishments to demonstrate an ability to control and suppress fires which originate wholly independent of any logging operation or slash area, and which, at the present time, constitute by far the bulk of the fires in this district. Slash is not a result exclusively of logging operations. There are enormous areas of burnt-over reproduction lands and lands bearing timber of pole size where the accumulation of slash as the result of fire is almost as dangerous as is the slash produced on logging operations. The acreage of such naturally produced slash is many times that of all the acreage of logging slash in the district, and operators have a very reasonable and almost incontrovertible argument against assuming the burden of slash disposal so long as the fire protective forces are incapable of handling the large proportion of fires which originate outside slash areas.

The problem of slash disposal cannot be considered independently and separately from the general problem of fire protection, and it is my belief that the natural sequence is, first, to provide adequate fire protection outside logging operations—which means on all the timbered lands in the district except a very small fraction of the total area—and then attack the slash menace as an improvement on an efficient system already devised and in operation. I think it will be found that this is the sequence of development in all those lumbering districts where slash disposal by burning has become established as a recognized part of a logging operation. It is the only truly logical course of development, and, in view of the many complexities of timber ownership and timber land administration which prevail on both Dominion and provincial lands, a procedure which does not have incontrovertible logic to support it has a very small chance of success.

SASKATCHEWAN

By G. A. Gutches, District Inspector of Forest Reserves, Dominion Forestry Branch, Saskatchewan District

Instructions were issued early in October, 1913, to all rangers of forest reserves in this district that the brush was to be piled on all timber operations within the reserves. Results show that it is far easier and cheaper to pile and burn the brush in connection with the cutting than it is to make piles suitable for burning and then burn them at a later date. The following figures show the results on three areas within the Nesbit reserve. All are cordwood operations in jack pine. Labour was in each case paid at the rate of 25 cents per hour.

Area 1. The cutting was done in 1913, and the brush left scattered according to the old method. The brush and all refuse on an area of 20 acres of this old cut was piled and burned. The average cut was twenty-two cords per acre. Total cut of 440 cords. Total cost \$20.50. Cost per acre \$1.025. Cost per cord 4.7 cents.

Area 2. The timber was cut in the winter of 1913, and the brush was piled and burned as soon as cut. On an area of 18 acres the average cut was 20 cords per acre. Total cut of 360 cords. Total cost \$19.75. Cost per cord 5.4 cents. Cost per acre \$1.097.

Area 3. All brush was piled and burned. The area comprised 210 acres, with average cut of 20 cords per acre. Total 4,200 cords. Total cost \$208.00. Cost per acre \$0.99. Cost per cord 4.9 cents.

The average cost for above areas was \$1.00 per acre, or 4.9 cents per cord. The brush was disposed of on these areas under practically the most difficult conditions, as the brush was as heavy as any in this locality; the above figures are therefore a fair average.

The areas cut over under permit on the Nesbit reserve have been well cleaned up, and the brush and refuse have been piled and burned by holders of permits on 58 acres, and piled on an additional 1,350 acres.

The permittees at first felt that brush piling would be a hardship, but, after they had tried it for a short time, they found it was far easier to get at the wood than under the old system, and this was especially true on areas where low stumps were cut. In former cuttings, the stumps were cut from two to four feet in height, and it was very difficult to get to the piles with sleighs without getting hung up on stumps. After a little experience the permittees found that the brush disposal and low cut stumps did not entail any extra cost on the wood delivered, as any extra expense caused by cutting low stumps, and piling and burning brush was saved by making the wood more accessible for hauling.

Mr. Williscroft, an experienced woodman, reports that, when the cost of hauling is considered, the cutting of low stumps and piling the brush saves the extra cost of swamping. The swamping is usually done by the teamster, and means the cost of the team while the work is being done. The extra cost of cutting low stumps and piling and burning the brush is balanced by the reduced cost of hauling. Mr. Williscroft estimates that the cost of piling and burning brush in connection with cutting will run from a minimum of five cents per cord to a maximum of fifteen cents per cord, but that all this will be saved in hauling, so that practically no extra cost will be attached to the wood when delivered.

Mr. Vandine, another experienced woodman, reports, in part, as follows, on the cost of brush disposal;—"The cost of piling brush will be five per cent of the operation, and, if piled and burned as the timber is cut, seven per cent of operation. As the average cost for cutting cordwood in this district is one dollar per cord, this would mean that it would cost from five cents to seven cents per cord to pile and burn the brush." Mr. Vandine further states that it would cost more if the brush were piled and left to be burned at a later date, and he says that the best and cheapest way is to have the brush burned by the permittee at the time of cutting.

Messrs. Williscroft and Vandine have both had experience in the bush in various parts of the country and have worked for the past few years as foremen for lumber companies throughout the northern part of Saskatchewan. Their judgment in this matter, therefore, is practically as good as any that can be obtained in this section of the province.

The following is a statement of the cost of top-logging on a tie-cutting operation on the south half of section 17, and the south-east quarter of section 18, township 45, range 3, west of second meridian. This was a heavy stand of spruce. All the trees were cut and the ties removed before the parties were notified that the tops were to be lopped, making the cost of the operation a maximum for this district. The area was visited when the operation was about half completed, and the tops were completely lopped, even to the smallest twigs. Approximately 300 acres were cut over and 16,178 ties were removed. The top-logging cost \$161.75, or approximately one cent per tie, or 53.9 cents per acre. The statement as to cost per acre is not very satisfactory, as the entire 300 acres were not cut over, the timber being in various-sized bunches on the area. and, consequently, the cost per acre would be much increased if the figures had been derived from the area actually cut over. These ties were much above the



HEAVY LUMBERING SLASH BEFORE PILING AND BURNING

Fire danger extreme. At left, area on which the debris has been piled and burned, thus greatly reducing the fire hazard. Nisbet forest reserve, Saskatchewan.



PILING AND BURNING SLASH ON LOGGING AREA

Dominion Forestry branch crew at work. Nisbet forest reserve, Saskatchewan.

railroad standard insofar as size is concerned, and the operator estimates that the timber removed would have sawn 521,000 feet board measure, and, on this estimate, the top-logging would have cost 31 cents per thousand feet.

The operator reports, in part, as follows: "I am of the opinion that had I had information of the intention of the Department to enforce top-logging last autumn before starting in the work, I could have arranged with the tie-makers to do this logging and have had it done for less money per tie. I am also confident that the cost per thousand feet would have been less for saw-logs than for ties, as generally the tops will run out smaller."

The regulations concerning brush disposal have been enforced during 1914 with much success, and practically all complaints have disappeared on reserves where operations were in progress in 1913, showing that it is simply a matter of enforcing the regulations to secure proper brush disposal.

I find also that practically all the lumbermen in the district will be willing to make proper brush disposal provided each lumberman in the district is compelled to do the same. The manager of the Prince Albert Lumber Co., Ltd., has stated publicly that the company would not mind having to cut according to forest reserve regulations, provided all the other lumber companies in the country were doing the same, so that one company would not be competing with another under any disadvantage. This is the opinion of practically all the lumbermen in the district, and it is obvious that it would be unfair to compel one company to dispose of the brush and permit another to cut according to old methods. It is the duty of the Government to see that each and every lumberman makes proper brush disposal, as it is almost impossible to protect young growth on cut-over areas according to the present methods of logging. In the past two or three years valuable stands of young spruce have been destroyed simply because it was impossible to check the fire on account of the enormous amount of slash.

MANITOBA

By F. K. Herchmer, District Inspector of Forest Reserves, Dominion Forestry Branch, Manitoba District

The extent of slash menace and its seriousness as a fire hazard are very general, more especially on those areas where timber limit holders have been operating for many years in the reserves, and also where settlers have been taking out permit timber. The danger is very great, and should fires break out in certain of the old cuttings

when the woods are dry, water in the streams low, and vegetation, such as grass and pea-vine, rank, as was the case last autumn, it is feared it would be impossible to control them.

Under present regulations, slash has to be disposed of by either piling and burning, or lopping and dropping to the ground. Though these regulations have been in force for some time, it has been found possible by many operators to evade compliance, but it is hoped that from now on matters will improve.

As to methods of brush disposal found or considered most advisable under specific conditions, where the timber is not cut clean or where a new growth would be in danger should burning be resorted to, lopping and dropping to the ground is recommended, so that *debris* may rot more readily or at least get so damp that it would not burn fiercely.

Where a clean cut of all standing timber is made, and where there is no new growth to be endangered, piling and burning is the best method.

The compensating advantages to the operator from brush disposal are additional security from fires, and, in the case of berth-holders, protection of their remaining standing timber; to the settler, an increased assurance that he and his successors may have a convenient, cheap, and lasting supply of timber.

The estimated cost of piling and burning, or lopping and dropping to ground of *debris*, is 50 cents per thousand feet.

The past attitude of all classes of timber operators in my district, insofar as I have knowledge, has been marked opposition to doing anything whatever toward protection. I consider this feeling to be now somewhat relieved, due, I think, to the fact that fear of losses by fires is getting more prevalent, the scarcity of timber being brought home to the people generally; possibly, also, the activity of our forest officers, who are impressing the settlers with the importance of fire protection and prevention, and in many ways showing that they are now taking more interest in forest business.

BRUSH DISPOSAL IN EASTERN PROVINCES

ONTARIO

Nothing is being done in Ontario at the present time with regard to brush disposal in operations on Crown lands. It is not believed, in any event, that the work could be undertaken satisfactorily with the present organization.

This matter was, however, considered tentatively, and, about two years ago, a clause providing for brush disposal was inserted in one

of the licenses on a saw-timber limit. This situation is explained in the following extract from a statement received from the Provincial Department of Lands, Forests and Mines:

"There have been no brush disposal clauses inserted in timber sales in Ontario, except in the case of the Jocko limits. The Jocko limits contain mature white pine, averaging some five trees to the acre, scattered amongst the hardwood growth. The manner of brush disposal was left to the discretion of the officers of the department, and it was felt that lopping of tops and burning of brush along roads and about camps would be all that was necessary to insure reasonable protection.

"The lopping of tops was carried out satisfactorily the first season, but very severe wind-falls throughout the area have placed the limits in a very dirty condition. The amount of *debris* caused by taking out the big pine was so small a factor that this season the clauses in regard to brush disposal have been withdrawn. At the present time, I do not think the government favours any brush disposal conditions in regard to timber sales, as the later sales have contained no clauses to this effect."

QUEBEC

Aside from a certain amount of experimental work carried on by the Laurentide Company, upon selected portions of their pulp wood limits on the St. Maurice watershed, relatively little consideration has been given the matter of brush disposal in the Province of Quebec. So far as the provincial government is concerned, the following extract from a statement by Mr. G. C. Piché, chief of the Forest Service, Department of Lands and Forests, will explain the situation:

"As to progress made in brush disposal, I must say that, to my knowledge, nothing has been done except to induce the limit-holders to cut into the tops as much as possible, and the Minister has approved a proposal to allow them a rebate of 50 per cent on the stumpage dues for the logs less than six inches in diameter. In the St. Maurice district, out of 20,000,000 logs made during the last three years, about 20 per cent were logs less than six inches, which volume represented some 33,000,000 feet board measure. A few years ago this material would have been lost and would have increased the danger of fire. Therefore, I believe our action is fully justified and will induce the lumbermen to be more and more economical and the province will benefit by increased revenue from timber previously wasted. Also, the forest will be conserved for a much longer period, as we gained about 10 per cent by the removal of these small logs. I had expected

to do something in the way of brush disposal on our township reserves, but the lack of men and of funds has, thus far, prevented any further action. It is hoped that these obstacles may be overcome in the near future."

COST OF TOP-LOPPING

Investigation on the Lands of the Laurentide Co., Ltd., by Ellwood Wilson and D. W. Lusk

Through the courtesy of Mr. M. C. Small, manager of the logging division of the Laurentide Company, Ltd., the authors were given every facility to make the following study on the lands of the company in the St. Maurice watershed, Quebec. They were given a free hand with the jobbers, and Mr. Lusk was appointed an assistant scaler and inspector so that he could control the work.

The object of the investigation was to ascertain, as nearly as possible, the actual cost of top-logging and to determine its practicability and the resulting advantages.

The disposal of lumbering waste and *debris*, either by top-logging or otherwise, is one of the most important questions now under consideration by foresters and lumbermen. There are three possible methods, fire, decay and utilization. In some countries of Europe, where the forests are near the markets and firewood commands a high price, all the *debris* can be utilized as firewood, the smaller branches being tied up into bundles of faggots, and even the leaves and needles are used as bedding for animals. This method is impossible with us. Owing to the condition of our forest floor, it is inadvisable to burn the slash, as the soil is so shallow that fire burns off all the humus and is very difficult to keep under control. Burning would have to be done before the snow was entirely off the ground and would entail the piling of the brush, making the work so costly as to be out of the question. The only other method is that of decay, and it is to facilitate and hasten this that top-logging is undertaken.

The larger the top of a tree left by the loggers, the longer it takes to decay, chiefly because it has more large limbs, and these, holding it up higher off the ground, allow it to dry out, and once dry it may last for many years. If the limbs are cut off, the trunk lies flat on the ground and the branches, being in constant contact with the moist soil, decay much more quickly; also being always wet they do not catch fire so readily or burn so quickly. Large tops left in the woods catch fire very easily, and they burn so rapidly and with so much heat that a fire once started in a slashing is almost impossible to extinguish until the whole cut-over area has been burnt, with the conse-

quent destruction of the trees left and of the future crop. Cut-over areas with large tops left on them are very difficult for surveyors, cruisers and fire-rangers to travel over and the cost of such work is increased by this condition.

The second growth on cut-over lands is hindered to some extent by the presence of large tops, which shut out the light, cover the ground with decaying needles and make the young trees, which have to grow up through the old tops, crooked.

The fire risk is increased fully one hundred per cent after lumbering, but, if the tops are properly lopped, this is much reduced.

In discussing this matter, there are two fundamental questions to be considered, the cost of logging and the cost of fire protection, the first of which is increased and the second decreased by top-logging. Do these two items balance, and if not, do the advantages obtained by top-logging compensate for the added cost? The present prices of lumber and pulpwood do not permit of any extra expenditure for logging, and unless top-logging is made compulsory by law, so as to place all operators on the same basis, few of them would be willing to undertake it. Then too, it is a question which concerns the lumberman more than the pulpwood man, as the latter takes out all logs down to three and a half inches in diameter, and all crooked and forked trees, as well as many logs which are partly unsound. When tops are taken to such a small diameter they lie close to the ground and rot fairly quickly. On the other hand, where trees are cut for lumber, all tops over eight inches in diameter, all forked and many crooked trees and all unsound ones are left in the woods, making the very worst possible conditions, from the standpoint of danger from fire. The amount and character of the material left in the woods are also dependent on the distance from the point of utilization and the difficulty and cost of transportation. It is axiomatic that material which would cost more to remove from the woods than the price which could be obtained for it must be left to decay.

From the standpoint of the good of the forest and its better protection from fire there is no question but that top-logging is beneficial, and one might almost say necessary, and, if made compulsory by a regulation binding on all timber operators in a province, so that the added charge would fall on all, and, if uniformly enforced so that there would be no favoritism or discrimination, it would be a wise measure.

The cost of top-logging is influenced by the following factors: Whether logging is done by company camps or jobbers, attitude of foremen and inspectors, character of labour, nature of the ground

and the time of the year. If the work is done in company camps, the lopping is part of the routine work of felling and is taken as a matter of course and will be better and more economically done. Jobbers working on contract feel that it is extra labour and expense, and will consequently slight the work and will demand more money per thousand feet for doing it.

If the foreman or inspector is in favour of lopping, he will endeavour to have it done thoroughly and cheaply; if not, he will slight it, and make the cost higher if possible.

As in every other class of work the character of the labourers employed is a very important factor in the cost of operation. We found that where boys or old men were used in top-logging the cost was materially increased; the better the labour the cheaper the lopping could be done.

On rough ground, the tops are harder to get at, and the cost is more than on level ground. Tops can be lopped cheaper before the snow comes than after, as it is easier to get around, and the branches are not frozen and covered with snow.

The actual cost is shown by the following tables: Number one shows the number of logs made in each district and the average per man per day; number two shows amount of time spent on lopping; number three the actual cost, and number four shows the probable cost under thoroughly efficient crews and supervision.

TABLE NO. 1—STATISTICS ON LOGS MADE TO DEC. 19, 1913

District No. 1—Jobbers did lop

Jobber	No. logs	Working days	No. men working	Aver. No. logs per day per camp	Aver. No. logs per day per man	Probable log run B.F.
1	4,572	18	12	254	21	25
	4,902	21	12	234		
	3,535	15	11	236		
	<u>13,009</u>	<u>54</u>	<u>34</u>	<u>724</u>		
2	3,148	23	6	137	23	27
	1,843	15	5½	123		
	<u>4,991</u>	<u>38</u>	<u>11½</u>	<u>260</u>		
3	1,069	19	2½	56	24	28
	753	12	2½	63		
	<u>1,822</u>	<u>31</u>	<u>5</u>	<u>119</u>		
4	1,871	23	3	81	25	28
	932	14	3	66½		
	<u>2,803</u>	<u>37</u>	<u>6</u>	<u>147½</u>		
5	1,396	20	3	70	23	27
	837	13	3½	64½		
	<u>2,233</u>	<u>33</u>	<u>6½</u>	<u>134½</u>		
6	1,817	12	6	151½	26	28
	3,612	24	6	150½		
	2,304	14	6	164½		
	<u>7,733</u>	<u>50</u>	<u>18</u>	<u>466½</u>		
7	2,290	31	3	74	26	31
	751	14	2	53		
	<u>3,041</u>	<u>45</u>	<u>5</u>	<u>127</u>		
8	1,577	17	4	93	23	27

District No. 2—Jobbers did not lop

Jobber	No. logs	Working days	No. men working	Aver. No. logs per day per camp	Aver. No. logs per day per man	Probable log run B. F.
9	1,741	8	7	217½	28	30
	5,063	16	7½	211		
	3,078	24	8	192		
	<u>9,882</u>	<u>48</u>	<u>22½</u>	<u>620½</u>		
10	308	3	3	103	35	
	2,265	22	3	103		
	1,719	15	3	114		
	<u>4,292</u>	<u>40</u>	<u>9</u>	<u>320</u>		
11	2,620	20	4	121	31	27
	2,946	24	4	123		
	2,046	16	4	128		
	<u>7,612</u>	<u>60</u>	<u>12</u>	<u>372</u>		
12	2,605	17	4	153	31	31
	2,545	24	4	106		
	1,770	16	4	111		
	<u>6,920</u>	<u>57</u>	<u>12</u>	<u>370</u>		

There is no accurate manner of obtaining data on the number of logs lost per day. Figuring backward from the cost of lopping per "No. feet," we find that it means the loss of four to twelve logs per horse per day, or from one to two logs per man per day.

The average number of logs per day per man in District No. 1 is eight below that in District No. 2. With the liberal allowance of two logs for the added work of top-logging, there still remains a difference of six logs. This is explained by the inferior quality of the labour employed on District No. 1. On District No. 2 the jobbers and their men are old, experienced hands. Many of the sawyers have themselves been jobbers in previous years, and they thoroughly understand their work. On the other hand the jobbers in District No. 1 are many of them new at the work and their men are, with a few exceptions, entirely unaccustomed to woods work. In many instances boys from the larger towns are employed. This class has had no previous experience in logging or with horses. Generally speaking the men working in District No. 1 are but two-thirds to three-quarters as efficient as those in District No. 2. The wages are not correspondingly low, hence costs are high.

The log run in District No. 2 is estimated to be higher than that in District No. 1. This is due to the large number of white pine and big

balsam in District No. 2, considerable area of one to two log balsam in District No. 1 and lack of white pine in District No. 1.

Nos. 1 and 5 show fewer logs per man per day than their associates, due to the presence of boys and cheap labour on the pay roll.

TABLE NO. 2—ACTUAL TIME CONSUMED IN LOPPING AT VARIOUS CAMPS

Jobber	Trees per crew per day	Aver. No. trees per camp per day	Lopping time in hours	Loafing and smoking time	Other work	Time charged to lopping		No. trees lopped per hour
						Hours	Days	
1	50	96	6	2	1	8	$\frac{8}{50}$	8+
	46		6			1		8	8-
2	28	52	$3\frac{1}{2}$	1	$4\frac{1}{2}$	$4\frac{1}{2}$	$\frac{1}{2}$	8
	24		$2\frac{1}{4}$			$6\frac{3}{4}$		$2\frac{1}{4}$	$10\frac{1}{4}$
3	24	24	$2\frac{1}{4}$	0	$6\frac{3}{4}$	$2\frac{1}{4}$	$\frac{1}{4}$	10+
4	28	30	3	0	6	3	$\frac{1}{8}$	9+
5	28	27	$3\frac{1}{2}$	1	$4\frac{1}{2}$	$4\frac{1}{2}$	$\frac{1}{2}$	8
6	30	62	3	0	0	6	$\frac{1}{3}$	10
	28		3			0		6	$9\frac{1}{3}$
7	27	25	$2\frac{1}{4}$	0	$6\frac{3}{4}$	$2\frac{1}{4}$	$\frac{1}{4}$	12
8	36	37	$3\frac{1}{2}$	0	$5\frac{1}{2}$	$3\frac{1}{2}$	$\frac{2}{5}$	10+

TABLE NO. 3—ACTUAL COST OF LOPPING

Jobber	Feet skid-ded per day	Time used in lopping in days	Wages of lopper	Cost of food	Horse time lost	Cost per day per crew for top-logging	Cost per M.B.F. for lopping	Character of labour for top-logging
1	3,012	$\frac{8}{50}$	100	70	none	\$1.51	.50	small boy
	3,012		100	70	none	1.51	.50	small boy
2	1,788	$\frac{1}{2}$	100	70	1 hour	.85	.47	small boy
	1,788		154	70	1 hour	.56	.31	man
3	1,680	$\frac{1}{4}$	154	70	2 hours	.56	.33	man
4	2,109	$\frac{1}{8}$	192	70	2 hours	.88	.41	man
5	1,842	$\frac{1}{2}$	100	70	3 hours	.85	.44	small boy
6	2,208	$\frac{1}{2}$	173	70	1 hour	.81	.37	man
	2,208		173	70	1 hour	.81	.37	man
7	1,984	$\frac{1}{4}$	173	70	1 hour	.61	.31	man
8	2,511	$\frac{2}{5}$	173	70	1 hour	.97	.39	man

Grand average 40 cents, men average $35\frac{1}{2}$ cents, boy average 48 cents.

TABLE NO. 4—IDEAL CREW FOR TOP-LOPPING

Four men—men do cooking; pay, \$52 per month.
One horse—125 logs per day.
Two fellers—fell, buck up, make bark marks and do branching up to top.
One swamper—lop the tops and assist skidder in making trails.
One skidder—skid logs, roll logs, make skidways and make trails.
Ration estimate before Christmas, averaging in Sundays, 70 cents.
Two-fifths swamper's time to lop the tops, at \$2.00 per day.
Log average, 27 board feet skidded per day—3,375.
Cost of lopping per day, \$1.08.
Cost of lopping per M. feet, 32 cents.

Top-logging, except under proper supervision, is only a waste of time, as the men, especially under the jobbing system, will try to evade the work, often piling brush on tops to conceal them.

The holders of timber lands are disposed to look upon top-logging as a matter for careful investigation, and are willing to approach the subject with open minds. As has been said before, it is not likely that anyone would lop tops unless all his neighbours did the same. Some are disposed to use the following argument, which can be illustrated by the experiment described above. The cost of lopping per acre was found to be \$1.63; the benefits from the standpoint of fire protection, reduced cost of cruising, etc., could under no circumstances extend over fifteen years, which would make the cost per acre per year eleven cents. As limit-holders in this section are now getting good fire protection for one-quarter cent per acre per annum, and for two or three cents practically perfect protection could be had by more numerous patrols, would it not be better therefore to spend the additional money in fire protection rather than in top-logging? This, of course, applies only to lumbermen, for the pulp operators, by taking trees down to three and one-half inches in the tops, are practically leaving small enough tops; in fact, that is within one-half inch of the limit prescribed by the top-logging law in New York state.

To sum up, the authors agree that top-logging is well worth while from the standpoint of the good of the forests, but can only be a practical measure when compelled by a general regulation well enforced.

NOTES ON SITUATION IN THE UNITED STATES; SOME SUGGESTIONS ON BRUSH DISPOSAL*

By Elers Koch, Forest Supervisor, United States Forest Service, Missoula, Montana

On a large percentage of the Forest Service timber sales fire protection has been insured by piling and burning the slash, which costs usually from 30 cents to 75 cents per thousand feet. Brush piling, in most cases, is done by the logger, and, of recent years, the timber sale contract usually requires the operator to burn the brush also. With stumpage prices running from \$1 to \$4 per thousand feet, the cost of brush disposal, which, of course, comes out of the stumpage paid the government, takes a large proportion of the value of the timber. On a big timber sale, with a heavy stand per acre, the total amount expended for temporary protection of the sale area reaches a rather alarming figure, and the thrifty forester must, of necessity, cast about for a less expensive means of protection from fire.

Observations made on old slashings indicate that, in from five to seven years, the slash has rotted down and disappeared so as to bring the fire risk back to normal. The problem, then, is to secure protection for the cut-over area during the danger period, after which the ordinary protective measures in force on the forest should suffice. Piling and burning the brush reduces the danger to a minimum, but the expenditure for a few years' fire protection is extremely great.

The fire risk on a timber sale area is generally either from fire starting in an adjoining slash on private lands, or from some human agency, such as logging engines, campers or smokers within the area. If a system of fire lines is constructed, by piling and burning the brush on strips 100 to 300 feet wide along the danger zones, and combined with a very intensive patrol for about five years after the cutting, it should be possible to reduce the fire risk to a minimum at a fraction of the cost of piling and burning the slash on the entire area. In general, the brush should be piled and burned on a strip 200 feet wide around the border of the area if it adjoins slashing on private lands. A wide strip should be cleared of brush on either side of logging railways, and narrow strips along the main logging roads would break the area up into blocks and reduce the danger of fires starting at those points apt to be frequently traversed by human beings.

Lopping the tops may prove desirable in some stands where the brush is very heavy, in order to hasten the rotting of the branches

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and needles. In many cases this is not necessary, particularly on steep slopes, where the tops are pretty well shattered to pieces by felling and logging. Recent inspection of slashings near the Lolo forest, where no disposal had been made of the tops, showed that, in the course of five or six years, the slash had practically disappeared in both the yellow pine and fir-larch types.

A specific example of a Forest Service timber sale will illustrate the saving which could be made on the present method of brush disposal. A sale made to the Anaconda Copper Mining Company, in the Bitterroot forest, cutting on which has been completed, covered an area of approximately 3,300 acres, with a total cut of 52,600,000 board feet, chiefly yellow pine. The area is situated on the edge of the forest, adjoining private lands cut over by the Anaconda Copper Mining Company. The brush on this sale was all piled by the logging company and burned by the Forest Service. The brush piling cost, on an average, about 40 cents per thousand feet. Much of the work was contracted at this figure, and it is safe to say that, at any time, the company would have been glad to modify its contract with an increase in stumpage of 40 cents per thousand, if brush piling could be dispensed with entirely. The brush burning cost the Forest Service six cents per thousand, making a total cost of 46 cents per thousand, or in round numbers, \$24,000 total. That is to say, as much money was expended on the special protection of this 3,300 acres for a period of about five years, as the annual cost of protection and administration of the entire Bitterroot forest, containing 1,154,550 acres. Only the greatest risk could justify the concentration of such a large proportion of the fire protection funds on this limited area. The expense is probably justifiable if no other cheaper means of protection were available. The writer believes that an almost equal degree of protection could have been secured for an expenditure of about \$10,000, a saving of about 58 per cent.

The great danger on this area is from fire starting in the adjoining slash on the Anaconda Copper Mining Company lands. A strip 200 feet wide along the forest boundary on which the brush is piled and burned would offer a good base of protection from fires of this class. This should be further supplemented by a system of cleared belts along the main logging roads. A total of ten per cent of the area would provide for a very extensive system of fire belts. As the brush is heavy on this area it would probably have been advisable to lop the limbs from the tops, which could be done for not to exceed ten cents per thousand feet. The area would then be left in good shape for repelling fires, with all the greatest danger points cleared up. For further protection, until the brush had rotted away, two guards

employed for four months in the year would give very intensive patrol. Each guard would have only two and one-half sections to patrol and should be able to see every foot of the ground several times a day.

The following summary makes clear the relative cost of the two methods:

Plan Adopted

Area cut over, 3,300 acres.
 Total amount cut, 52,600 thousand feet.
 Cost of piling and burning at 46 cents per thousand \$24,000

Proposed Plan

Cost of piling and burning 10 per cent of brush for fire lines	\$2,400
Cost of lopping brush on balance of area at 10 cents per thousand	4,700
Cost of patrol, two men, four months each year at \$75 per month for five years	3,000
	\$10,100
Saving by proposed method	\$13,900

It is believed that this system of partial piling and burning brush in the danger zones, supplemented by intensive patrol for a few years, can be applied successfully to most stands in the yellow pine, the fir-larch or Douglas fir types. Further advantages of leaving the brush unburned might be cited. Most of the yellow pine type in this locality occurs on dry south and west slopes. The brush and needle cover would help to retain moisture in these very dry situations and would probably be an aid to securing reproduction. In the fir-larch type there is very often an advance seedling growth, frequently eight or ten feet high, besides a large number of poles below merchantable size. Brush burning on an area of this sort must, of necessity, destroy a large amount of seedling and pole growth, besides being so expensive that it often deters a prospective purchaser from buying the timber.

The problem in white pine, spruce and cedar timber is somewhat different. The amount of brush in timber of this sort is so large, and the fire risk in the white pine belt is so great, that, in most cases, extreme care must be taken to prevent fire in the slashings.

In the old, over-mature white pine stands, which are characteristic of the merchantable white pine type of the Lolo forest, the only feasible system which has been proposed for securing natural reproduction is the reservation from cutting of scattered groups, strips or single trees well distributed over the area, constituting 10 to 15 per cent of the total stand. If the brush is to be burned in a stand of this

sort, it must necessarily be piled, in order to prevent the total destruction of the seed trees. The cost of piling and burning brush on a mixed stand in the white pine type is estimated at 60 cents per thousand feet. In a stand averaging 25,000 feet to the acre this involves the enormous expenditure of \$15.00 per acre, several times the cost of planting.

The obvious alternative, then, is to cut clean, burn the slash broadcast, and plant the burned area with nursery stock. No very accurate figures are at hand for the cost of broadcast burning, with the area controlled by cleared fire lines, but an estimate of 20 cents per thousand feet is certainly conservative.

Let us then take a specific instance and compare the cost of the two methods. A timber sale has recently been made to the Mann Lumber Company, on Big creek, in the Lolo National forest, covering an area of 3,600 acres, estimated at 80,000,000 feet, a mixture of white pine, spruce, Douglas fir, larch, cedar, hemlock, and white fir. The contract provides that, except on clean-cut areas, the brush shall be piled and burned. The clean-cut areas will be practically nil, so that they need not be considered. In this particular case a part of the area is fire-killed timber where there will be no brush disposal; but to make the case typical of average conditions, it will be assumed that it is entirely a green timber stand.

By clearing a system of fire lines one chain wide along the principal ridge tops, thus dividing the area into blocks, broadcast firing could be done safely and cheaply, and the ground would be left in good shape for planting.

The following figures give the relative cost of the two systems:

Area of tract, 3,600 acres.	
Total stand, 80,000,000 feet.	
Cost of brush piling and burning, at 60 cents per thousand (per acre, \$13.33). Total.....	\$48,000
Cost of broadcast burning at 20 cents per thousand (per acre, \$4.44). Total	16,000
	<hr/>
Saving by broadcast burning, per acre, \$8.89. Total.....	\$32,000
Cost of planting white pine 8 x 8 ft., per acre, \$5.22. Total...	\$18,792
	<hr/>
Net saving after burning and planting, per acre, \$3.67. Total	\$13,208

These figures, if correct—and it is believed that they can be demonstrated—indicate that, if the contract could be amended to permit the company to burn broadcast instead of piling the brush, the stumpage price could be increased sufficiently to amount to \$32,000. The sum

of \$18,792 could then be devoted to planting the area, leaving a net saving of \$13,208. We would then have a well-spaced, completely stocked plantation of white pine, or whatever species was deemed desirable, instead of a more or less incomplete, natural reproduction of perhaps 25 to 50 per cent white pine. The weed trees, the hemlocks, white fir and cedars, would all be eliminated, and there would be prospects for a succeeding crop of timber which would have double the value of the mixed, natural stand. A further advantage, which has not been included in the calculation, is the saving of stumpage in the seed trees. In an over-mature stand much of this will be lost by death of the trees before the end of the next rotation, and the amount of timber left would probably not justify a logging operation before that time. This item would amount to from \$2 to \$4 per acre. The operator would also get the advantage of an increased cut with the same improvement investment, as well as the cheaper cost of logging a clean-cut area.

The planting cost is figured as follows:

Cost of three-year-old white pine transplants, per thousand..	\$3.00
Transportation, per thousand .....	.50
Planting, per thousand	4.00
	<hr/>
Total.	\$7.50

Spacing 8 x 8, or 670 per acre, gives a cost of \$5.22 per acre.

About a million and a half of eastern and western white pine transplants will be shipped from the Saranac nursery this fiscal year, at a cost not to exceed three dollars per thousand ready for shipment. The planting crew on the Lolo forest this fall is planting white pine at the rate of 1,000 per man per day. The final cost has not yet been obtained; but it is certain that it will not exceed \$4 per thousand plants.

The obvious difficulty in carrying out a policy of clear cutting and planting on Forest Service sales is, of course, lack of funds to handle the planting. The increased stumpage receipts go into the United States treasury and the extra expense must be carried by the regular funds of the Forest Service. It would seem, however, that arrangements must be made to cover this expense, if the Forest Service is to make any pretence to a businesslike administration.

The Forest Service policy is, perhaps, not to be criticized. Increased appropriations are hard to get and the present funds barely cover current work; but the fact remains that an attempt to regenerate over-mature white pine stands by natural methods is an economic waste, which will cost the United States government tens of thousands of dollars within the next decade if the policy is continued.

SITUATION IN NATIONAL FORESTS IN MINNESOTA, MICHIGAN,
SOUTH DAKOTA, COLORADO AND WYOMING

The following statement is furnished by the District Forester at Denver, Colorado, in charge of U. S. Forest Service District No. 2.

Heretofore our methods of brush disposal have differed, of course, with the various timber types and ground conditions in each case. In the lodgepole type, we have resorted to piling and burning entirely. In the open yellow pine type in Colorado, scattering has been our usual method, and this method has also been used almost exclusively in our rather dense stands of spruce and alpine fir in mixture. In the Black hills, and in Colorado, where fire danger is great, yellow pine brush has been piled and burned as a strictly protective measure. In comparison with other districts more heavily timbered, and not subject to a fair amount of precipitation during the summer months because situated at lower altitudes, the fire risk in this district is not great and our reasons for piling and burning in lodgepole have taken reproduction into consideration as well as to present a clearer surface to possible ground fires. With the exception of the Minnesota and Michigan forests now in this district, piling has generally been done by the operator as cutting progressed, and the burning has been carried out by the Forest Service later, when light snow or other conditions made it least dangerous. Lately, we have been using a clause in our contracts, however, which requires the purchaser to furnish a sufficient number of men to properly burn the brush, under the supervision of the Forest officer in charge, at any time the latter may order such men. On the Minnesota forests, and in Michigan, piling and burning are carried on simultaneously as the cutting progresses, and we are giving this method a thorough trial in the lodgepole type in Colorado and Wyoming, with a view to determining its feasibility in these regions.

The following is an extract from a letter submitted to this office last winter by Supervisor Marshall of the Minnesota Forest, describing methods of brush disposal in that region:

"Brush piling and burning costs vary so much according to conditions that it is impossible to give any figures which will govern all cases, but I will give you such data as I have and you can fit them to local conditions.

"For an open stand of Norway, running from five hundred thousand to a million to the forty, brush burning should cost nothing if properly handled. By this I mean, that, if as soon as the trees are felled, the brush is piled and burned, the extra amount of logs that the teams will skid on cleared ground will offset the cost of brush disposal. This may be considered one extreme.



A PROGRESSIVE LUMBERING OPERATION
The fire risk is reduced by the disposal of the debris. Brush is piled, ready for burning. Clear cutting of very heavy stand of spruce. Deerlodge National Forest, Montana.



SELECTION CUTTING OF LODGEPOLE PINE, DEERLODGE NATIONAL FOREST, MONTANA
Only marked trees are allowed to be cut, brush must be piled and burned later. Sufficient trees remain to ensure a next crop.

"If you have a bunch of scattered pine timber situated in a growth of poplar and aspen, where the felling of a pine will bring down a dozen or so aspen with it, and where it is necessary to cut a skid road through birch and aspen to get to the tree, the cost of piling and burning will come close to seventy-five cents. This is assuming that you would do as we do here, make them burn all of the brush cut out of the skid roads and all of the aspen knocked down by the pine. We have had instances where there was more brush to be burned on the skid road and more knocked down aspen and birch than there was to be burned on the pine tree they were after. This is the other extreme.

"We figure an average of from eighteen to twenty-five cents for piling and burning. If piled and burned later, it will cost from twenty to forty cents for piling and from five to ten cents for burning, but this is the most costly method and not used here at all. Assuming that you intend to have the brush piled, it is just as easy to take ten minutes in the morning and start a small fire of dry wood and pile the brush on. After the fire is once started, you need do no more than pile, except that, instead of piling it on bare ground or snow, you pile it on the fire and, in this way, brush that would make two or three piles is burned in one fire, and time is saved in carrying the brush. After the first one is made, other fires may be started easily by using a square-nosed, long-handled shovel and carrying some coals to the point where the next fire is to be started. It is very difficult to make a pile of brush that will burn clean without repiling but by burning as you pile, everything is cleaned up.

"Another thing to be taken into consideration is that, if you are working in a country where there is considerable reproduction, the number of ash piles will be greatly reduced, in fact, from figures we have made here, the area burned over will be only about one-fourth of what it would be if piled and burned later. If brush cannot be piled and burned as soon as it is made, I would just as soon not require piling for, if piled in the winter, the snow drifts in and the pile will be the last thing to dry out in the spring. If left unpiled, just as soon as the spring thaw comes, a crew can go in and pile and burn it at one operation before there is any danger of fire spreading.

"While in District No. 1, figures were taken from this forest on brush burning to be used in the west, and I found that at the various supervisors' meetings which I attended, a great deal of the opposition to brush burning was from the supervisors themselves. I will admit that to get general brush burning under way was some job, but now that we have been burning for nine years, the lumbermen think nothing of it and it is considered as much a part of a logging operation as the cutting of the logs themselves. Employment offices around here advertise for brush burners just the same as they do for swampers and sawyers. We were told when we first attempted brush burning that it would cost \$2.00 per thousand. Others said that green brush could not be burned in the winter at all. To date, we have cut about six hundred million and the brush has all been burned. This.

winter we have cut nearly fifty million and the brush will all be cleaned up within two weeks, and for the last month we have had nearly three feet of snow."

Generally, we feel that burning should not be attempted on an extensive scale in less than six inches of snow. It can be done with safety, however, on a small scale after rains and on damp days.

The cost of brush disposal naturally varies very much with the timber and ground conditions. Twenty-five cents per thousand should cover scattering in western yellow pine stands, unless the timber is unusually limby. The cost of scattering properly in spruce should rarely exceed 40 cents per thousand, and piling can be properly done in the lodgepole type for 30 to 45 cents per thousand, depending on the quality and density of the timber, and these piles can later be burned for three to ten cents per thousand, if weather conditions are just right. If the snow is too deep, however, or the piling has been poor, the cost of burning can go as high as 20 cents per thousand. These figures assume an average cost of \$2.50 per day and meals for temporary labour and the cost of at least one forest officer at an average of \$1,100 per annum, supervising the work. Aside from the piling and burning costs there appear to be no additional costs to operators from this source, and in many cases I believe skidding is facilitated by piling and burning, and the cost thereof lowered a few cents per thousand, offsetting a portion of the direct brush disposal cost. Following are figures on burning cost furnished from the Medicine Bow forest:

Average depth of snow, 6 inches.	
Acreage burned	514
Average <i>cut</i> per acre	5,000
Average piles burned per man per day	451
Brush had been piled one year.	
"Tepee" and low, flat piles.	
COSTS	
Oil and matches	\$4 05
Teaming	9 00
Temporary labour at \$2.50.....	72 00
Forest officers' time.....	56 39
	\$141 44
Cost per acre	\$0.275
Cost per thousand cut	0.0542

The costs of burning with a large crew in the Bighorn forest in the season of 1911, were as follows:

COSTS, SEASON 1911

Wages of temporary labourers	\$534 00
Wages of Forest Service employees	141 86
Meals furnished temporary labourers	137 53
81 gallons oil, at 25 cents per gallon	20 25
Freight on 81 gallons oil	7 29
Supplies purchased from Bighorn Timber Co.	9 05
Two lb. wicking at 35 cents per lb.	70
Freight on food supplies (Dayton-Woodrock)	27 40
	<hr/>
Total cost	\$878 08
Area burned over, acres	4,236
Total amount timber removed from above area, ft. B.M. . .	24,532,875
Amount of timber removed per acre burned over, ft. B.M. .	5,791
Cost per acre	\$0.207
Cost per M. ft. B.M.	0.0357

When brush disposal was initiated, operators throughout this district were very much opposed to it, but now take it as a matter of course, and we have very few complaints from this source. One of our largest operators in the lodgepole type in Wyoming has complained on several occasions of the added responsibility thrown on the operator's shoulders from this source, and has asked that the Service take entire charge of brush disposal, carrying it out at such times as may seem best and meeting the costs from funds deposited by the operator for this purpose from time to time. This is an unusual case, however, and, where the burning is properly supervised by the operator, little trouble occurs. Shortly after piling and burning was initiated we had some trouble with operators because of their lax supervision of this phase of the operations, and, because of a general inclination on their part to consider brush disposal impracticable, they make no effort to carry it out properly. When an honest effort is made to secure efficiency in its disposal, operators secure results at very low cost and rarely, if ever, complain of this feature, particularly in view of the fact that our stumpage appraisals now consider brush disposal as a distinct item of operating costs and allow a rather liberal figure for it.

The only compensating advantages I can think of which ensue to the operator through brush disposal, are the slight reduction in the fire hazard and, as previously mentioned, the slightly increased freedom in skidding operations. If a sufficient margin has been allowed for brush disposal in the stumpage appraisal, I think these two points can really be considered as distinctly advantageous to the operator. How-

ever, if brush disposal has not been considered in the stumpage appraisal, they would, of course, not offset its cost.

It is our belief that the piling and burning of brush undoubtedly reduces the fire hazard and certainly lessens damage to which timber is liable through ground fires. However, under certain conditions in this district, piling and burning is impracticable, owing to the nature of the stand or ground conditions. In our spruce-fir type, for instance, there is so much advance reproduction on the ground as a rule and such a large amount of dead timber and other inflammable *debris*, that piling and burning would hardly be practicable, unless we required the purchaser to pile this other material in addition to the brush resulting from his cutting operations, and, in many cases, this would prove so expensive as to make the requirement impracticable of enforcement. In the yellow pine type we rarely pile and burn because the stands are generally very open and the ground rather bare; we have also felt that the slight addition to ground cover and soil moisture occasioned by scattering was very desirable from a standpoint of possible reproduction, and that the risk of fire was negligible. I believe that it is very generally conceded in most portions of the west and in the Lake states, to-day, that brush disposal does lessen the fire hazard, although I do not know of any tests having been recorded on this subject or any reports showing the comparative intensity of fires on cleared and uncleared cut-over land.

The effect of brush disposal on reproduction seems to be dependent on a number of factors, the most important of which are the weight of cutting in the stand, the tree species, and soil conditions. In our lodgepole type, brush burning is undoubtedly conducive to reproduction, and investigators of this office have reported that reproduction following the scattering of brush in the lodgepole type in Wyoming was very unsatisfactory in comparison with that following piling and burning. Based on cutting areas examined in the past several years and the general knowledge of conditions in the lodgepole type, it is my opinion that scattering would not give good reproduction in this type if applied as a general rule. I believe that piling and burning in the spruce-fir type might possibly result in better reproduction, but, as explained above, it is impracticable owing to the character of the stand usually encountered. Where the cutting in this type is rather heavy and the scattering is carried out with the idea of assisting reproduction as much as possible, I think we will obtain very fair results. In our open yellow pine stands, scattering is undoubtedly more favourable to reproduction than piling and burning. The greatest difficulty we encounter in securing reproduction in such stands is

the occurrence of grass and weeds and the dryness of the soil, and I feel that any method which assists in killing the grass or weed cover is more conducive to reproduction than a system which would not destroy this cover on portions of the area. I am sorry to state that we have as yet no information on file in this office as to the effect of brush disposal on reproduction in timber types found in the Lake states.

Brush disposal is now so firmly established in the sale policy of the Service that I can foresee no radical change in the near future. Changes may be made from time to time in the exact methods of disposal, either from silvicultural or administrative standpoints, but I do not believe the general principles we have been following will be relinquished.

STATE WORK IN BRUSH DISPOSAL—MINNESOTA*

By W. T. Cox, Minnesota State Forester

The control of fires and the handling of slash has been the body of the work of the Minnesota State Forest Service since its organization. A large number of people are vitally interested in the disposition of the logging slash, either because they have such to dispose of or are dangerously menaced by its existence. Since the slash disposal laws have been in effect, it has been the custom of many of the logging companies to leave the slash scattered and strewn all over the logged ground, and then make a grand clean-up in the spring with a general fire. This system has not worked out satisfactorily, not only because of the destruction of the remaining timber and reproduction, but because of the damage of resulting fires that escape control.

A study of the situation for the last few years has revealed a few new facts. Statistics show that 16.5 per cent of the total fires during the last year were fires escaping from slash burners, and that these fires caused 16 per cent of the total damage done.

All kinds of slash do not burn the same, nor does any one kind burn the same under different conditions. Green slash of pure cedar and spruce, for instance, is hard to burn, but, if a fire is started and the green slash piled on, it burns well. Pine slash burns well either in winter or summer. Where the timber is dense and the slash considerable, the expense of burning at the time of logging is very nearly balanced or may even be more than offset by the increased convenience in skidding. Actual operations have shown that where timber is heavy

* Extracts reprinted from *Fourth Annual Report of State Forester of Minnesota*, for the year ending July 31, 1914, pp. 36-40.

(150 M per "40" or greater), slash will be so dense that considerable piling will be necessary before skidding can be done, and under these circumstances it would be much cheaper to burn at the time of cutting than to wait until spring. Figures from further operations also show that 25 cents is a fair average cost for burning of slash at time of logging, to say nothing of the increased benefit to skidding and to the operation as a whole.

In summarizing conditions generally, the policy has been adopted to enforce winter burning, or very early spring burning wherever winter burning would entail unreasonable expense.

Below are general instructions for disposing of various kinds of slash under different conditions:

CEDAR, AND TO A CERTAIN EXTENT, TAMARACK

I. Isolated or very small tracts.

Pile and burn in winter or early spring, a strip at least 150 feet wide along roads or any dangerous points. Pile and burn any slash that falls from the cedar swamp on to high land.

II. Larger tracts.

Where there is much small cedar or other timber remaining, pile slash well in at least a 150-foot strip around slashing, and burn strip in early spring.

III. Upland Cedar and Hardwoods.

On good agricultural soil with very little or no valuable timber remaining, fire line as in No. II, or let burn hard with general fire, but in early spring only.

IV. Summer cutting of Cedar.

When it can safely be done, pile and burn a fire line along roads, rights-of-way, and settlements as cutting proceeds. Otherwise, slash to be disposed of as per Nos. I, II and III when dry season is over.

SPRUCE AND BALSAM

I. Upland type.

Where spruce alone is cut and the stand is mixed with pine or hardwoods, burn the slash as logging proceeds.

II. Swamp type.

Where 40 to 50 per cent of the number of trees remain standing, fire-line a strip at least 150 feet wide around entire slashing by burning slash in winter or early spring. If clean cut, pile slash in windrows and burn in early spring.

III. Any Spruce or Balsam.

Where most of spruce or balsam is cut out, but where there is considerable timber remaining that may be valuable in the future, pile slash in windrows as logging proceeds and burn in early spring.

PINE

I. Very scattering.

Burn a 150-foot strip as logging proceeds, or pile and burn in very early spring all dangerous slash, old and new, along rights-of-way, standing timber, roads and farmsteads. No late spring burning. This would apply to land with pine alone or where pine is in mixture with other timber.

II. Scattering to 150 M per "40."

Burn slash in winter over entire area as logging proceeds, or pile, as logging proceeds, all slash either old or new in a 150-foot strip around entire cutting and burn the slash on this strip either in winter or early spring.

III. 150 M per "40" and heavier.

Burn all slash as logging proceeds.

IV. Summer logging.

Burn all slash as logging proceeds, except during dangerous periods, when slash should be piled for burning at first safe time.

V. On strictly non-agricultural land.

If dense (150 M or more to the "40"), winter burn all slash. In lighter stands, winter burn or pile all slash in 150-foot strip or greater, fire line around entire area and along all roads, rights-of-way and standing timber, and burn piled strips in early spring. No late burning.

VI. Steam skidding.

Clean burn winter cutting in early spring. For summer logging, burn settings as safe conditions will permit, or keep a fire-line around slashing as cutting proceeds.

VII. Homesteaders, settlers, wood cutters and small jack pine operators.

Early spring-burn scattered slash, or fire line as provided for other slash.

(Wherever the term "early spring" is used, it is meant immediately after the snow has gone and while the frost is yet in the ground. At this time the surface is moist enough so that fires will not run in the woods.)

NATIONAL FORESTS IN WASHINGTON AND OREGON

Following is a statement of the developments in brush disposal, during the past year, in National forests in Washington and Oregon. This statement was prepared by the District Forester, District No. 6, U. S. Forest Service.

The slash on two of our National forest timber sales in Oregon was burned broadcast last autumn (1913), and the fire menace on these two cut-over areas was thereby considerably reduced. On one of these

areas, consisting of 120 acres, the cost of burning the slash was 43c. per acre, or, when figured in terms of the amount of timber taken from the area, \$0.0034 per thousand board feet.

We have experienced very little difficulty in securing the consent of purchasers of National forest timber to the brush disposal requirements in the sale contracts. Practically the only point to which they object is the cutting of snags on the sale area, and this requirement is usually confined to only three snags per acre in addition to the snags which must be cut in the construction of fire-lines. I believe that almost all the present purchasers of National forest timber in this district fully appreciate the importance of the proper disposal of brush. In one of our yellow pine sales in southern Oregon, where big wheels are used in the logging, comparatively wide roads must be cleared through the forest, so that a good deal of the brush is piled in advance or at the time of the felling operations.

A suggestion has recently been made that slash burning on Douglas fir sales, where all of the merchantable timber is cut and removed, should be confined to only one burn. The idea set forth is that the seed which has fallen from the trees in the past few years is present in the duff and humus and, after the forest cover is removed and light is admitted to the ground, this seed germinates. A single burning is supposed not to be so severe as to destroy this seed, but a second or numerous subsequent burnings would probably completely destroy it. If this idea is true, and we are now trying to corroborate it, it might be advisable to burn over such areas only once.

At the bottom of page 53 of *Forest Protection in Canada, 1912*, an error was made in stating that the Oregon forestry law requires that slashings shall be burned between June 1st and October 1st. The law prescribes that it is unlawful to burn slashings between June 1st and October 1st without first obtaining a burning permit from a state fire warden. No restriction whatever is placed on slash burning during the other eight months of the year.—C. L.

STATE WORK IN BRUSH DISPOSAL—WASHINGTON

The following is quoted from a statement by E. W. Ferris, State Forester of Washington:

The disposal of slash is one of the important problems of forest protective organizations. In this state we have three forest protective organizations working in co-operation. They are the State Forest Fire Service, the Washington Forest Fire Association, and the U. S. Forest Service.

In the forest protection laws of this state, consideration is given to the importance of slash burning, and provision is made that permission for burning shall be given only upon compliance with such rules and

regulations as the Board of Forest Commissioners shall prescribe, which shall be only such as the board deems necessary for the protection of life and property.

In considering methods of slash disposal in the past, the element of cost has figured largely, and the method of slash disposal has been to fire the cut-over areas when weather conditions were favourable.

On account of the abundant rainfall, the burning season is limited, especially west of the Cascade mountains, where the heaviest bodies of timber are situated.

Spring and autumn burnings are advocated. While spring burning is not as thorough as it is later in the season, the areas burned over reduce the amount of inflammable material and lessen the fire risk, if precaution be taken to extinguish the smouldering fires that result from such burning.

With such large areas of timber lands being cut-over each year in the state of Washington, the fire hazard has been on the increase. And with the season for successful burning on an extensive scale limited to the dry season, every effort must be made to burn slashings whenever it is possible and safe to do so.

Every slashing successfully burned over reduces the fire hazard, and the burned-over area acts as backfire guards that will prevent the spread of other fires that may occur.

The lumber operators are learning that it pays to systematically burn over their holdings after the merchantable timber has been removed. They realize that the element of fire risk is very great during the dry season, not only from their own operations but from cut-over lands of other operators which have been left unburned, and they are earnestly considering forest fire protection.

The additional cost of burning is insignificant when compared with the results gained by the reduced hazard to property from accidental fires.

Logging operators and millmen are realizing the importance of burning more and more each year and are making the burning over of their logged-off lands a systematic part of their operations. This has been brought about by the earnest and constant advocating of such burning by the State Forester and Fire Warden of this State, and by the Chief Fire Warden of the Washington Forest Fire Association, as well as by the experience gained from personal loss by forest fire, in equipment, saw-logs and standing timber.

In regard to the effect of brush disposal on forest reproduction, it has been observed that the areas burned of brush, etc., reproduce the better species of original forest growth; where unburned, the inferior species reproduce.

The lessened fire risk must be given consideration in the reforestation of logged-off lands. Repeated burnings are disastrous to the life of the soil.

In the important work of slash burning, important because it reduces the fire hazard, we endeavour to co-operate with those who have slashings or logged-off lands to burn over. The State Forest Fire Service and Washington Forest Fire Association work in co-operation in this matter through the efforts of the fire wardens and forest rangers. Our methods of slash burning are the same. The forest rangers in the employ of the association receive their commissions from the State Forester and Fire Warden, which gives them authority to issue burning permits and make arrests for violations of the forest protection laws.

THE NORTHERN PENINSULA OF MICHIGAN

The Northern Forest Protective Association is composed of timber land owners in the northern peninsula of Michigan.

Thos. B. Wyman, Secretary-Forester of this association, writes as follows:

"In relation to brush disposal in this peninsula, permit me to say that the Northern Forest Protective Association is advocating continuously the disposal of brush as the most rational fire preventive measure, and we are meeting with some slight success in stirring up a feeling along this line. Several of the large companies are undertaking to burn their slash, and we are furnishing patrolmen for them as a means of greater safety.

"Occasionally fires get started in cut-over lands, and, instead of making a huge effort to put them out, we prefer rather to simply control them and permit of the burning of as great an acreage as is consistent with safety. I am expecting to see a large area burned over during the coming season."

TOP-LOPPING IN THE ADIRONDACKS

The top-logging situation in the Adirondacks was very fully discussed in the 1912 report. The present situation is explained in the following statement, by C. R. Pettis, Superintendent of State Forests, state of New York:

"The only question of brush disposal which we have considered in this state is the lopping of evergreen branches. The law, which we proposed as a result of the investigation last winter, was enacted. It provides that all limbs and branches down to three inches in diameter shall be cut off at the time of cutting of evergreen trees. The present statute prescribes a penalty for failure to do so. The lumbermen are co-operating in this matter and we are having no trouble in

enforcing the provision. The additional cost amounts to approximately 25c. per M. feet, but there are certain offsets; for example, they are securing material which in some cases before was wasted, and some operators claim that it reduces the cost of skidding. I do not think that top-logging seriously interferes with reproduction, and the experience has been that the fire danger is, perhaps, increased the first year or two; but, on the other hand, should a fire start, they are able to build a fire line quicker and easier, and that, on the whole, there is not any material disadvantage, even during the first year or two.

“The tendency in softwood operations is, so far as possible, to get away from river-driving and to adopt shipping by rail instead. This has led to bark peeling, and there are large areas in the Adirondacks where spruce is now being peeled in the woods. I think that this is a very serious situation, as the bark does not decay for years, and should a fire occur it would afford excellent fuel. The law charges us with protection of various areas from fire and, of course, we cannot accomplish what the law or people expect unless certain precautions are taken.”

THE ENTOMOLOGICAL ASPECT OF SLASH DISPOSAL*

By Ralph Hopping

There is one protection factor in slash disposal that Mr. Koch, in his article, “The Economic Aspect of Slash Disposal,” in the July, 1914, number of the *Proceedings of the Society of American Foresters*, fails to consider. This is the danger of an insect infestation resulting from the breeding of large numbers of destructive bark borers in the unburned refuse from timber sales, such as cull logs, tops, and limbs.

That the danger from slash left on the ground should be considered from all sides of the question is obvious, and that the danger from insects is not negligible is recognized by foresters the world over. While in France, Austria, and Germany the very small limbs may not always be piled and burned, the utilization of all tops and limbs is so thorough as to practically eliminate this danger. The very small branches and twigs do not breed any very dangerous species. In America, however, the absence of settlers and distance from market precludes this thorough utilization. Logs are seldom used under ten feet in length and limbs not at all, except in cases where they are used for fuel in logging engines, or in the rare instances where cordwood sales are possible.

* Reprinted from *Proceedings of the Society of American Foresters*, Vol. X, No. 2, pp. 183-185.

Mr. Koch and Mr. Mitchell* have very ably considered the cost and necessity of slash disposal from a fire-protection standpoint. That the protection of our forests from insects is probably of as great importance is beginning to be recognized by foresters in the United States and Canada. I will cite one instance of damage from insects, resulting from unavoidable slash, as an illustration of the importance of this phase of the question in America.

During the winter of 1912-1913, the southern part of the Sierra Nevada mountains, extending from the Merced river on the north to Kings river on the south, was visited by a storm which caused a large amount of snowbreak, especially in the pole and sapling stands. This slash bred a bark borer (*Ips confusus*), which is very destructive to young growth of western yellow pine and the tops of mature trees of the same species. The beetles increased in this slash to such an extent that, in the spring and summer of 1914, groups of 75 and 100 dying trees were not uncommon. Strenuous efforts have been made to check this epidemic in some of the more important commercial stands, at a cost of approximately \$5,000. What the ultimate cost will be it is impossible to estimate at the present writing. This was a natural cause, and only serves to illustrate the immense damage resulting from fresh material which is not promptly burned, or at least before the broods escape to near-by standing timber.

Settlers and commercial activities in our wooded areas, especially in the western United States, have added another cause for epidemics of insects in our forests. Visitors and residents in these sections are continually reporting the increase of dying timber due to this cause. Prof. E. P. Stebbing,† a well-known English forester, says:

“Experience has shown that in countries where very large tracts are covered with a single species of conifer, such, *e.g.*, as is the case in America and to a lesser extent perhaps in India, uncontrolled fellings have resulted in the most disastrous infestations of bark-boring beetle pests.”

Unburned slash constitutes “uncontrolled fellings.” I do not mean to state, nor does Professor Stebbing, that all uncontrolled fellings start epidemics, but that many of them do, and that the damage and consequent loss is so large that it will greatly exceed any expenditures for slash disposal. Certain investigations in California have proved that the annual loss of timber from the depredations of forest insects has increased from year to year. If only natural causes, such as snowbreak, windbreak, and climatic conditions, were responsible, the loss

**Proceedings of the Society of American Foresters*, Vol. VIII, No. 3, 1913.

†*Indian Forest Memoirs*, by E. P. Stebbing, Vol. III, Pt. 1, page 1, 1911.

would probably not exceed that in the past. This loss, however, has been augmented by freshly cut, unburned material.

It has been the general policy on the National forests and on some private holdings to burn all slash, but this slash has not always been burned at the right time. In order to prevent the insect broods which destroy standing timber from escaping, the slash must be burned before the brood escaped. Where these broods have escaped from public and private operations resulting in slash, small epidemics have started wherever the conditions were favourable. An instance of this is the Cox timber sale on the Plumas National Forest, where an epidemic, started from the cull logs and slash, killed a large percentage of the standing timber on the hillside above the mill the following year.

An epidemic has just appeared in the eastern Lassen National forest, along the right-of-way for the Fernley and Lassen branch of the Southern Pacific railway. This started in the logs and slash felled in clearing for construction. Unless controlled, these epidemics increase from year to year and are often augmented by broods from other freshly cut material.

The infesting species is often different, due to different species of trees or parts of trees. Thus a cull log or top of yellow pine (*Pinus ponderosa*) breeds the western pine beetle (*Dendroctonus brevicomis*), the most destructive beetle to yellow pine on the Pacific coast. Tops and limbs breed another very destructive species, an engraver beetle (*Ips confusus*), killing tops of trees and young growth. No matter what the species of tree the slash resulted from, that slash breeds under ordinary circumstances the insect or insects destructive to standing timber. The annual loss from this cause alone far exceeds any cost incurred from the burning of the slash at the proper time. Therefore, the consideration of the burning or non-burning of brush must be taken up from a broad protection standpoint and not from the standpoint of fire risk or cost alone.

PART IV

The Effect of Repeated Forest Fires upon the Reproduction of Commercial Species in Peterborough County, Ontario

BY

C. D. HOWE, Ph.D.

OBJECT OF THE WORK AND THE CONCLUSIONS IN BRIEF

DURING the summer of 1912, while engaged in a survey of the forest conditions of the Trent watershed, Ontario, the writer attempted to secure an insight into the amount of damage occasioned by forest fires. The result of this incidental, and somewhat superficial, work, presented in the report* of the Commission of Conservation, was such as to make a closer and more detailed investigation of a smaller area appear desirable. The writer was, therefore, engaged by the Commission to make such an investigation.

At the outset, it may be stated that the general results obtained in 1912 have been fully substantiated by the detail work carried on in 1913. While, in 1912, the total loss, as the result of repeated fires, was figured at over \$12,000,000 on a territory of 620,000 acres, or practically \$20 per acre, the loss on the 85,000 acres more closely investigated during the following year could be estimated at around \$3,000,000, or \$35 per acre—a loss that could have been prevented, to a large extent, by more effective fire protection.

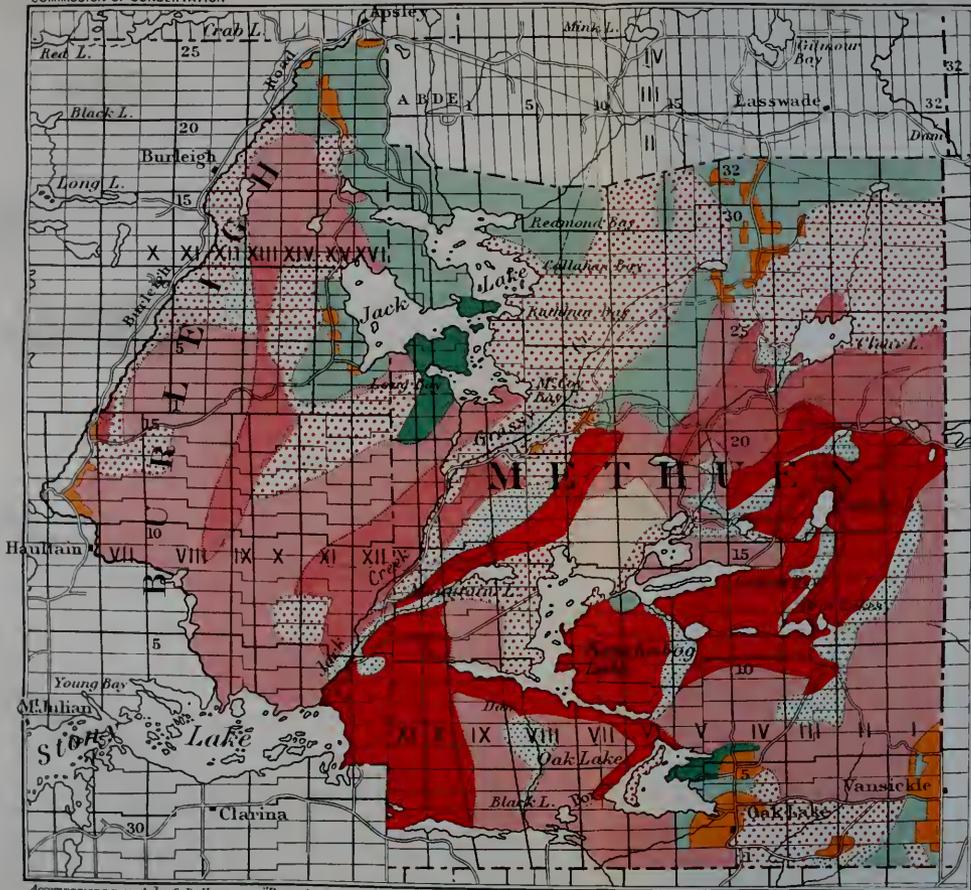
A more detailed statement of the conditions on the Burleigh-Methuen area, investigated in 1913, shows that the areas burned only once now have 110 young pine trees on the average acre; the areas burned twice, 14; areas burned three times, seven trees, and those burned many times, three pine trees per acre. (See p. 190).

Assuming that the areas burned twice had been burned only once, and that they had been restocked with pine by natural processes at the

**Trent Watershed Survey*. Commission of Conservation, Canada, Ottawa, 1913.



Map of the [illegible] [illegible]

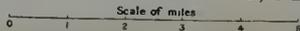


Legend

- Burned once
- Burned twice
- Burned three times
- Burned many times
- Cutted hardwoods
- Mixed hardwoods and soft-woods
- Forested swamps
- Marshes
- Oak barrens
- Cleared land
- Not examined

Accompanying report by C. D. Howe on "Reproduction of commercial species"

FOREST FIRES IN BURLEIGH AND METHUEN TPS, PETERBOROUGH CO., ONT.



same rate as the areas burned once, then it will be seen that the second burning reduced the then existing potential stumpage and dues values of the pine by more than \$1,500,000.

Under like assumptions, we find the financial loss on the much smaller total area burned three times to be \$646,000, and that on the areas burned many times to be \$891,000. Thus, as already stated, the repeated fires represent a loss already incurred, in previously existing potential values of pine, of approximately \$3,000,000 (see p. 199).

The greater portion of the poplar on the area is less than 25 years old, consequently the amount of material now suitable for pulpwood is very small, being one cord per acre on the area burned once; one-fifth cord per acre on the area burned twice; one-eighteenth cord per acre on the area burned three times, and only one-forty-fifth cord per acre on the area burned many times (see p. 190).

According to the calculations given in table, p. 200, it is estimated that the area burned once will yield nine cords of pulpwood per acre in 30 years from the present date; the area burned twice five cords per acre; those burned three times 2.5 cords per acre, and the area burned many times will yield less than one-third cord per acre at the end of the next 30 years. The repeated fires have therefore occasioned a loss of nearly \$200,000 in pulpwood.

Notwithstanding the tremendous loss already incurred, however, the investigation shows that the potential stumpage value of the remaining stock of pine is \$1,563,540, and the potential value of the dues \$446,718, or a total of over \$2,000,000 potential value of existing pine (see p. 199). The potential value of the existing stand of poplar is \$265,325 (see p. 200). Thus, with proper methods for the prevention of further fire damage, the existing young growth of pine and poplar is capable of producing a future value of more than \$2,275,000. That it is worth while to make this saving should scarcely need argument.

The rate of occurrence of forest fires on the area under consideration has increased 300 per cent in the past eight years. More efficient fire protection is recommended. It is shown that the cost of adequate protection for the next 50 years would be less than \$5 per acre, while the value of the crop at that time would be \$33 per acre, a saving that would certainly justify the cost of protection (see p. 204).

The report concludes with the recommendation that the cut-over and burned-over lands in the region under discussion be turned over to the county of Peterborough under the Counties Reforestation Act, unless the wiser or the more practicable plan be adopted, viz., placing these areas under the administration of the Dominion Government. This latter action would be fully justified by the importance of the

area in question, as a portion of the watershed of the Trent canal, which is an enterprise of the Dominion Government.

An incidental advantage attaching to transfer to the Dominion Government, with administration by the Forestry Branch, Department of the Interior, would be the probable establishment of a forest experiment station. Such action would have for its object the securing of information calculated to furnish a solid scientific basis for the silvicultural handling of existing forests, as well as for the establishment of new forests, in order to secure the most economic use of the timber and forest products. A more exact knowledge of the indirect benefits of the forest, such as the influence of forest cover upon stream-flow, might result from the establishment of a forest experiment station. There is great need for the prosecution of such investigations, under Canadian conditions.

INTRODUCTION

That trees of relatively inferior value, such as birch and poplar, follow fires on areas previously occupied by pine, is a matter of common observation, but the amount of this material and its potential value are not so well known. It is also well known that repeated fires on former pine lands greatly retard, or completely exclude, the re-establishment of pine trees thereon, but the rate of this retardation in relation to the number of fires is not so well known. The financial losses involved in the replacement of valuable pine destroyed by fires, by the less valuable poplar, have been estimated in certain cases, but these estimates have been based upon relatively few actual measurements.

Three aspects of the problem of the burned pineries present themselves for solution, namely: (1) An estimate of the amount of young pine and poplar now present in relation to the number of times the area has been burned; (2) an inquiry as to whether the amount of the pine and poplar restocking the burned areas has sufficient present or potential value to justify care and protection; (3) an estimate of the financial losses, if any, incurred by allowing fires to replace pine forests with poplar or other inferior forests.

Area Under Investigation

The area examined in 1913, and covered by this report, comprises some 85,000 acres, and includes all of the township of Methuen and that portion of the township of Burleigh which lies east of Eels brook, both being situated in the county of Peterborough, Ont. The region was selected because it contains, in a relatively compact space, considerable areas which have been burned once, twice, thrice and many times.

The work was carried on for three and one-half months by the writer and two student assistants, Messrs. J. D. Aiken and Miles Burford, of the Faculty of Forestry, University of Toronto, whose efficient co-operation made possible the gathering and the organization of the data for the report.

The original plan was to run parallel compass lines one-half mile apart through the burns of various ages, and to measure all of the trees one inch and more in diameter. This plan was adhered to for the first month, when it was found that the composition of the various types was so constant that the running of the lines so near together appeared to be unnecessary. None of the lines, however, were more than a mile apart. At least one line was run through each type in its longest direction and the trees were counted and measured with calipers. Then paced reconnaissance lines were run parallel or perpendicular to the calipered lines and in this way the boundaries of the various types were determined. The strips, a chain (66 feet) wide, on which the trees were actually counted and measured, aggregated nearly 25 miles, while the reconnaissance lines aggregated over 80 miles.

Basis of Classification In the field work, the following types were found within the burns of various ages, and separately tallied: (1) Low amphibolite ridges; (2) low granite ridges; (3) low limestone ridges; (4) sand ridges; (5) depressions between ridges; and (6) sand plains. Upon compilation of the results, however, it was found that, while there were interesting differences botanically, there were not differences enough as regards the amount of second growth pine and poplar to justify such classification. Hence, the differences due to topography, soil, and attendant conditions have been neglected, and the areas have been classified alone according to the number of times burned.

In the field work, also, an area burned a certain number of times was sub-divided into several smaller areas, according to the amount of pine and poplar reproduction per acre, but, in the final tabulation, it seemed best for the purposes of this report, to group these areas and to strike the average in terms of the young pine and poplar for the entire area burned a stated number of times.

The number of times an area had been burned was determined in two ways: (1) By the age of the stands of poplar, and (2) by the number and age of the fire scars on the old trees. For example, it would be found that the great majority of the young trees on a certain area fell into three age classes, of 8, 16, and 25 years. In addition, the poplars 25 years old would show that they had been burned at the base 8 and 16 years ago, while the poplars 16 years old would have

fire scars eight years old. By counting the annual rings of the wood covering the fire scars on the few mature trees still standing, it would be found that they had been severely injured by fire approximately 8, 16 and 25 years ago. Therefore, the area would be classed as having been burned three times. Severe fires usually burn off the brush and duff down to the mineral soil. These areas form ideal germinating beds for poplar, which requires plenty of light, and whose seeds are easily and widely distributed and germinate quickly. The poplar grows rapidly for the first few years, and the young seedlings soon cover the ground. The seedlings from the seed crops of the few succeeding years are too much shaded to compete successfully with those already on the ground. The result is a pure or a nearly pure stand of even-aged trees. Fire is practically the only agent that can make the proper conditions for the development of such stands. Clean cutting without the usual subsequent fire might bring about pure stands in restricted patches, but, taking the area as a whole, it would be found that the poplar would not come among the brush piles until they decayed. The result would be "patchy" stands of different ages. In any case, the presence or absence of fire scars on the escaped mature trees would furnish the necessary corroborative evidence that we are dealing with burned areas.

One is, then, not dependent upon hearsay or tradition in determining the number of times an area has been severely burned. Every severe fire leaves its record burned into the trees not actually killed, and stamps its impress upon the succeeding generation of trees.

Many
Smaller
Fires

The designation *number of times burned*, in these discussions and on the accompanying map, means that the greater portion of the area so designated has been *severely* burned the number of times indicated; that is, burned sufficiently to scar the standing trees and to kill off portions of the young growth periodically, so that stands of different age classes have resulted where more than once burned. It will be seen that this method of designation takes no account of the ground fires, which did not develop sufficient heat to burn into the wood of the trees or to kill the young trees in large quantities. Fires of this kind are frequent in the dry periods of the last week of April and the first week of May, when the leafage is not sufficiently developed to feed the flames and when only the upper layer of the vegetable *debris* on the ground is dry enough to burn. It is evident that fires of this kind are very destructive to the tender seedlings of pine and, on the other hand, that they stimulate the reproduction of birch and poplar, both because the fires make a clean seed-bed and because the birch and poplar sprout vigorously.

The preponderance of birch or poplar of the smaller diameter classes on the areas burned once or twice, as indicated in the accompanying tables (see pp. 176-177, 180-181), is due to ground fires.

PHYSIOGRAPHIC CONDITIONS

The geology, topography, and soil conditions of the region in which the area under discussion lies were fully discussed in the report on the Trent Watershed Survey.* Only enough of the description will be repeated here to give the reader a general picture of the area now under consideration.

The portion of Burleigh township examined includes the territory lying east of Eels brook, and is drained into Stony lake by that brook and by Jack creek. The central and eastern portions of Methuen township drain through Kasshabog lake into North river, thence by the Crow river into Trent river. The waters in the north-western portion flow through Jack creek into Stony lake. The extreme south-eastern portion drains into Otter creek, a tributary of Deer river, whose waters also fall into the Trent through Crow river.

General Description of Territory †The general elevation of the country is approximately 850 feet above sea level, and it has the appearance of a dissected plateau, sloping gently in a south-south-western direction. Between Eels brook, Jack creek and its tributary, Grassy brook, the underlying rock is mostly crystalline limestone, through which are frequent intrusions of granite, especially in the southern division of Burleigh. The topography, on the western side near Eels brook, is quite flat, but becomes more diversified and rougher eastward to the Blue mountains, in Methuen township. These mountains are the most conspicuous objects in the topography of the area, and they are situated almost in the centre of the region under discussion. They rise abruptly on all sides to about 300 feet above the general level and extend about four miles in a northeast and south-west direction. The crest of these mountains is a bare ridge of syenite rock, and the "foothills" consist of numerous ridges of sharply inclined amphibolite or granitic ridges, with deep gullies between. The amphibolite, in a strip about a mile wide, is continued north-eastward to the extreme northeast corner of the township.

Eastward and southward from the Blue mountains, the country has the appearance of a granite plain, into which innumerable gullies and

**Trent Watershed Survey*. Commission of Conservation, Ottawa, 1913. Pp. 35-39; 75-76; 108-113.

†This description is summarized from Geological Survey Report, Memoir No. 6, *Geology of the Haliburton and Bancroft Areas*, Province of Ontario, by Frank D. Adams and Alfred E. Barlow, 1910.

ravines have been worn by ice and water action. The result is a topography of low rounded ridges and depressions. The monotony of this plain is relieved by a few granite hills, rising from 100 feet to 150 feet above the general level. The highest of these hills lies half way between Clear lake and Bass lake. Another stands about a mile southeast of Sandy lake. Kasshabog lake, on the southern side, is hemmed in by a high granite ridge, which increases in elevation in going westward. The eastern and south-eastern margins of the granite outcrop are bordered by amphibolite rock, whose ridges are, for the most part, higher and sharper, and, as there are more of them, their topography is much rougher than that of the granitic areas. At Oak Lake and Van Sickle settlements there are two detached plateaus of sedimentary limestone of Trenton age.

The depressions between the ridges are a very noticeable phase of the topography. They are abundant in both townships, but are more abundant in Methuen. At least one-quarter of the region is occupied by these depressions, and they vary from a few yards to a thousand yards across. Some of them may be traced continuously for several miles and are evidently former stream channels; others are the bottoms of former small lakes and ponds.

**Rapid Erosion
of the Soil**

The soil on the crests of the ridges is very thin, and often entirely lacking, although there are crevices and pockets on most of them with soil deep enough for scattered tree growth. In studying the conditions on these ridges, one cannot but be convinced that the soil was, at one time, much more generally distributed and deeper than at present. One frequently finds stumps of trees from one foot to two feet in diameter on bare rock, in such a position that the roots could not have penetrated crevices. The trees could not have germinated and lived for many years on bare rock. Then, too, trees still standing on bare rock are held up by roots extending into crevices several feet from the base of the tree. There must have been soil at the base of the trees when they started in life. One needs only to note, after a heavy rain, the accumulations of soil washed down from above, to be impressed by the rapidity of the soil-erosion on these ridges. The soil-washing is the result of the repeated fires, which kill and loosen the natural retainers, the roots of the trees and shrubs, and the decaying vegetable matter.

The soil on the lower slopes and about the bases of the granite ridges varies in composition from gravel to sand, not uniformly distributed, but in alternate deep and shallow patches, owing to the minor undulations in the topography. The wider depressions between the ridges are often filled with sand to the depth of many feet, and there

are also occasional sand ridges and sand plains. The soil on the amphibolite is often deeper and is almost invariably of finer texture than on the granite, frequently approaching a loam in composition. The crystalline-limestone soils are nearly all light sandy loams. While they are often very thin on the ridges and plains, as a whole, these areas are more deeply soil-covered than either the amphibolite or granite areas, because a larger percentage of the area is composed of broad, gentle slopes, where the soil accumulates, or where it has not been washed away as rapidly as on the steeper slopes of amphibolite and granite.

The soils of the depressions between the ridges are formed by the accumulated washings from the slopes. Only the finer material reaches them, the coarser being left above. Mixed with the decaying portions of a rank vegetation these soils become a very rich muck, usually three to four feet, or more, deep.

The only really good farm soils, with perhaps one or two exceptions, are to be found on the sedimentary limestones, in the south-eastern portion of Methuen township.

FOREST CONDITIONS

The total land area of Methuen township is 63,152 acres, and the portion of Burleigh township covered by this survey is 23,181 acres. This makes a total of 86,333 acres, of which approximately 2,000 acres have been cleared for farms. The remaining 84,333 acres are partially or completely under forest cover. Of the forested portion, 15,000 acres are covered with mature forest. Seventy-seven per cent of this is the hardwood forest characteristic of the Trent Valley region, in composition approximately one-half being sugar maple and one-quarter beech, the remaining quarter consisting of basswood, yellow birch, elm, hemlock, balsam, white ash, red oak, large-toothed aspen, white pine and cherry, in occurrence in the order named. The remaining 23 per cent of the mature forest is represented by swamps.* The swamps bearing mature forest are practically all of the mixed type. Several sample lines run through them reveal the trees to be mostly black ash, balsam, red maple and elm, these entering into the composition in the proportion of 30, 23, 15 and 6 per cent, respectively. There are relatively few swamps of the undrained peat bog type.

The remaining forested portion, some 69,333 acres, was originally dominated by pine. It is evident that the red pine was the more

*Only the larger swamp areas were mapped. Small swamps containing commercial trees, swamps covered with non-commercial trees and open marshes, compose at least one-quarter of the total area. Proper deductions are made for these in estimating the amount of material in the different types given below.

abundant on the coarser granitic soils, while the white pine predominated on the deeper, finer-textured soils of the amphibolite and crystalline limestone. At present, single trees, or widely separated groves, constitute all the pine of commercial value. With the possible exception of the pine of the Blue mountain region, the cost of harvesting would be prohibitive. Fifty years ago lumbering operations were commenced on the area, and were continued for 25 years. Since these operations ceased, the area has been picked over twice, the last time three years ago. These former pine lands have all been burned at least once, and some of them eight times, since the lumbering was begun. It is the present condition on these burned pineries with which this report is chiefly concerned.

AREAS SEVERELY BURNED ONCE

So far as could be ascertained, there are no places in the former pineries, outside of the swamps, that have not been burned at least once since lumbering. The stands designated as burned once evidently followed a severe fire. Patches which escaped the fires in the areas burned more than once are included in this group, either because they were originally established after a fire, or because they were burned once since establishment, as revealed by a fire scar.

The largest continuous area burned but once is found in the north-western corner of the township of Methuen. The best pine reproduction on lowland is found in the southern portion of the area, where the average stand is 94 white pine and 35 red pine per acre; of these 16 per cent of the white pine are from six inches to ten inches in diameter, while all of the red pine fall between the one-inch and six-inch diameter classes. The pine on the ridges is much less abundant, averaging only six trees per acre.

In the south-eastern portion of Burleigh township the best reproduction of pine was found, and it covers 365 acres, at the rate of 88 white pine and 173 red pine per acre, and single acres containing 350 trees could be picked out. On the average acre, 70 per cent of the trees belong to the one-inch and two-inch diameter classes, and the trees eight inches in diameter and above average only six to the acre. There is evidence that about 2,000 acres in this vicinity were once bearing young pine in similar quantities, but a fire about eight years ago cleared them off.

The other areas in Burleigh classed as burned but once, namely, the rather narrow strip east of Eels brook, in the north division, and west and south of the hardwoods, have good pine reproduction. Patches in these areas were burned 35 years ago, and other patches 16 years ago, but, as a whole, the areas were burned about 25 years ago.

Patches, several acres in extent, containing 550 young pine from one inch to six inches in diameter, were frequently encountered, but the average is 125 white pine and 53 red pine per acre. In the area east of Eels brook there are occasional groups of pine, varying in extent from a few trees to those covering several acres, which apparently escaped the fire with only slight injury, and they are now approaching commercial value, one-half of the stands being from six inches to ten inches in diameter and averaging 70 trees to the acre. An area of similar character was found just west of Kasshabog lake, in Methuen township, and it covers about 800 acres; here the number of pine trees approaching commercial value averages 15 per acre. Scattered through this area are frequent groves, aggregating about 300 acres, which contain 30 trees from 9 inches to 15 inches in diameter per acre, and are, therefore, of commercial value.

TABLE IA

PRESENT COMPOSITION AND AVERAGE NUMBER OF TREES PER ACRE ON 17,349 ACRES SEVERELY BURNED TWICE, BASED ON SAMPLE STRIPS TOTALING 40.4 ACRES

	Per cent	Per acre
Trembling aspen.....	26.3	164.8
Large-toothed aspen.....	14.8	92.8
White pine.....	10.4	64.8
Red pine.....	7.1	44.6
Jack pine.....	.2	1.3
White birch.....	17.0	106.9
White oak.....	.4	2.5
Red oak.....	2.4	15.0
Red maple.....	6.0	37.7
Sugar maple.....	1.7	10.2
Balsam.....	2.5	15.6
White spruce.....	1.4	8.8
Cedar.....	5.2	32.7
Hemlock.....	1.9	11.7
Hop-hornbeam.....	.7	4.0
Yellow birch.....	.2	1.3
Basswood.....	.8	4.7
White ash.....	.2	1.2
Beech.....	.4	2.6
Tamarack.....	.4	2.6
Total number of trees per acre.....	.....	625.8

TABLE 1B

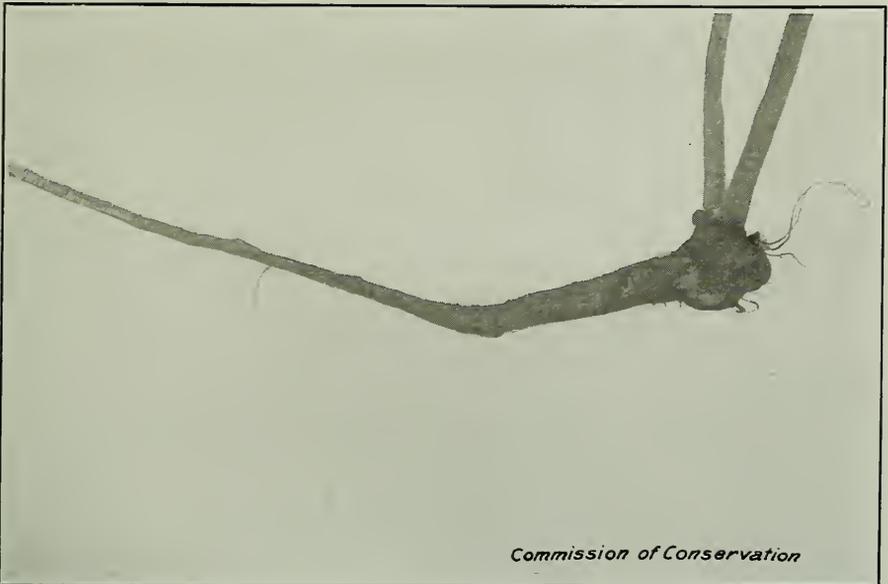
DIAMETER CLASSES AND THE AVERAGE PROPORTION OF OCCURRENCE IN EACH ACRES SEVERELY BURNED ONCE

	Inches	Trembling aspen	Large-toothed aspen	White pine	Red pine	Jack pine	White birch	White oak	Red oak	Red maple
Per cent...	1	28.5	25.7	18.8	30.1	1.9	39.5	37.8	18.7	54.9
Per acre...		46.7	24.0	12.1	13.4	..	42.3	.9	2.9	20.7
Per cent...	2	30.2	37.6	23.5	26.1	..	31.7	16.8	16.2	25.8
Per acre...		50.0	34.9	15.2	11.6	..	33.8	.4	2.4	9.7
Per cent...	3	20.3	21.0	20.7	17.8	3.8	16.0	17.9	22.6	11.9
Per acre...		33.5	19.3	13.4	8.0	.05	17.1	.5	3.3	4.5
Per cent...	4	8.8	8.5	13.8	10.4	13.2	7.4	6.9	16.7	3.8
Per acre...		14.5	7.9	9.0	4.6	.2	7.9	.2	2.5	1.4
Per cent...	5	5.4	4.0	8.4	6.4	15.1	3.2	6.9	13.7	1.9
Per acre...		9.0	3.7	5.4	2.9	.2	3.4	.2	2.2	.7
Per cent...	6	3.2	1.6	5.8	4.7	28.3	1.2	2.9	7.4	.8
Per acre...		5.2	1.5	4.0	2.2	.4	1.3	.1	1.0	.3
Per cent...	7	1.4	.8	2.9	2.0	11.3	.5	3.9	3.3	.4
Per acre...		2.4	.8	1.9	.9	.1	.6	.1	.5	.2
Per cent...	8	1.0	.4	2.9	1.0	20.8	.2	3.9	.5	.2
Per acre...		1.6	.3	1.9	.4	.3	.2	.1	.1	.1
Per cent...	9	.6	.3	1.3	.5	5.6	.2	1.0	.7	..
Per acre...		1.0	.2	1.0	.2	.1	.2	..	.1	..
Per cent...	10	.3	.1	.7	.3	..	.05	1.0	..	.1
Per acre...		.5	.1	.4	.1	..	.05	..	..	.05
Per cent...	11	.2	..	.4	.4	..	.05	1.0	..	.1
Per acre...		.3	..	.2	.2	..	.05	..	..	.05
Per cent...	12	.1	..	.2	.2	..	..	..	.1	..
Per acre...		.1	.1	.1	.1	..	..	..	..	..
Per cent...	13	..	..	.1	..	..	..	..	..	..
Per acre...		..	..	.05	..	..	..	..	..	..
Per cent...	14	..	..	.1	..	..	..	..	..	.1
Per acre...		..	..	.05	..	..	..	..	..	.05
Per cent...	15	..	..	.2	.1	..	..	..	..	..
Per acre...		..	..	.1	..	..	..	..	..	..
Per cent...	16	..	..	..	..	..	..	..	..	..
Per acre...		..	..	..	..	..	..	..	..	..
Per cent...	17	..	..	.1	..	..	..	..	.1	..
Per acre...		..	..	.05	..	..	..	..	..	..
Per cent...	20	..	..	.05	..	..	..	..	..	..
Per acre...		..	..	..	..	..	..	..	..	..
Per cent...	21	..	..	.05	..	..	..	..	..	..
Per acre...		..	..	..	..	..	..	..	..	..
Total										
Per cent..		100.0	..	..	..	..	..	..	..	..
Per acre..		164.8	92.8	64.8	44.6	1.3	106.9	2.4	15.0	37.7



Commission of Conservation

GENERAL VIEW OF AN AREA BURNED THREE TIMES
Poplar largely predominating.



Commission of Conservation

ROOT COLLARS OF POPLARS REPEATEDLY BURNED ARE SWOLLEN AND TUBEROUS
No commercial trees come from such roots.

The areas burned once, as indicated on the map (facing page 166), aggregate 18,898 acres. Deducting one-quarter of these as areas occupied by marshes and swamps, there are left 14,174 acres occupied by poplar and pine. The patches that escaped the fire, in the areas burned more than once, total 3,175 acres. Therefore, the total number of acres burned but once is 17,349. It will be seen, by referring to the accompanying table (page 175), that white pine on this area averages 65 trees and red pine 45 trees per acre, or a total of 110 pine trees. Seventy-nine per cent of these trees are from one inch to three inches in diameter. Judging from the results of the growth studies, it takes about 25 years, on the average, to make a three-inch pine tree. These areas were burned about 25 years ago; therefore, practically four-fifths of the present quantity of pine has established itself since the last severe fire.

Regarding the trees eight inches in diameter and above as capable of producing viable seeds, there are on the average three seed trees per acre on the area as a whole, an ample quantity, if properly distributed, to fill up the open places and to replace the trees that die from natural causes. If the 110 trees per acre were allowed to come to maturity, the area would probably be more fully stocked with pine than it was at the time the first lumbering operations began, for the original forest was a very old one, with large trees, a condition under which the trees must necessarily have been scattered to have received light and food enough to reach large dimensions. But, with the present high price of pine lumber, and the consequent utilization of comparatively low grade stock, pine forests like the original will never be duplicated. Instead of cutting trees 200 to 300 years old, as was originally done, the trees will be harvested at 100 years, 80 years, and even, in some cases, 60 years of age. The pine trees standing at present will be cut at these ages, if not burned in the meantime, and the present number of trees per acre on the areas severely burned once is about right for proper development for harvest in that condition. It would seem, therefore, that one burning after lumbering does not seriously interfere with the reproduction of pine in commercial quantities. This statement, of course, is based on the assumption that the fire came very soon after lumbering, since otherwise it would destroy the first crop of seedlings established.

The pine trees above ten inches in diameter on the average acre would yield only 185 board feet, a very small amount, but when multiplied by the number of acres, it becomes 3,000,000 feet of commercial material.

It will be seen from the table (page 175) that the poplars contribute the largest number of trees per acre, the trembling aspen having

165 and the large-toothed aspen 93, a total for the two species of 258 per acre, and they thus comprise 41 per cent of the stand. Nearly 90 per cent of these trees have not yet attained commercial size, if we regard those as non-commercial which are less than five inches in diameter at breast height, that is, the height at which the trees were measured. By using a volume table for poplar, it is calculated that the trees of this species now of commercial size, yielding only one cord of pulpwood per acre, would run 17,000 cords on the whole area burned once. Yet, if the 230 trees per acre under commercial size, or the normal percentage of them, were allowed to come to maturity, the outlook for pulpwood as a secondary product to the pine would be more hopeful.

The other commercial trees, whose rate of occurrence is given in the table (page 175), probably had only a scattering distribution in the original forest. The oak, cedar, balsam and hemlock occur in sufficient quantities—in the aggregate 100 trees of all kinds per acre—to form a valuable commercial adjunct if allowed to come to maturity.

AREAS SEVERELY BURNED TWICE

The areas indicated on the map (facing page 166) as burned twice aggregate 26,000 acres. In these are 1,750 acres which escaped the second fire, and hence these were classed among the areas burned once. Deducting this amount, and the 25 per cent estimated to be occupied by swamps of various kinds, there are 17,750 acres actually burned twice. The two severe fires on the Methuen areas occurred approximately 25 years and 16 years ago. Patches too small to be delimited were burned eight years ago, and there are indications of numerous local ground fires. One of these marked some of the trees five years ago. The two severe fires on the Burleigh areas occurred 25 years and 8 years ago, while the fires of 16 years and 5 years ago were light, and only left their scars in some places.

The largest area burned twice is found in southern and south-eastern Methuen and comprises, exclusive of swamps, 8,760 acres, but 28 per cent of this escaped the fire, so that the area actually burned is 6,300 acres. Although a relatively large proportion escaped, the fires were very severe upon the pine reproduction on the areas actually burned, since it now averages only 1.3 pine trees per acre, whereas, before the second fire, the area averaged 33 pine trees per acre. The second fire then practically obliterated the potential pine stand. The area burned twice around Bottle and Barrette lakes now contains five young pine trees per acre. Only one small unburned patch was discovered, and this contained young pine at the rate of 50 to the acre.

TABLE IIA

DIAMETER CLASSES AND THE AVERAGE PROPORTION OF OCCURRENCE IN EACH ACRES SEVERELY BURNED TWICE

	Inches	Trembling aspen	Large-toothed aspen	White pine	Red pine	White birch	White oak
Per cent.....	1	55.5	54.7	19.3	27.8	69.3	56.2
Per acre.....		80.1	61.7	1.6	1.6	81.3	9.1
Per cent.....	2	28.2	31.0	19.0	21.3	23.5	18.7
Per acre.....		40.8	35.2	1.6	1.2	27.4	3.0
Per cent.....	3	10.3	10.1	14.6	17.5	4.6	15.8
Per acre.....		14.8	11.4	1.2	1.0	5.5	2.6
Per cent.....	4	3.3	2.5	11.0	12.2	1.5	4.5
Per acre.....		4.8	2.8	1.0	.7	1.8	.8
Per cent.....	5	1.3	.8	10.0	9.1	.8	3.0
Per acre.....		1.9	.9	.9	.5	.9	.5
Per cent.....	6	.7	.4	9.5	6.1	.2	.5
Per acre.....		1.0	.5	.8	.4	.2	.1
Per cent.....	7	.3	.3	7.2	1.8	.04	.5
Per acre.....		.4	.3	.6	.1	.1	.1
Per cent.....	8	.2	.1	4.4	1.1	.04	.3
Per acre.....		.3	.1	.4	.1	.1	.05
Per cent.....	9	.1	.08	2.1	.8	.02	..
Per acre.....		.2	.1	.2	.05	..	..
Per cent.....	10	.05	..	1.8	.5	..	.1
Per acre.....		.1	..	.1	..	..	..
Per cent.....	11	.05	..	.5	.8	..	..
Per acre.....		.1	..	.05	.05	..	..
Per cent.....	12	..	..	.2	.5	..	.3
Per acre.....		..	..	..	..	..	.05
Per cent.....	13	..	.02	..	.5	..	..
Per acre.....		..	..	..	..	..	..
Per cent.....	14	..	..	.2	..	..	..
Per acre.....		..	..	..	..	..	..
Per cent.....	16	..	..	..	..	..	.1
Per acre.....		..	..	..	..	..	..
Per cent.....	17	..	..	.2	..	..	..
Per acre.....		..	..	..	..	..	..
Total							
Per cent.....		100.00	..	..	..	..	..
Per acre.....		144.5	113.0	8.4	5.7	117.3	16.3

DIAMETER CLASS OF THE SPECIES ENUMERATED IN TABLE IIb, OCCURRING ON 17,750

Red oak	Red maple	Sugar maple	Balsam	White spruce	Cedar	Basswood	White ash
67.6	93.7	86.0	46.1	37.7	76.8	58.8	90.1
48.3	30.9	2.2	1.3	.6	1.6	1.7	1.4
20.0	3.3	7.5	30.5	27.6	13.7	23.6	8.5
14.3	1.1	.2	.8	.4	.3	.6	.1
7.9	1.5	..	14.8	13.0	8.4	2.3	1.4
5.6	.5	..	.4	.2	.2	.1	..
2.7	.3	2.5	1.6	8.7	1.1	10.7	..
1.9	.1	.1	.05	.1	..	.3	..
1.0	.4	..	2.4	4.4	..	3.0	..
.7	.1	..	.1	.1	..	.1	..
.3	.4	..	1.6	7.1	..	.8	..
.2	.1	..	.05	.1	..	..	..
.2	.05	.8	1.6	..	..	..	..
.1	..	.02	.05	..	..	..	..
.2	.05	..	.8	..	..	.8	..
.1	..	..	..	..	..	..	..
.1	.05	.8	..	..	..	..	..
.1	..	.02	..	..	..	..	..
..	..	..	..	1.5	..	..	..
..
..	.05	.8	..	..	..	..	..
..	..	.02	..	..	..	..	..
..	.1	..	..	..	..	..	..
..	.05	..	..	..	..	..	..
..	.1	.8	..	..	..	..	..
..	.05	.02	..	..	..	..	..
..
..
..	..	.8	..	..	..	..	..
..	..	.02	..	..	..	..	..
..	..	..	.8	..	..	..	..
..
71.3	33.0	2.6	2.8	1.5	2.1	2.8	1.5

TABLE IIb

PRESENT COMPOSITION AND AVERAGE NUMBER OF TREES PER ACRE ON 17,750
ACRES SEVERELY BURNED TWICE, BASED ON SAMPLE STRIPS TOTALING
46.2 ACRES

	Per cent	Per acre
Trembling aspen	27.6	144.5
Large-toothed aspen	21.6	113.0
White pine.....	1.6	8.4
Red pine	1.1	5.7
White birch.....	22.4	117.3
White oak	3.1	16.3
Red oak	13.7	71.4
Red maple.....	6.3	33.0
Sugar maple .....	.5	2.6
Balsam .....	.5	2.8
White spruce.....	.3	1.5
Cedar .....	.4	2.1
Basswood .....	.6	2.8
White ash .....	.3	1.5
Total number of trees per acre.....	.....	522.9

The areas burned twice in Burleigh township, after making the deductions for swamps, total 8,540 acres. The largest of these is along the east side of Eels brook, in the southern division. This limited area now averages 26 young pine per acre, a high average for an area burned twice, but the lower half of the area at least had a remarkably large stock of pine before the second burning, about eight years ago. This, as stated on page 174, was 260 trees per acre. The whole area burned twice has, on the average, two pine seed trees per acre, which, in the course of a long time, might bring back the pine, if protected from fire.

The area in the south-eastern portion of Burleigh township, lying between the areas marked as burned once and three times, respectively, on the north, and the area marked as burned three times, on the south, and extending up to Jack lake, in Methuen township, is mostly on granite. It differs in composition from all the other areas in its large amount of oak, about 50 per cent of the stand being red oak and 17 per cent white oak. While the soil is rather thin, and much of the oak naturally stunted, it is probable that considerable quantities would attain commercial size if protected from fire.

As a whole, the areas burned twice now support eight white pine and six red pine, a total of 14 pine trees per acre. The areas burned once contain 110 young pine trees per acre. Therefore, as a whole, the second burning reduced the amount of pine to one-eighth of that on the areas burned once.

The number of poplar trees on the average acre at present—it being 8 years or 16 years since the last burning—is practically the same as after the first burning. Eighty-five per cent of these trees, however, belong to the one-inch and two-inch diameter classes, and are not over 16 years old. They are mostly sprouts, stimulated to growth by the last fire. The number of commercial trees averages six per acre, while the number of like trees on the areas burned but once averages 27 per acre. There is one-fifth of a cord of poplar now fit for pulpwood on the average acre, while the pulpwood on the areas burned but once averages one cord per acre. Trees of other species of potential commercial value average practically the same (100 per acre) as on the areas burned but once.

AREAS SEVERELY BURNED THREE TIMES

The areas severely burned three times cover 9,300 acres. Deducting the usual one-fourth of the area for swamps, there are 6,975 acres actually occupied by this type. The area in Methuen township was burned approximately 25 years, 18 years and 5 years ago, while the areas in Burleigh township were swept by fires 25 years, 16 years and 10 years ago. One of the Burleigh areas extends into Methuen, near the point at which Jack creek leaves the township.

The last fire on the Methuen area was very severe. The dead trees resulting were counted on sample plots totalling eight acres. Before the fire there were 276 poplar trees; 23 pine trees and 41 oak trees per acre; after the fire there were only two living poplar trees, one pine and one oak tree per acre.

The area burned three times in south-eastern Burleigh is on crystalline limestone, and the stand is open and park-like in many places, where the three generations of trees, due to the three fires, are quite easily distinguished. Continued burnings on limestone areas stimulate the development of grass beneath the trees. The soil being thin, however, the grass completely dries up in the drier portions of the year, so that such areas would be of only temporary service for grazing purposes. The area burned three times in the central portion of Burleigh is chiefly composed of low granite ridges, the tops of which, in many cases, have been burned practically clear of trees.

TABLE IIIA

PRESENT COMPOSITION AND AVERAGE NUMBER OF TREES PER ACRE ON 6,973
ACRES SEVERELY BURNED THREE TIMES, BASED ON SAMPLE STRIPS
TOTALING 34 ACRES

	Per cent	Per acre
Trembling aspen	35.2	96.9
Large-toothed aspen	26.1	71.8
White pine	1.1	3.0
Red pine	1.5	4.2
White birch	24.0	65.8
White oak.....	.5	1.3
Red oak.....	3.9	10.7
Red maple	5.3	14.7
Sugar maple .....	.5	1.4
Balsam.....	.8	2.0
White spruce .....	.7	2.0
Cedar .....	.4	1.1
Total number of trees per acre.....	....	274.9



GENERAL VIEW OF AN AREA BURNED MANY TIMES
Forest Growth Scattered. Note soil erosion.



BURNED MANY TIMES
Note the number of stumps and the absence of reproduction.

TABLE IIIb

DIAMETER CLASSES AND THE AVERAGE PROPORTION OF OCCURRENCE IN EACH DIAMETER CLASS OF THE SPECIES ENUMERATED IN TABLE IIIa, OCCURRING ON 6,975 ACRES SEVERELY BURNED THREE TIMES

	Inches	Trembling aspen	Large-toothed aspen	White pine	Red pine	White birch	White oak	Red oak	Red maple	Sugar maple	Balsam	White spruce	Cedar
Per cent.....	1	57.2	51.7	24.0	35.2	70.5	17.4	41.5	77.4	91.6	44.3	28.6	21.1
Per acre.....		55.5	37.1	.7	1.5	46.4	.2	4.4	11.4	1.3	.9	.5	.2
Per cent.....	2	25.4	33.5	14.0	28.1	21.4	34.8	30.0	15.2	6.3	24.3	22.2	47.4
Per acre.....		24.6	24.1	.3	1.2	14.	.4	3.1	2.3	.1	.5	.4	.5
Per cent.....	3	9.6	10.3	21.0	7.7	6.0	19.5	14.6	4.4	..	12.8	11.1	28.9
Per acre.....		9.3	7.4	.6	.3	3.9	.2	1.6	.6	..	.3	.2	.3
Per cent.....	4	4.9	2.8	18.0	9.1	1.3	4.3	7.7	1.4	..	8.6	22.2	2.6
Per acre.....		4.8	2.0	.5	.4	.9	.1	.8	.2	..	.2	.4	.05
Per cent.....	5	1.1	.7	6.9	4.2	.5	6.6	4.6	1.0	2.1	5.7	3.2	..
Per acre.....		1.0	.5	.2	.2	.4	.13	.5	.13	..	.1	.1	..
Per cent.....	6	1.0	.3	4.9	1.5	.2	2.2	.8	.4	..	2.9	3.2	..
Per acre.....		.9	.2	.1	.1	.1	..	.1	.1	..	..	.1	..
Per cent.....	7	.3	.5	2.9	3.5	..	..	.2	..	..	..	1.6	..
Per acre.....		.3	.3	.15	.13	..	..	.03	..	..	..	.05	..
Per cent.....	8	.2	.1	.9	3.5	.1	2.2	..	..	..	1.4	1.6	..
Per acre.....		.2	.1	.05	.13	..	..	..	..	..	..	.05	..
Per cent.....	9	.2	.1	.9	3.5	..	4.3	.2	.2	..	..	1.6	..
Per acre.....		.2	.1	.05	.13	..	.1	.03	.03	..	..	.05	..
Per cent.....	10	..	..	1.9	1.5	..	..	..	..	..	..	4.7	..
Per acre.....		..	..	.1	.1	..	..	..	..	..	..	.15	..
Per cent.....	11	.1	..	.9	..	..	..	..	..	..	..	..	..
Per acre.....		.1	..	.05	..	..	..	..	..	..	..	..	..
Per cent.....	12	..	..	1.9	.7	..	4.3	.2	..	..	..	..	..
Per acre.....		..	..	.1	..	..	.1	.03	..	..	..	..	..
Per cent.....	13	..	..	..	1.5	..	..	..	..	..	..	..	..
Per acre.....		..	..	..	.1	..	..	..	..	..	..	..	..
Per cent.....	14	..	..	.9	..	..	..	..	..	..	..	..	..
Per acre.....		..	..	.05	..	..	..	..	..	..	..	..	..
Per cent.....	16	..	..	..	..	..	2.2	..	..	..	..	..	..
Per acre.....		..	..	..	..	..	..	..	..	..	..	..	..
Per cent.....	18	..	..	.9	..	..	..	..	..	..	..	..	..
Per acre.....		..	..	.05	..	..	..	..	..	..	..	..	..
Per cent.....	19	..	..	..	..	..	2.2	.2	..	..	..	..	..
Per acre.....		..	..	..	..	..	..	.03	..	..	..	..	..
Total													
Per cent.....	..	100.00	..	..	..	..	..	..	..	..	..	..	..
Per acre.....	..	96.9	71.8	3.0	4.2	65.8	1.3	10.7	14.7	1.4	2.0	2.0	1.1

On the area burned three times there are, on the average, seven pine trees to the acre, three white pine and four red pine,—a reduction of one-half from the number on the areas burned twice, and approximately only one-sixteenth of the number on the areas burned but once. The reduction, in terms of the reproduction, is even greater than this indicates, for 30 per cent of the trees are of such size as to show that they antedate the first fire; that is, they are the larger trees which have withstood all the fires.

The trembling aspen is represented by 95 and the large-toothed aspen by 70, a total of 165 per acre, compared with 258 trees on the areas burned once and twice. Although the percentage ratio of the poplar of the one-inch and two-inch diameter class to the other diameters is practically the same as on the areas burned twice, as a matter of fact, the condition is really not as favourable as would appear, since a large proportion of the smaller material has been materially weakened as the result of the successive fires; it is crooked, deformed, and already attacked by disease. The lower illustration opposite shows two shoots springing from a root collar that has been injured by fires. The swollen portion on a similar stock was about 25 years old. It had sent forth shoots twice before, only to be burned to the ground. Shoots arising in this manner are weak and probably never make trees of commercial size. The amount of commercial pulpwood is reduced from one-fifth of a cord on the areas burned twice to one-eighth of a cord per acre on the areas burned three times.

The number of other species of potentially commercial trees, such as oak, basswood, balsam, cedar and spruce, reaches approximately 100 on the average acre on the areas burned once and twice, but the same or similar species total only 18 per acre on the areas burned three times.

AREAS SEVERELY BURNED MANY TIMES

Thirteen thousand acres of the region examined have been burned over many times. Making the usual deduction of one-quarter of the area for swamps, and a deduction of five per cent for patches which escaped most of the fires, there are still 9,260 acres actually included in this class. The greater portion of the area so designated has been severely burned seven times, five of which have occurred since lumbering operations began in the vicinity. Practically all of the few old pine trees still standing show from five to seven fire scars. One of these, which little by little had been severed at the base by fires, disclosed the fact that it had been fire-scarred when 25, 43, 55, 64, 82, 88 and 96 years old. It finally succumbed to the last fire at the age of 100 years. This means that the tree was burned, on the average, at

intervals of 12.5 years. These are only the recorded fires. There is much evidence that ground fires have been still more frequent. In fact, hardly a season passes that some portion of this area is not run over by ground fires.

There are three classes of persons principally responsible for these fires: Cattle rangers, marsh hay makers, and berry pickers; and the most careless of these are the berry pickers. The area is commonly called the huckleberry barrens. The term "barren," however, can be applied only to its present, not to its original condition, for it was once well covered with pine trees. The pine stumps were counted on sample plots aggregating 28 acres, and those eight inches and over in diameter averaged 17 per acre. This refers only to those that still show they had been cut for lumber. Those so far decayed or so severely burned as to leave this point in doubt were not included. Considering the length of time since lumbering began on the area, and the number of times it has been burned, it is fair to conclude that many of the stumps of former merchantable trees do not now exist; hence it is reasonable to assume that this area was originally well stocked with pine. At the present time, however, judging from sample plots aggregating 62 acres, there are only 0.7 white pine and 2.4 red pine an acre, on the average. Regarding the trees eight inches and more in diameter as capable of producing seed, one may find at present one such white pine seed tree to each seven acres and one red pine seed tree to each four acres. In fact, the average number per acre of all kinds of trees is only 22, without doubt considerably less than the original number of commercial pine trees per acre; and of these nearly one-half (48 per cent) are not over two inches in diameter.

Approximately five per cent of the area, exclusive of swamps, has escaped serious injury by fire. The average number per acre of trees of all kinds in these situations is 278, or over twelve times as many as on the adjacent areas burned many times. The pine on the patches that have not been badly burned averages 158 trees per acre, 53 white pine and 105 red pine, over 50 times as much as on the surrounding areas burned many times. This is an indication of what might have been, had the fires been prevented. The poplar also shows a similar increase, averaging 87 trees per acre on the unburned patches, compared with ten on the adjoining areas burned many times. The poplar large enough for pulpwood on the unburned areas at the present time averages 1.3 cords per acre; on the nearby areas burned many times, only one-forty-fifth of a cord per acre.

TABLE IVa

PRESENT COMPOSITION AND AVERAGE NUMBER OF TREES PER ACRE ON 9,260
ACRES SEVERELY BURNED MANY TIMES, BASED ON SAMPLE STRIPS
TOTALING 62.3 ACRES

	Per cent	Per acre
Trembling aspen.....	38.9	8.7
Large-toothed aspen.....	6.0	1.3
White pine.....	3.2	0.7
Red pine.....	10.7	2.4
Jack pine.....	20.7	4.6
White birch.....	10.0	2.2
White oak.....	2.3	0.5
Red oak.....	4.3	1.0
Red maple.....	3.9	0.9
Total number of trees per acre.....		22.3

TABLE IV_B

DIAMETER CLASSES AND THE AVERAGE PROPORTION OF OCCURRENCE IN EACH DIAMETER CLASS OF THE SPECIES ENUMERATED IN TABLE IV_A, OCCURRING ON 9,260 ACRES SEVERELY BURNED MANY TIMES

	Inches	Trembling aspen	Large-toothed aspen	White pine	Red pine	Jack pine	White birch	White oak	Red oak	Red maple
Per cent.....	1	30.5	25.0	22.7	42.3	7.3	35.5	..	6.7	44.4
Per acre.....		2.6	.33	.16	1.01	.3	.8	..	.06	.38
Per cent.....	2	28.6	19.0	6.8	9.4	22.2	32.0	3.1	15.0	39.0
Per acre.....		2.5	.25	.04	.22	1.0	.7	.01	.14	.32
Per cent.....	3	20.5	21.4	9.5	5.4	24.0	22.4	12.5	23.3	5.6
Per acre.....		1.8	.28	.06	.13	1.1	.5	.06	.22	.04
Per cent.....	4	9.6	26.2	11.4	4.7	21.9	5.8	28.1	16.7	1.8
Per acre.....		.9	.35	.08	.11	1.0	.13	.14	.16	.01
Per cent.....	5	6.2	2.4	4.5	2.7	10.1	2.2	15.6	11.7	1.8
Per acre.....		.6	.02	.03	.07	.5	.04	.08	.11	.01
Per cent.....	6	1.7	3.6	16.0	8.0	7.6	0.7	21.9	8.3	5.6
Per acre.....		.1	.05	.11	.21	.4	.01	.11	.08	.04
Per cent.....	7	1.5	..	4.5	6.7	3.2	..	9.4	5.0	..
Per acre.....		.1	..	.03	.16	.14	..	.04	.05	..
Per cent.....	8	0.6	..	4.5	4.7	2.8	0.7	3.1	11.7	..
Per acre.....		.05	..	.03	.11	.13	.01	.01	.11	..
Per cent.....	9	0.4	1.2	4.5	6.0	0.3	..	..	1.6	..
Per acre.....		.03	.01	.03	.14	.01	..	..	.02	..
Per cent.....	10	0.2	1.2	2.2	2.0	0.3	..	..	..	..
Per acre.....		.01	.01	.01	.04	.01	..	..	..	..
Per cent.....	11	0.2	..	..	4.7	0.3	..	..	..	..
Per acre.....		.01	..	..	.11	.01	..	..	..	..
Per cent.....	12	..	..	..	0.7	..	..	..	..	..
Per acre.....		..	..	..	.01	..	..	..	..	..
Per cent.....	13	..	..	4.5	0.7	..	..	..	..	..
Per acre.....		..	..	.03	.01	..	..	..	..	..
Per cent.....	14	..	..	2.2	2.0	..	..	6.3	..	1.8
Per acre.....		..	..	.01	.04	..	..	.03	..	.1
Per cent.....	15	..	..	2.2	..	..	0.7	..	..	..
Per acre.....		..	..	.01	..	..	.01	..	..	..
Per cent.....	19	..	..	4.5	..	..	..	..	..	..
Per acre.....		..	..	.03	..	..	..	..	..	..
Total										
Per cent.....		100.00	..	..	..	..	..	..	..	..
Per acre.....		8.7	1.3	0.7	2.4	4.6	2.2	0.5	1.0	0.9

SUMMARY OF FOREST CONDITIONS

The forest conditions described on the preceding pages may be summarized as follows:

Partially or completely forested, 84,333 acres.	
Unburned mature forest	15,000
Burned areas (second growth forest)	51,334
Unburned swamps within the burned areas	16,799
Oak barrens	1,200
Total	<u>84,333</u>

The areas actually burned over, with reference to the number of times burned, may be grouped as below:

Burned once	17,349
Burned twice	17,750
Burned three times	6,975
Burned many times	<u>9,260</u>
Total	<u>51,334</u>

Comparing the conditions, as a whole, on the areas burned many times with those burned once, twice, and three times, we find that the pine averages three trees per acre, in contrast to 7, 14, and 110 on the areas burned thrice, twice and once, respectively; the poplar ten per acre, in comparison with 169 on the areas burned three times, and to 258 on the areas burned once and twice; the amount of pulpwood ready to harvest, one-forty-fifth cord, in contrast to one-eighth cord on the areas burned three times, to one-fifth cord on the areas burned twice, and to one cord on the areas burned once.

The condition of affairs in order of the number of times the area has been burned may be summarized in tabular form, as below:

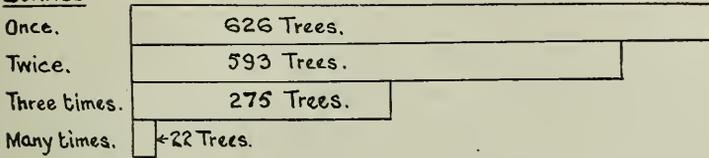
TABLE V

NUMERICAL PROPORTION OF REPRODUCTION OF VARIOUS SPECIES ON THE AVERAGE ACRE IN ORDER OF THE NUMBER OF TIMES BURNED, BASED ON SAMPLE PLOTS TOTALING 180 ACRES

	Burned once	Burned twice	Burned thrice	Burned many times
Whole number of trees at present.....	626	523	275	22
Pine.....	110	14	7	3
Poplar	258	257	169	10
Other commercial species	106	101	18	7
Cords of pulpwood now merchantable..	1	$\frac{1}{5}$	$\frac{1}{8}$	$\frac{1}{45}$

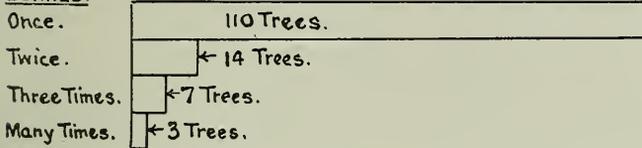
These conditions may be represented graphically by the following diagrams:

BURNED.



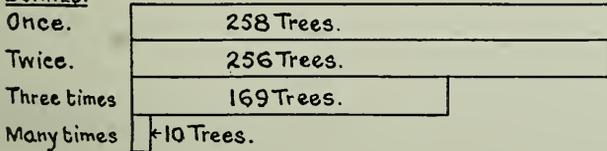
Whole number of trees of all species, one inch and above in diameter now present, according to the number of times burned.

BURNED.



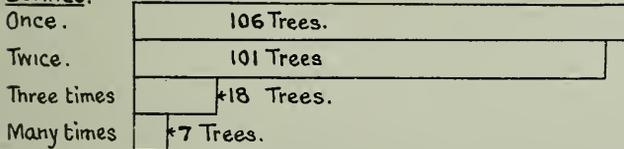
Young pine trees, one inch and above in diameter now present, according to the number of times burned

BURNED.



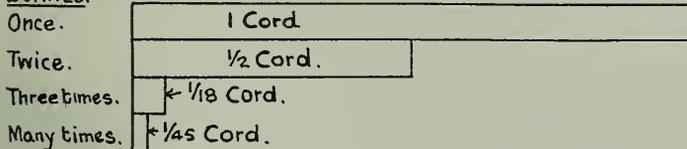
Young poplars, one inch and above in diameter now present, according to the number of times burned.

BURNED.



Other commercial species, one inch and above in diameter now present, according to the number of times burned.

BURNED.



Cords per acre of merchantable poplar pulpwood now present, according to the number of times burned.

The area marked "oak barrens" on the map consists of about 1,200 acres. It is situated in the "foothills" of the Blue mountains, and consists of bare ridges and deep gullies, the latter often only a few yards across and 15 yards to 25 yards deep. The ridges are covered with stunted oak trees, growing mostly in the crevices of the rocks, while the gullies are filled with poplar. Occasional stumps in the gullies indicate that pines of large size once grew there. The area has been burned several times, but it is so evidently a natural barren that it has been excluded from consideration of the burned areas.

GROWTH STUDIES

To secure data upon which to base an estimate of the financial losses involved in the fires, some growth studies were undertaken.

In the case of the pines it was found that their rate of growth was so variable that, to secure a satisfactory statement, a larger number would have had to be analyzed than time permitted and the object in view would have warranted. Moreover, reliable tables already exist for these species, and these have been used. The rate of growth of poplar has, however, been especially studied.

Growth studies of poplar were made in three places: In lot 15, concession II, and lot 25, concession III, in Methuen; also in lot 2, concession III, in Burleigh. The area on which the trees grew was of second quality for the locality, and was selected because it represented the average condition of the region as a whole. The soil would be classed as sand, and its depth was from 8 to 12 inches. The composition of the soil may be judged by the average of four samples, given below, which were taken from the areas where the growth studies were made.

	COMPOSITION PER CENT
Fine gravel	16.3
Coarse sand	24.5
Medium sand	10.6
Fine sand	18.1
Very fine sand	8.2
Clay	13.9
Silt	4.8
Organic matter	3.6
Total	100.0

In the table given on page 193 six per cent of the trees included are the large-toothed aspen. The growth of these was figured separately, but as practically no difference in the rate of growth from the trembling aspen was to be ascertained, and since for commercial purposes the two species are not distinguished, it was thought best

for the purposes of this report to group the two aspens together, under the designation of "poplar."

It is difficult to tell, after the first few years, whether a tree has come from a seedling or from a root sucker, but it is probable that most of the trees on which the growth studies were made came from seedlings.

TABLE VI

RATE OF GROWTH OF POPLAR, SITE QUALITY II, BASED ON 166 TREES

Age	Average diameter, inside bark, at ground, inches	Average height, feet	
3	0.24	3.5	
4	0.39	5.1	
5	0.43	5.3	
6	0.60	7.8	
9	0.80	8.0	
10	0.86	9.0	
11	0.98	10.4	

Average age	Diameter class, breast height	Average height, feet	Average merchantable volume, cubic feet
13	1	14	....
21	2	20	....
26	3	24	....
30	4	30	....
31	5	36	1.909
36	6	39	2.352
40	7	47	5.752
41	8	48	6.233
44	9	48	6.714
45	11	55	13.706

Rate of Growth of Poplar The rate of growth, as indicated in Table VI above, may seem very slow to many, for poplar is generally considered one of the most rapidly growing trees. If these trees had been taken from the best soils, the rate of growth would have been considerably faster, but they were taken from the kind of soil in which the greater majority of the trees of the region were growing and this was of second quality. There is a tendency in the popular mind, however, to over-estimate the rate of growth of trees, for the judgment is usually made from trees growing in the most favourable soil, and other conditions, not from the average conditions actually found in the forest, where competition for food and light is generally severe.

The average height growth of the 166 poplar trees employed in table VI, is 10.8 inches in a year, and the average increase in diameter is one inch in six years. It will be noted that it takes approximately 30 years' growth to produce a poplar tree five inches in diameter, breast high, the lowest diameter at which trees are cut for pulpwood. Further, it takes 13 years, on the average, to produce a tree one inch in diameter, 26 years for a tree three inches in diameter and 36 years for a tree six inches in diameter. Growth studies were made on a few trees of larger diameter than those given above, but they were on a much better quality of soil and so were not included. Basing the statement upon growth studies of poplar from other sources, one may say that it does not reach its most rapid growth in volume until about the fiftieth year. Since none of the trees studied had reached that age, it is assumed, in forecasting the yield at the end of the next 30 years, that the trees will grow at the rates stated above.

Applying the rate of growth indicated above to the average number per acre of poplar trees of the various diameter classes on the areas burned once, as given in table 1B (pages 176-177), and assuming that all were to live, it would be found that, at the end of the next 30 years, the diameters, number of trees and their contents in cubic feet would be as indicated in the table below:

TABLE VII

NUMBER OF POPLAR TREES PER ACRE AND VOLUME TO BE EXPECTED ON THE AVERAGE ACRE AFTER THE NEXT 30 YEARS ON THE AREAS BURNED ONCE, ASSUMING ALL TREES SURVIVED

Number of trees	Diameter class, inches	Total volume, cubic feet, bark excluded
71	5	135.0
90	6	211.6
53	7	304.8
22	8	137.1
13	9	87.2
7	10	81.9
3	11	41.1
2	12	44.0
1	13	30.0
		<hr/> Total 1,072.7

A cord of peeled pulpwood contains 90 cubic feet solid. This figure, used as a converting factor, gives 11.9 cords as the estimated yield per acre. If twenty-five per cent be deducted from this, as the amount that would die in the natural course of events in the next 30

years, the average yield per acre would be 9 cords. Multiplying this by the acreage, 17,350, we get 156,150 cords as the expected total yield of pulpwood at the end of 30 years, on the areas which have been burned but once.

Treating the poplar of the various sizes now present on the areas burned twice in the same manner, we find that the following conditions may be expected at the end of the next 30-year period:

TABLE VIII

NUMBER OF POPLAR TREES PER ACRE AND VOLUME TO BE EXPECTED ON THE AVERAGE ACRE AFTER THE NEXT 30 YEARS ON THE AREAS BURNED TWICE, ASSUMING ALL TREES SURVIVED

Number of trees	Diameter class, inches	Total volume, cubic feet, bark excluded
142	5	171.0
76	6	178.7
26	7	149.5
8	8	49.8
3	9	20.1
1	10	11.7
1	11	13.7
	Total	594.5

Using the converting factor given above, and subtracting twenty-five per cent for the normal decay, the average yield per acre to be expected at the end of the next 30 years, is five cords. The areas burned twice aggregate 17,750 acres, so the total expected yield on such areas becomes 88,750 cords of peeled pulpwood.

Following this assumption as to rate of growth, the following conditions would be found at the end of the next 30 years on the areas burned three times:

TABLE IX

NUMBER OF POPLAR TREES PER ACRE AND VOLUME TO BE EXPECTED ON THE AVERAGE ACRE AFTER THE NEXT 30 YEARS ON THE AREAS BURNED THREE TIMES, ASSUMING ALL TREES SURVIVED

Number of trees	Diameter class, inches	Total volume, cubic feet, bark excluded
90	5	171.8
47	6	110.5
16	7	92.0
7	8	43.6
1	9	6.7
1	10	11.7
1	11	13.7
	Total	450.0

Assuming the same converting factor as previously, the 450 cubic feet given above becomes an even five cords of pulpwood on the average acre, before deduction is made for decay. Because of the deformed and diseased condition of the young growth on the areas burned three times, as described on page 186 a much larger percentage of it will die, or at least will not make commercial pulpwood, than on the areas burned once and twice; consequently, 50 per cent is deducted on this account, making the estimated yield per acre 2.5 cords. The areas burned three times aggregate 6,970 acres, so the total estimated yield of pulpwood becomes 17,425 cords.

On the areas burned many times, the expected yield of poplar will be as follows:

TABLE X

NUMBER OF POPLAR TREES PER ACRE AND VOLUME TO BE EXPECTED ON THE AVERAGE ACRE AFTER THE NEXT 30 YEARS ON THE AREAS BURNED MANY TIMES, ASSUMING ALL TREES SURVIVED

Number of trees	Diameter class, inches	Total volume, cubic feet, bark excluded
3	5	5.7
3	6	7.0
2	7	11.5
1	8	6.2
1	9	6.7
		Total 37.1

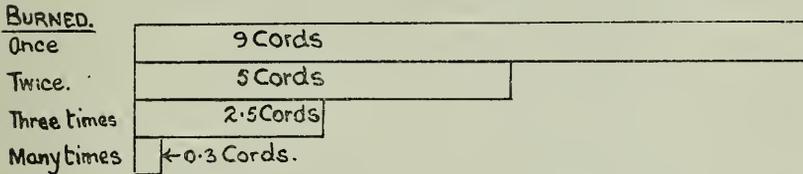
If the converting factor of 90 cubic feet to the cord be applied to the above, the average yield per acre becomes 0.4 cord. Since the trees on this area are not "crowded," a smaller deduction may be made for the normal death rate, say, 25 per cent. On this basis, the expected yield will be 0.3 cord per acre. There are 9,260 acres in the burned-many-times areas, so the expected yield on the whole area will be around 3,000 cords.

**Probable
Yield of
Pulpwood**

The forecasted yield of poplar 30 years from the present date, according to the number of times the area has been burned, may be summarized as follows:

	Number of acres	Average per acre, cords	Total, cords
Areas burned once.....	17,350	9	156,150
“ “ twice.....	17,750	5	88,750
“ “ thrice.....	6,970	2.5	17,425
“ “ many times.....	9,260	0.3	3,000
Total.....			265,325

This relationship may be expressed by the following diagram:



The forecasted yield of poplar per acre, 30 years from the present date, according to the number of times burned.

FINANCIAL LOSSES BY FOREST FIRES

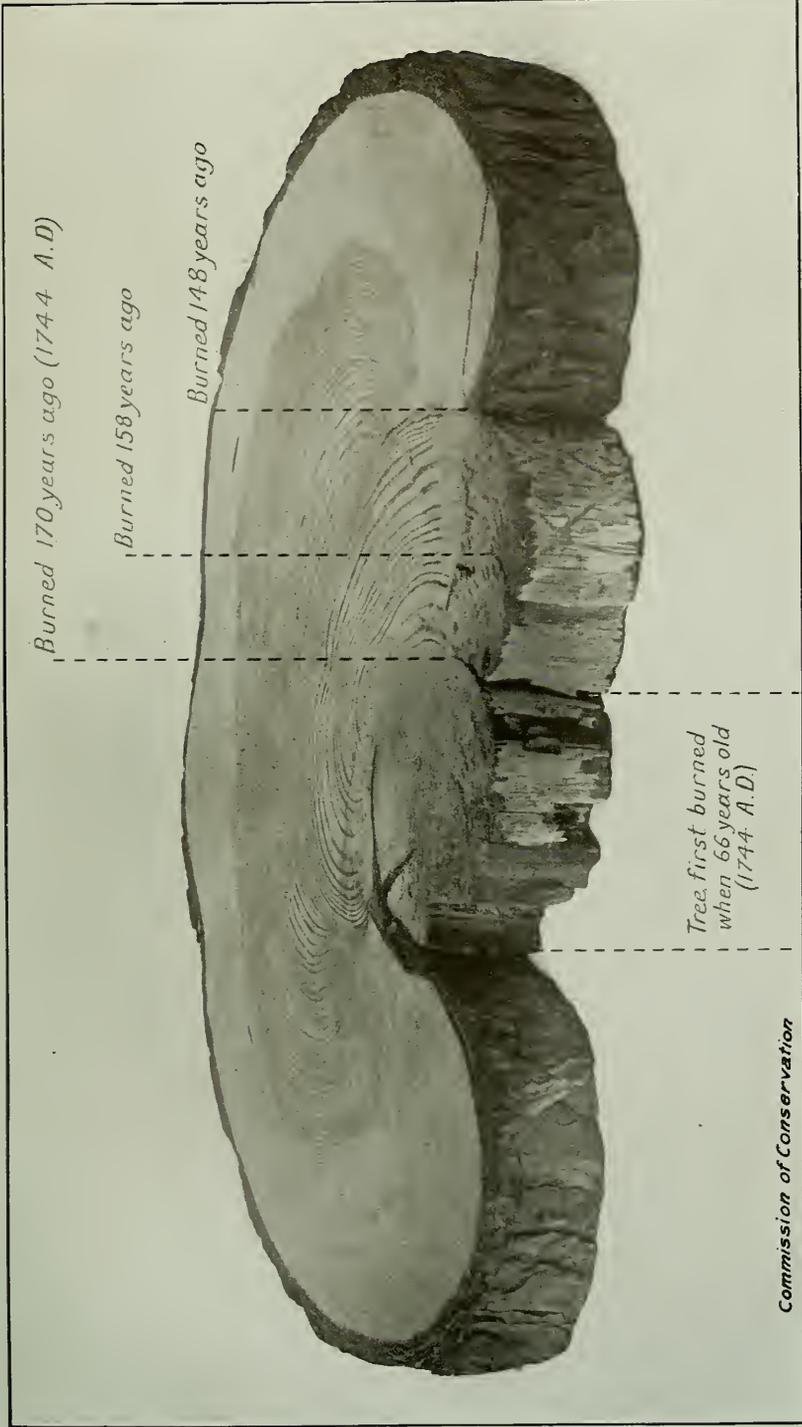
There can be little doubt that, if the public understood the cost of forest fires in terms of the future yield, more efficient methods of protection would be demanded. People do not burn, nor allow to be burned, what they value. It is in the hope of securing a better understanding of this question that the following estimates of the financial losses due to repeated fires on the Burleigh-Methuen areas are presented.

Repeated Fires Destroy Seed Trees In most lumbering operations, in pine stands, a certain number of the larger trees, because of disease or deformation, escape the axe. Seed from these trees, together with the trees too small to be of commercial value at the time of lumbering, would, if left undisturbed, in time, restock the area to pine. When young, pine is very easily killed by fire. Only in the older stages, after a thick bark is formed and the crown has raised itself out of reach, does it become to any extent resistant to light fires. Large trees readily fall a prey to the heavy fires. The slash left behind lumbering operations is almost invariably burned accidentally, sooner or later. If seed trees are left, if the slash is burned within a year or two after lumbering, and especially if the fire comes in a year of a heavy yield of seed, the burning, by clearing the ground of debris, probably stimulates the reproduction of pine. Every fire after the

first one kills not only a large number of seedlings and young trees, but also many of the seed trees. Every severe fire reduces the number of seed trees, and so reduces by so much the reproductive capacity of the area. This process goes on until, with the death of seed trees, the remaining trees become so scattered that it would take several hundred years for them to bring the area back to its original stand of pine. As an example of this, the area burned many times, as indicated on the accompanying map, facing page 166, where there is only one seed tree to each five acres, may be cited. This does not mean that each five-acre plot actually has a seed tree on it. As a matter of fact, in the area under discussion, there are probably several hundred acres without any seed trees. It is merely a statement of the average condition.

**Future
Production
of Pine**

It will then be readily seen that successive fires result in a progressive diminution of the future yield of pine. From the data on the preceding pages of this report, it will be seen what is the numerical diminution of the future yield of pine on the areas under consideration, namely, 110, 14, 7, and 3 trees per acre on the areas burned once, twice, thrice and many times, respectively. It should be emphasized that the data have been obtained by actual measurement. Knowing, in this way, the number of pine trees per acre in relation to the number of times burned, knowing also, at least, their minimum value at maturity, in terms of stumpage values and of timber dues, we may compute with reasonable accuracy the money losses involved in the progressive diminution of future yield owing to successive fires. This computation is presented in the table below. The figures are derived from the assumption that each tree now present will grow to maturity and at maturity will yield 100 feet board measure. This is the yield of an ordinary pine tree from 12 inches to 13 inches in diameter, according to the Scribner rule. The stumpage value is placed at seven dollars per thousand, the present average value, and the dues at two dollars per thousand feet board measure, the present rate, although the price of the former at least will undoubtedly be much higher by the time these young trees produce saw logs.



Commission of Conservation

SECTION OF A TREE TRUNK TO SHOW HOW THE DATES OF FIRES ARE ASCERTAINED FROM THE REMAINING SURVIVING TREES. Each fire which injures the tree leaves a permanent scar, and the date when it occurred can be determined, or at least very closely approximated, by counting the number of annual rings between the scar and the outer circumference of the tree.

TABLE XI

PINE REPRODUCTION ON BURNED AREAS, WITH ESTIMATES OF THE PROSPECTIVE FUTURE VALUE OF PRESENT STOCK IF PROTECTED FROM FIRE, AND THE LOSS ALREADY INCURRED IN PREVIOUSLY EXISTING POTENTIAL VALUES, DUE TO REPEATED FIRES

	Burned once, average young pine trees per acre, 110	Burned twice, average young pine trees per acre, 14	Burned three times, average young pine trees per acre, 7	Burned many times, average young pine trees per acre, 3	Totals	Total losses
Acres	17,350	17,750	6,970	9,260	51,330	.....
Potential value of dues if burned but once	\$381,700	\$390,500	\$153,340	\$203,720	\$1,129,260	.....
Potential value of dues with present stock	381,700	49,700	9,758	5,560	446,718	.....
Loss of dues by re- peated fires .....	.....	340,800	143,582	198,160	682,542	.....
Loss in previously exist- ing potential dues, at \$2 per M .....	.....	.....	.....	.....	.....	\$682,542
Potential stumpage value if burned but once	1,336,000	1,366,750	536,690	713,000	3,952,440	.....
Potential stumpage value of present stock	1,336,000	173,950	34,150	19,440	1,563,540	.....
Loss of stumpage val- ues by repeated fires .....	.....	1,192,800	502,540	693,560	2,388,900	.....
Loss in previously existing potential stumpage values at \$7 per M .....	.....	.....	.....	.....	.....	\$2,388,900
Total loss already incurred, on account of repeated fires, in previously existing potential dues and stumpage values .....	.....	.....	.....	.....	.....	\$3,071,442
Potential value of present stock, if protected from fire (dues \$446,718, plus stumpage \$1,563,540) .....	.....	.....	.....	.....	.....	\$2,010,258

Great Loss of Stumpage Values It will be seen from the figures in the above table that if the entire area had been burned but once, if it had become stocked with young pine in the same quantities as the present area burned once, and if it were protected from further destruction by fire, the stumpage value of this pine at maturity at present prices would be over \$3,900,000. As stated on page 198, this estimate is based on the assumption that each tree thus theoretically present would attain sufficient size to yield 100 feet of boards. This condition would be reached when the trees averaged between 12

and 13 inches in diameter. The numerous fires which have been allowed to run over this area have so reduced the stock that its stumpage value at maturity will be about \$1,500,000, or, in other words, the fires have cost, in terms of pine stumpage, nearly \$2,400,000, and the dues on the young pine burned would have amounted to \$680,000. So the fires have destroyed more than \$3,000,000 in potential pine values. As a result of the fires, however, we have sufficient poplar to make, at maturity, 265,000 cords of pulpwood. Considering this to be worth one dollar a cord when ready to harvest, we have \$265,000 to deduct from the cost of the fires. So the final charge against the forest fires, in terms of potential value of pine destroyed, is, approximately, \$2,800,000.

While the value of poplar is very much less than that of the pine, yet the successive fires have very materially lessened the potential value of its crop. Assuming the poplar to be worth one dollar a cord on the stump, for pulpwood, and that it could be harvested 30 years hence, the following data may be given in regard to the reduction of its value on the areas burned more than once:

TABLE XII

YIELD OF POPLAR 30 YEARS HENCE ON BURNED AREAS, WITH ESTIMATES OF ITS VALUE AND THE LOSS IN VALUE BY REPEATED FIRES

	Burned once, average cords per acre, 9	Burned twice, average cords per acre, 5	Burned three times, average cords per acre, 2.5	Burned many times, average cords per acre, 0.3	Total
Acres	17,350	17,750	6,970	9,260	51,330
Potential value of poplar 30 years hence if area burned but once.....	\$156,150	\$159,750	\$62,730	\$83,340	\$461,970
Potential value of the present stock 30 years hence.....	156,150	88,750	17,425	3,000	265,325
Loss on each area.....	.....	71,000	45,305	80,340	.....
Total loss .....	.....	.....	.....	.....	196,645

From the figures in the above tables, it will be seen that the value of poplar on the whole area is reduced only 43 per cent by repeated fires, while the reduction in the case of the pine is 60 per cent. This is due to the well-known fact that fires make conditions favourable for the reproduction of poplar. But, in spite of this, some of the areas

have been so often and so severely burned that the value of the poplar is less by \$196,645 than if there had been only one burning. This should be charged to the fire account, so that adding it to the \$2,800,000 loss of pine, we have a total loss of practically \$3,000,000 from fires which have occurred in the past 25 years on 85,000 acres (including swamps and other conditions), or \$35 an acre.

FIRE PROTECTION

Adequate protection from fire is the necessary preliminary stage to any management of the area under consideration for future returns. There has been no lumbering on a large scale in this region for nearly 25 years. Since that time, judged by the number of fires, there has been little or no real fire protection. Deducting the swampy areas within the former pineries, it was found that, of the area actually burned, only one-third has escaped with a single burning since lumbering has been discontinued; another third has been burned twice; one-sixth has been burned three times, and one-sixth has been burned many times. The most severe and widespread fires occurred 25, 16, 8, 5, and 1 year ago, or in other words, there were three destructive fires in the past eight years and one each in the two former eight-year periods, an increase in rate of 300 per cent in the past eight years. If this rate continues, the young pine and poplar at present on the area will inevitably be destroyed. As shown on pages 199 and 200 this would involve a further loss of \$2,275,000 in existing potential stumpage and dues values of pine and potential stumpage values of poplar, in addition to the above \$3,000,000 loss already irrevocably incurred. It would seem worth while from a business point of view to save this \$2,275,000 if possible.

Forest Protection Can be Secured Officials, and the public in general, assume a rather fatalistic attitude toward the occurrence of forest fires. They are considered to be inevitable and unavoidable phenomena, like earthquakes and tornadoes. Such an attitude of mind perpetuates many an economic waste, one of the greatest of which is the destruction of forest wealth, present or potential, by fire. Experience has demonstrated that forest fires can be reduced to a minimum at a reasonable rate of expenditure, compared with the value of the property involved. As an example of this, the co-operative forest fire protective associations in the province of Quebec may be cited, where fairly efficient protection of large areas costs from one-quarter of a cent to one cent per acre per year. In order to accomplish this, however, two things are necessary: (1) An earnest desire to prevent fires, through a real appreciation of the value of the pro-

party involved, and (2), efficient, business-like administration of the protective organization when once established. It will be seen that the area under consideration lacks both of these prerequisites. The territory has been cut over several times. One-half of it has been abandoned by the limit-holders and the remainder has been so far abandoned that it is not considered of sufficient value to be patrolled by a fire ranger. The latter condition is the logical result of throwing the entire cost of fire protection upon the limit-holder. He has usually no financial interest in the cut-over lands, because they will eventually revert to the Crown, since he can not, as a rule, afford to wait for the young growth to reach merchantable size. As a rule he is financially interested only in the timber of present commercial value; that gets the protection, and the cut-over lands are neglected. Fire on them receives attention only when it endangers standing timber.

Value of Protection Not Appreciated Under the former regulations, when the Government paid one-half the cost of fire protection, the lessee could justly be required to patrol the cut-over areas as well as the timber areas, but, under the present regulations, this hardly seems practicable, unless it be assumed that limits are to be held in perpetuity, and this assumption is usually not justified. In the actual working out of the new regulations, then, the cut-over lands are abandoned to the ravages of fire, both by the Government and by the lessees. That such a condition of affairs could exist is due to the fact that the actual owners of the land, or, in other words, the people, do not appreciate the value of their property. "Waste land" is the common appellation applied to these cut-over and burned-over areas, yet the figures already given demonstrate that they are far from that. As has been pointed out, this relatively very small area contains sufficient young growth to be worth at maturity \$2,275,000. The harvesting of this timber, and the many million dollars worth of material on similar areas in the province, would mean the employment of many people; with its destruction by fire, the opportunity for such prospective employment is removed. The dues received by the Government help to meet public expense; the removal by forest fires of the possibility of collecting such dues means that money for current public expenses must be raised in some other way, with the consequent increase in taxes, either direct or indirect. The people, therefore, have a direct financial interest in these cut-over lands. When they realize this, and appreciate their value, they will be efficiently protected from fire.

Where fire protection has been most efficient, it has been chiefly preventive. The means of prevention usually adopted are lookout



FIRE-SCARRED POPLARS

Value of timber largely destroyed, even where not killed outright.



STUMP SHOWING SIZE OF FORMER FOREST GROWTH ON AREA COVERED BY THIS REPORT

Little of the land is suited for anything except timber production.

towers, patrolmen, trails, telephone lines, tools and men for fighting the fire. These are all accessories to reaching and putting out the fire before it gets beyond control. Another phase of efficient protection is in preventing the occurrence of fire, by educating the frequenters of the forest to be careful in the use of fire. This is the hardest task that has to be done.

Suggested Means of Protection Turning to the phase of efficient protection, the object of which is the quick extinguishing of the fire when once started, and applying it to the area under consideration, it was found that it could be adequately protected by one lookout station on the Blue mountains, situated in the centre of the territory and commanding a view of nearly every acre of the area. It should be connected by telephone with the neighbouring communities, to summon help in case of fire. A rural telephone line is already in operation on two sides of the area and most of the inhabitants live along this line. It could be tapped from the Blue mountains for a distance of eight miles, and could be installed for \$500, including cost of materials. The lookout man could be provided with a cottage at the foot of the mountains, not more than a half mile from the best position for the lookout station. Such a building, suitable for summer occupation, could be erected at a cost of \$500, making a total outlay of \$1,000 for the telephone line and the cottage. This initial capital investment could readily be made from the sale of mature material now on the ground.

The cost of patrol, fire-fighting and supervision need not exceed three cents per acre per year. For this sum it is possible to afford a very good degree of protection. The cost of overhead supervision per acre chargeable to fire protection would be reduced if a larger area than that discussed in this report were to be included in the proposed reserve, or if some line of scientific investigation, preferably a forest experiment station, were to be carried on, in connection with the general work of forest protection and administration. However, it will be safe to estimate the average cost of fire protection at three cents per acre per year.

Results of Protection It has already been shown that the potential value of the existing young growth of pine and poplar is, in round figures, \$2,275,000. Out of the total of 85,000 acres, only 15,000 acres are unburned mature forest (see p. 190), leaving approximately 70,000 acres which were occupied by the former pineries and have been more or less burned over. This includes unburned swamps and oak barrens, which must be included in any scheme for protection, being scattered in relatively small areas. Using

this figure of 70,000 acres, then, as a basis, the potential value of the existing young growth is approximately \$33 per acre. If the period of maturity be taken as 50 years hence, then three cents per acre per year, at 4 per cent interest, compounded annually, becomes \$4.58 at the end of 50 years. Therefore, after a total of less than \$5 per acre had been spent, including interest, distributed over a period of 50 years, the province would have a property of 70,000 acres, worth \$33 per acre, a clear profit of more than \$28 an acre.

Fire Pre-vention and Education Turning now to the second phase of efficient fire protection, namely, the actual prevention of the occurrence of fires, we come to the greatest need of fire protection propaganda, that is, a campaign of education and publicity. There is already considerable public sentiment in favour of fire protection, but it is mostly subconscious and non-expressive. It must be aroused and made virile and aggressive. This could be best accomplished by accentuating the financial results following fire protection. The common tendency is to think of the benefits resulting from fire protection as something remote—a sort of entailment in favour of future generations. But it should be emphasized that the present generation would reap the benefits of protection even on cut-over lands. While the value of the yields forecasted on page 199 would hardly be attained in one generation, yet in 30 to 50 years, at the present rate of growth, if protected from fire, the area under consideration will yield over \$2,000,000 worth of pine lumber and \$265,000 worth of poplar for pulpwood. The harvesting of this would give employment to many members of the community in which it is located, and, if the area were large enough, the employment would be permanent.

Permanent Benefits to be Derived This, then, is the argument from the business standpoint: Effective fire protection leads to a stable and permanent lumber industry in the community, with consequent permanent employment of its members. Those who would not benefit directly by securing employment would serve or supply those who would so benefit. Contrast this with the present system, in which the lumberman removes all of the trees, and is steadily forced farther and farther from the markets in order to obtain merchantable timber, with the consequent increase in cost of production and transportation and, therefore, increased cost to the consumer. The present system leaves former timber lands open to recurring fires, greatly retarding or, in some cases, completely preventing the natural restocking of the area by commercial trees. It also results in increased taxation, abandoned farms, and a stranded population, often compelled to eke out a mere existence by hunting and fishing.

Communities not infrequently offer special inducements to certain industries to locate in their midst, and such industries often furnish, directly or indirectly, the means of livelihood for the greater portion of the inhabitants. They become such an integral part of the community that their withdrawal would be an economic calamity. A suggestion of such a thing would be fought vigorously by the citizens. If the citizens realized the value of the forest to the country as a source of permanent employment and permanent supply, they would fight against its removal just as vigorously and they would promote any means leading to its perpetuation.

So the work of the propagandist of fire protection is to present to the public the relation of the forests to the industries dependent upon their products, the relation of forest industries to other industries and the relations of the forests to the public treasury. The annual value of the products of the lumber industry in Canada is surpassed only by those of agriculture and manufactures. A large, but, in reality, diminishing, portion of the revenues of the eastern provinces is obtained from the forests. The taxpayer should be made to appreciate the relation of all this to his pocketbook. When he does, the unrestrained destruction of forests by fires will be regarded as an economic waste not to be tolerated.

RECOMMENDATIONS

In devising a policy for the proper management of this watershed there should first be made a classification and segregation of the lands which are capable of agricultural use from those which should be forever given over to timber culture.

Agricultural Possibilities As has been shown in a previous report*, many farms which had been abandoned, and others which are still farmed, are really too poor for successful farming.

Nevertheless, there are areas which are capable of agricultural use. Indeed, the richest and, probably, the most potentially profitable soils have been overlooked. These could be made useful for cattle ranching and specialized farming.

The area burned many times, as indicated on the accompanying map (facing page 166), is over 12,000 acres. At least one-quarter of this is composed of marshes and swamps. Many of these already have hay of such quality that cattle readily fatten on it, and many more could be made to do so without a prohibitive amount of work upon them. The more intractable portions could be fenced for grazing purposes, while the more easily managed areas could raise the hay to

**Trent Watershed Survey*. Commission of Conservation, 1913.

support the cattle in the winter. It is claimed, and probably with truth, that cattle can be brought to the "stocker" condition by free range in the forest. It is to be noticed, however, that in the later and drier portions of the season they do most of their grazing along the edges of the marshes, especially those along moving streams, where both food and water are accessible. Even under the most favourable conditions in the bush, cattle range over large areas in a day to find satisfying quantities of food. It is evident that they would fatten more readily if kept more closely confined in ranges, including areas of the more solid blue-joint grass-producing portions of the marshes (to avoid the danger of cattle being mired), and larger areas of the uplands. It is noticeable that white clover and blue grass grow luxuriantly along the margins of trails. It is also noticeable in cases of severe burning, where everything is killed and the litter burned down to the mineral soil, that pure stands of white clover and blue grass often cover patches several square rods in extent. It might be that pasturage could be materially increased in this way. If, by carefully managed trials, the cattle-raising industry should prove successful, it could be made a source of considerable profit through rentals of grazing areas. Indeed, it might well prove to be more profitable to utilize these semi-barren areas for permanent pasturage than for forest purposes.

**Market Gar-
dens from
Swamps**

Another alternative measure is the conversion of the marshes and swamps into market gardens. As stated above, many of them are already grass covered, and these vary in size from a few acres to those containing several hundred acres. Some would require but little drainage, others considerable. Nearly all of these marshes have streams flowing through them; they are not of the undrained peat bog type, and consequently are but slightly acid, a condition readily rectified by liming. An analysis of the soil of one of these marshes showed it to consist of decaying vegetable matter to the extent of 60 per cent of its dry weight, 25 per cent silt, 4 per cent clay, and the rest mostly of the finer grades of sand. Soils of this kind extend to the depth of three to twelve feet and if properly managed they would furnish a practically inexhaustible supply of plant food matter to garden crops.

The utilization of these soils would, of course, be a matter of provincial control. The beginnings could be small, without a great initial outlay of money. It would be very desirable to establish an experimental farm on these soils. If it were demonstrated that they could be successfully managed, then encouragement could be given settlers to take up these lands by aiding in drainage, the cost being

charged in the form of rent for a certain number of years, at the conclusion of which the settlers could be given title under the usual homesteading conditions. Ten acres of such soil devoted to garden crops would support a family. There are about 15,000 acres that might be eventually used for this purpose in the township of Methuen alone.

**Reaching
the Markets**

The chief objection to such a plan is the present distance from markets, the average distance to a through railway being 20 miles. This could be met by a co-operative motor-truck service, and when the produce once reached the railway it could be brought to such a market as Toronto, for example, in two or three hours, so the distance from the field to the market would not be over six or seven hours. It may be argued that it is hopeless to offer inducements to utilize such soils, while better soils in other parts of the country remain yet to be occupied. It would be difficult, however, to find better soils from the standpoint of fertility. Only from the standpoint of mass and contiguous distribution are others superior. It is evident that the day of intensive and specialized farming has arrived, and the soils in question offer an opportunity for one line of development in that direction. It is to the advantage of the province to keep its farming population at home. Most of the depopulation of the rural districts has taken place in the regions of the poorer upland farms like this one. The opening up and successful utilization of the moist lowlands would undoubtedly induce most of the young men to stay at home, and would contribute to the up-building of their own communities.

**Forest Policy
Should be
Devised
for the area.**

The bulk of the land, however, was designed by nature for wood crops; it is absolute forest soil, and the principal effort should be to devise a proper forest policy

It seems obvious to one who has studied the problem of the cut-over and burned-over lands in the Trent watershed that they should at least be placed under some kind of control which would ensure adequate protection from repeated forest fires. From the calculations on the preceding pages of this report, it is equally obvious that such protection would prove a highly profitable investment for some long-lived institution. This protection, as has been shown, would involve a relatively small outlay of funds, compared with the potential value of the young growth, since mere protection is about all that is needed on at least one-half of the area covered by this report. It has been conclusively proven by the figures on the preceding pages that

nature, in time, if not interfered with, would re-establish the pine on the cut-over pineries in commercial quantities. If man would do his part and remove the interference (forest fires), all would be well, and the former pine lands would continue to produce pine indefinitely.

Plans for Control of Area

Three plans* have been suggested for future action on the cut-over and burned-over lands in the Trent watershed, namely, (1) municipal ownership and management; (2) provincial management, and (3) co-operative management between the Dominion and the Provincial governments, the latter because of the interest which the Dominion has in the protection of the watersheds of the Trent canal. Of these three plans the first seems the most logical and desirable to the writer, if it could be inaugurated.†

One of the chief arguments in favour of county ownership is the stimulation of local interest that would be created. Fire protection would be more effective under local management, for the inhabitants of the community would realize that they, and not some absentee landlord, would reap its benefits. On the other hand, one of the chief arguments against county ownership is that the financial backing of the enterprise would not be so strong as in the case of provincial or federal management, although the initial outlay of money need not be large, as has been shown on pp. 203-204. Moreover, most of the initial outlay, and, to some degree at least, the annual cost of protection, could be offset by the sales of merchantable material already on the area, such as is contained in the patches of hardwoods, scattered groups of pine, the elm in the swamps, and there are many places along the margins of swamps and in the gullies where 100 cords of poplar could be cut on a relatively small area. These operations would involve the establishment of a local sawmill, with its employment of local labour. Again, a local interest in the protection of the area from fire would be stimulated. At the end of 15 years the cutting of poplar on a fairly large scale could be begun and at the end of 30 years, according to the calculations on p. 200 some 328,000 cords of poplar could be harvested. By this time also, considerable young pine would have attained commercial size.

**Trent Watershed Survey*. Commission of Conservation, Canada, Ottawa, 1913. Pp. 15-20.

†It should be mentioned in this connection that Hastings county has already initiated a policy, through the Counties Reforestation Act, of acquiring cut-over and burned-over lands and holding them for their future timber yields. The councillors of Peterborough county, in which the area under discussion is situated, have a similar project under consideration.



REPRODUCTION OF WHITE PINE AND POPLAR ON AREA BURNED ONCE



GENERAL VIEW OF AN AREA BURNED TWICE

Note scattering young growth of pine remaining. Contrast with reproduction on area burned once.

**Re-Planting
of Pine
Necessary**

On the greater portion of the 9,000 acres burned many times, there are not enough pine seed trees to insure a restocking of the area by natural processes. Under forest management this would eventually require planting, but it would be a waste of money to do so until fire protection had been demonstrated to be effective. There is no doubt that, where fire risk is reduced to the minimum, forest planting would be profitable for a long-lived institution, but, if this area were placed in the hands of the county, planting could be delayed until the harvesting of the crop was assured, and other conditions justified it.

While then, theoretically, county management would recommend itself on account of the local interest which it would create, practically, it is open to question whether the counties are financially able to burden themselves with the responsibility of caring for such lands, especially for the poorer ones, which do not promise early returns. It is doubtful, also, whether they could be expected to employ the technical advice which is needful, to make a success of forest management. This is a new business and requires careful planning and circumspect detail attention, which only a specially fitted manager can give.

There are other practical difficulties and objections to the transfer of these lands to the counties, which, however, do not preclude the participation of the counties in the benefits, indirect as well as direct, which would come from a provincial or federal management.

The next logical proposition is for the province to place these lands under management for continuity. The only objection to this is the financial one.

It is realized that the province, because of more insistent demands for public expenditure in other directions, absence of sufficient public interest, or because of other reasons, may not be in a position to undertake a management which cannot furnish returns for a series of years.

Luckily, the interest of the Dominion in this watershed is paramount and, having in her Forestry Branch a technical bureau which could take charge at once and efficiently, no practical difficulty would be experienced in inaugurating a broad, comprehensive policy of management for the entire watershed.

Since the province is already receiving no rent for nearly one-half of the Burleigh-Methuen area under consideration, it being abandoned timber limits, and is receiving only ground rent—less than one cent an acre yearly, for the other half, the commercial timber being all cut off—the province might without serious financial loss, when the licenses on the latter are cancelled, turn the area over to the Dominion *gratis*.

This could be effected under a condition that the Provincial government and the counties receive a stated proportion of the net or

gross receipts which may be derived from the management of these areas. Such an arrangement exists in the administration of the United States National Forests, where 25 per cent of the gross returns is turned over to the states in which the forests are situated, to aid in the maintenance of roads and schools.

Forest Experimental Station An additional advantage that might be expected to follow the transfer of this area to the Dominion Forestry Branch, under any terms mutually acceptable, would be the local establishment of a forest experiment station, with one or more technically trained men, who would devote their whole time to investigating silvicultural problems. Such investigations would have for their object the securing of a thorough knowledge of the silvical characteristics and requirements of the various species of forest trees—a solid scientific basis for the silvicultural handling of existing forests, and for the establishment of new forests, to secure the most economic use of the timber and other products of the forest, and a more exact knowledge of its indirect benefits.

Scientific information can be secured only in a systematic manner and by intensive methods of study. So far as forestry work is concerned, such information can best be secured through the establishment of forest experiment stations. This idea has already been developed extensively in other countries, including France, Germany, India and the United States. The silvicultural investigations carried on by the United States Forest Service are classed under the following headings:

Forestation—

General Studies

Seed, production, fertility, methods of extraction, etc.

Nursery practice

Species, methods, and seasons for artificial forestation

Sites—limits upon the growth of each species fixed by site conditions

Introduction of exotics

Species

Forest Influences Upon Climate, Stream Flow, Erosion, etc.

Management—

General systems and their technical basis

Methods of cutting

Brush disposal

Natural reproduction

Thinnings

Valuation—immature growth, merchantable timber, soil for forest production

*Mensuration**Protection from—*

Fire
 Grazing
 Disease
 Insects
 Animals
 Snow

*Regional Studies of Types and Forest Conditions**Silvical Studies—*

Distribution of forest trees and types
 Forest types—description, basis of tree associations, etc.
 Special studies.

Tree Studies—

Growth, yield, silvical characteristics, methods of management,
 etc.

Utilization Studies

While the Dominion Forestry Branch could not be expected to undertake all the above lines of investigation immediately, the list will indicate the wide range of possibilities. Aside from the conduct of actual planting operations on a limited scale, by the provinces of Ontario and Quebec, and by various private interests in these and other provinces, but little systematic attempt has been made in eastern Canada to solve the class of forest problems indicated above. If forestry is to be placed on a permanent basis in Canada, a great deal of scientific investigation must be carried on, as in other countries, and the Dominion Forestry Branch is the most logical organization in Canada to undertake and prosecute such work. Forest experiment stations are needed at a number of points throughout the Dominion, where the results secured will apply to different conditions and have a wide general application. It is believed that the portion of the Trent watershed, discussed in this report, would be eminently suitable for the establishment of a forest experiment station, since the region is typical of very large areas of lands in eastern Canada, chiefly or only valuable for the permanent production of timber. Thus, the transfer of this area to the Dominion Forestry Branch, on any terms that might be agreed upon, would not only help to protect the large investment of the Dominion Government in the Trent canal, by furnishing adequate fire protection, but would also tend to greatly advance the general cause of forestry in eastern Canada, by facilitating the conduct of scientific investigations, and the establishment of a demonstration area for the elaboration of the various methods of handling forest properties.

PART V

The Reproduction of Commercial Species in the Southern Coastal Forests of British Columbia*

BY .

C. D. HOWE, PH.D.

OBJECT OF THE WORK AND THE CONCLUSIONS IN BRIEF

EVEN the casual observer, employing the usual methods of travel in the southern coastal region of British Columbia, would doubtless be impressed by the abundance of forest reproduction, especially that of Douglas fir. He sees young trees, often in dense stands, on all sides. If he reflects upon the significance of what he sees he gets the impression that there is nothing to fear in regard to the establishment of future commercial forests. However, for the most part, he sees this reproduction only along the margin of green forests, adjacent to cleared fields, highways and burned areas, where the conditions for the re-establishment of the forest are the very best. Are the conditions the same throughout the logged-over and burned-over areas? That is, are these very extensive areas in an adequate manner reproducing the forest which has been removed? The investigations, described on the following pages, were made in order to answer this question. The results are based not upon general impressions, so often misleading even to a careful observer, but upon a painstaking enumeration of the young trees on measured areas laid out in such a manner as to include all kinds of conditions.

As the result of such investigations, the question stated above may be answered thus: On about one-half of the area logged and burned in the past 20 years, the forest reproduction is not sufficiently abundant to insure the re-establishment of the commercial forest. The other half, however, is well stocked with young trees, and, if not burned, a forest yielding saw-logs is assured.

*The investigations reported in the following pages were carried on by the Commission of Conservation in co-operation with the Forest Branch of British Columbia. The writer is deeply indebted to the Chief Forester and members of his staff for their hearty co-operation and aid in facilitating the work.



A GROUND FIRE BURNING THE SLASH

The shade of the debris and under vegetation is removed, the mineral soil is exposed and sufficient seed trees are left. Conditions favourable for the reproduction of Douglas fir.



THE PROBABLE CONDITION OF THE AREA SHOWN ABOVE AFTER TWELVE YEARS
The area represented here was logged and burned twelve years ago and it now contains
5,000 young fir trees, 1,300 cedar and 400 hemlock per acre.

The barrenness, from the standpoint of young trees, on one-half of the logged area is due to the occurrence of repeated fires. One burning stimulates the reproduction of Douglas fir. In fact, it is regarded as necessary for the establishment of dense stands; but a second burning is very disastrous, because it kills both the seed trees and the young growth following the first fire. There is nothing left with which to start another crop of trees on the area.

Judging by the age of the fire scars on the older trees, and by the age of the stands following the first fire, the writer found that during the past 20 years four widespread fires occurred. That is, a severe fire occurred once in five years, the last one being four years ago. From 20 years to 100 years ago the average interval between widespread fires was 27 years, while from 100 years to 360 years ago severe and widespread fires took place at intervals of 86 years. Therefore, the rate of the occurrence of fires has increased enormously in the past few years. Practically all of these fires were upon the logged-over areas, and so endangered or killed the forest reproduction.

The significance of the increasing number of fires lies in the fact that the future supply of saw-logs must come from the logged-over areas. It takes, under average conditions, from 75 years to 100 years to make even the smallest trees now being used for saw-logs. The largest trees are from 400 to 900 years old. Adequate fire protection for the young growth on the logged-over areas should be installed at once.

NATURE OF THE INVESTIGATIONS

The following report upon the re-establishment of the forest after logging and after burning is the result of work on the eastern coast of Vancouver island as far north as Union bay and on the mainland coast as far north as Powell river. The investigations extend inland about five miles in each case, so that the total area explored covered about 1,000 square miles. After areas of second growth of various ages had been located by a general exploration, the number of young trees on them was counted by means of strips 33 feet (one-half chain) wide and their ages determined. The length of the strips depended upon the density and uniformity of the stand, being shortest in the more dense and more uniform stands. With the exception of the stands less than 10 years old, however, all the strips were at least 20 rods (5 chains) long, and some of them were two miles in length, the average being about one-fourth mile (20 chains). From these sample strips, the number of trees on an acre was calculated and the results are given in the tables below. The total area of such sample strips on which the young trees were counted was over 43 acres. Besides this, sample strips of like nature, amounting to 28 acres, were made in the

cut-over areas to determine the number of seed trees remaining after the logging operations. At the same time, studies were made on the influence upon the re-establishment of the commercial species of various agencies, such as logging without burning, logging with burning, and the presence of underbrush.

After a brief description of the mature forests in the southern coastal forests of British Columbia, the following report passes to a description of the young forests (the forest reproduction) dominated by fir, hemlock or cedar (pp. 218-222). The section of the report following this deals with the agencies which accelerate or retard the establishment of young forests. The last topic is discussed under such headings as logging without burning, logging with burning and the under-vegetation (pp. 222-229). The recommendations based upon the results of the investigations are presented in the final section (pp. 229-231).

The statements in regard to the ages of the older trees are to be considered only as approximate. The age is determined by counting the annual growth rings on the stumps, so an addition must be made for the time taken by the young tree to reach stump height. This period varies according to the favour of the growth conditions in which the seedling found itself; it may have grown in height very slowly or very rapidly. For example, some seedlings in very dense stands on poor soil were found to make an average height growth of three inches a year for the first ten years, while, on the other hand, seedlings in the best soil conditions grew at the rate of over a foot a year in the same time. From the measurement of several hundred seedlings in various conditions of density and soil, the rate of six inches a year for the first ten years was taken as the average height growth, and the age of a tree to the height of the stump was calculated on this basis.

The young trees, whose ages were to be determined, were cut flush with the ground, so the results in this case are quite accurate. There are chances of error in determining the age of fire scars, as it may happen that a growth layer is not laid down in some years on the side of the tree where the rings were counted.

MATURE FORESTS

In the coastal region of British Columbia, included in this report, from sea level to an elevation of approximately 2,000 feet, Douglas fir is the predominant tree species in the mature forest, both as to numbers, since it comprises from 70 to 80 per cent of the stands, and as to growth conditions, since it overtops its associates in the forest, and furnishes the greater portion of the lumber. If, however, the

immature and non-commercial trees were included in a tree census, the Western hemlock, for reasons to be stated later, would be found to outrank the fir in mere numbers.

The largest fir trees, from four to eight feet in diameter, and 200 to 300 feet high, occur in the deep sandy loam soils of the first bench lands above the lakes, streams and along the innumerable re-entrant arms of the sea. According to the writer's observations, they occur at present only in scattered groves, or relatively small patches, or scattered among trees of much smaller size. They are usually in situations well protected from fire, and this is doubtless the reason they have been spared. The medium-sized trees, from one and one-half to four feet in diameter, and from 150 to 200 feet high, are found on the stony loams and the sands of the second bench lands of the inland waters and of the old sea terraces of the coast. They are also found on soils of similar nature on the numerous glacial sand plains at the mouth of the mountain valleys. These medium-sized fir trees, in addition, extend up the lower slopes of the mountains to an elevation between 600 and 800 feet. The situations in which the medium-sized trees grow are very extensive, and they furnish by far the greater portion of the fir saw-logs.

Above an altitude of 600 to 800 feet the mature fir trees as a whole are small, from ten to thirteen inches in diameter, and from 75 to 125 feet high. Some medium-sized trees, however, may run up the ravines to the higher elevations. The soil is thin and very rocky, although, when not burned, the rocks are hidden by a luxuriant growth of mosses, ferns and small, woody undergrowth. The stands are dense and have every appearance of being "growth bound." This type of fir forest is quite extensive. Small mature trees also occupy the numerous gravel plains at lower elevations.

Western hemlock is the commonest associate of the Douglas fir in the coastal region under consideration, but it rarely, if ever, attains the proportions of the fir. Away from the immediate coast, it grows in rather more moist situations than the fir, or is more abundant and of larger size when it shares with the fir the better soil conditions. It is found in good development particularly along streams and on north-facing stream slopes, on flats at the head of lakes, in gullies and depressions in the sand plains. Hemlock occurs in suppressed condition, often in dense thickets, beneath nearly all of the mature fir stands whatever the kind of soil they may occupy, so that if these small trees be counted, the hemlock very often surpasses the fir in numbers, although the fir dominates the stand. The hemlock evidently recovers from its suppression when released by the death of the over-topping fir, for a break in the crown cover of the fir is usually occupied by

hemlock, so that even in the pure stands of fir there are scattered small groups of mature hemlock. At the higher elevations, the hemlock gradually displaces the fir in the forest.

Western cedar is much less common than the hemlock as an associate of the Douglas fir, but in its best situations it more nearly approaches the fir in size; in fact it sometimes surpasses the fir in diameter, but not in height. The largest cedars are found on moist flats along lakes, sea and streams. Cedar, however, like the hemlock, may be found in almost any soil condition, but it apparently does not reach large size on indifferent soils except on the immediate slopes of the shores.

Balsam, Sitka spruce and western white pine, so far as observed, occur only scatteringly in the Douglas fir forests. The balsam is the most common of the three.

One is impressed by the occurrence of a large number of stands of mature fir in which the trees are nearly all of the same age. The stands of medium-sized trees, for example, were prevailingly 315, 170 and 124 years old. In fact, representatives of these age classes were found on every area studied, whether on the island or on the mainland. The uniformity of age, however, was not so pronounced among the largest and oldest trees. The largest tree observed was seven feet in diameter and was 910 years old. Fire scars disclosed the fact that the tree was burned 856 and 335 years ago. The large trees, about six feet in diameter, at Chemainus, were 540 years old. Those near Cowichan lake and Gibson landing were 425 years old, with an average diameter of five feet. In both places they showed fire scars 230 years old. At Powell river they were 356 years old, and averaged four feet in diameter, while at Union bay they were 460 years old and six feet in diameter.

Younger stands, 70 and 100 years old, were also frequent on all of the areas investigated. These are the ages of most of the fir trees left after the logging operations at Shawnigan lake, Chemainus and Union bay, and also of the trees now standing on the logged-over areas on the north side of Burrard inlet, at Gibson landing and Powell river.

Judging by what we know of the method of re-establishing fir forests after the more recent fires, we are fairly safe in assuming that these mature Douglas fir forests were established as the result of fire. Moreover, all the five younger age classes mentioned above correspond with the ages of fire scars on the neighbouring older trees. This point may be made clear by describing the condition of affairs at Powell river, where a careful study of the history of the forest on a square mile was made. The majority of trees logged on the area would be approximately 315 years old if standing to-day. The fire scars on the

veterans were 316 and 70 years old. The scattered veterans were 356 years old, and they doubtless represent the remnants of the stand burned 316 years ago. One finds some trees 155 years old, but it is evident that they established themselves beneath an old stand, for they were suppressed for the first 55 years, being only two inches in diameter at that time. Something happened 100 years ago to release them, for they began to grow rapidly a few years after that date. It may have been the fire recorded by the scars 100 years ago on adjacent trees, although the stumps of the 155-year-old trees do not show fire scars of that date. Nearby stands, however, are 100 years old, and the effect of the fire recorded 70 years ago is to be found in adjacent stands of that age.

YOUNG FORESTS

Under the heading of young forests are included all those areas where the young trees of the commercial species are in the process of reproducing a forest. A new forest may be in process of re-establishment beneath an old forest or upon areas wholly or partially cleared by fire or by logging or by both. Practically all of the reproduction of Douglas fir forests is taking place on areas cleared by fire alone or by logging and fire combined. A new hemlock forest, however, may be established beneath an old fir forest. This is because young hemlock trees can endure shade, while young fir trees will not grow well if shaded by the crown cover of larger trees.

The object in this section of the report is to show the decrease in the number of trees per acre as the stands grow older. The death rate is greater, the greater the density of the stand, yet the denser the young stand, the better will be the quality of the lumber produced by the surviving trees. As the shade is so dense that the side branches are killed off early in the life of the tree, the wood laid down on the stem after this is free from knots, hence the quality of the lumber is improved. Crowding also forces the young trees to grow more rapidly in height and more uniformly in thickness, with the final result of more logs to a tree and less taper in a log.

Dense young stands are necessary to produce the largest quantity of the best quality of commercial timber. For this reason the agencies which bring about dense stands should be encouraged and those which tend to retard or destroy their development should be eliminated.

For convenience of presentation, the description of the forest reproduction will be given under three sub-titles, namely, that in which Douglas fir predominates, that in which hemlock is the most abundant, and that in which cedar is the most numerous.

Douglas Fir
Predominant

The table below gives the average density per acre of the young Douglas fir forests grouped into age classes of ten-year intervals. The actual age of these stands will be found under the section upon the influence of fires on forest reproduction.

TABLE I

NUMBER OF YOUNG TREES PER ACRE, ACCORDING TO AGE BY DECADES, BASED UPON
32 ACRES OF SAMPLE STRIPS

Age, by decades	Douglas fir	Hemlock	Cedar	Balsam	White pine	Total trees
Less than 10 years	53,300	1,000	3,300	..	..	57,600
10 to 20 years	3,900	270	470	30	5	4,670
20 to 30 years	1,100	220	170	20	5	1,510
30 to 40 years	410	270	100	10	..	790

PERCENTAGES OF YOUNG TREES PER ACRE, ACCORDING TO DECADES, AS ABOVE

Age, by decades	Douglas fir, Per cent	Hemlock, Per cent	Cedar, Per cent	Balsam, Per cent	White pine, Per cent
Less than 10 years	93.0	2.0	5.0	....	....
10 to 20 years	83.4	5.7	10.0	0.7	0.1
20 to 30 years	72.6	14.6	11.2	1.3	0.3
30 to 40 years	52.0	34.0	12.6	1.3	....

One frequently finds small patches of fir in which the number of trees on an acre was much higher than given in the table above. For example, four-year-old stands sometimes ran as high as 322,000 little trees upon an acre, and even in the 16- and 18-year-old stands the number per acre frequently reached 30,000. The figures in the table, however, give a good idea of the general condition of the reproduction, including the poor as well as the good.

The table above clearly shows the natural thinning-out that takes place as the trees increase in age and size. In the case of the 57,600, less than 10 years old on an average acre, each little tree occupies less than a square foot of soil. If all of these trees lived until they were a foot in diameter, the result would be a solid block of wood upon an acre. We know that trees do not grow that way. There is not room enough for them all, so the weak die and the strong survive. As shown by the table, in this case 91 per cent of the trees had died by the end of the nineteenth year, 97 per cent at the end of 29 years, and 98 per cent



A STAND OF DOUGLAS FIR ABOUT 100 YEARS OLD

Fire scars on adjacent older trees are of that age, so this stand evidently followed the fire. It has not been burned since.



THIS AREA HAS BEEN BURNED TWICE

The young growth is scattered and patchy in distribution. The dead saplings indicate that it was once well covered with young trees.

were dead at the beginning of the fortieth year, or, in other words, only one in fifty of the original trees was alive, that is, if we assume that the forest between 30 and 40 years old started in the same manner as the present stands less than 10 years old. Stated in another way, the death rate per acre was 5,000 yearly during the second decade; 300 yearly during the third, and 70 trees per acre yearly during the fourth decade. It will be seen that the death rate was still more pronounced in the case of the fir alone, since less than one in a hundred of the original trees was alive at the end of the fourth decade.

By referring to the percentage table above, one will see that the proportion of the hemlock gradually increases as the stands grow older. This shows that the hemlock can endure crowding and shading better than the fir. The tendency of the hemlock to crowd out the fir as the forest gets older seems to be a general rule in the coastal forests of British Columbia. This is particularly true in the better soil conditions, and, as stated in the preceding section, (p. 216), the hemlock is beneath the stands of fir on the poorer soils, ready to take the place of the fir as soon as it is removed, that is, if the natural conditions are not too violently disturbed.

In travelling through the southern coastal region of British Columbia one is impressed by the vigorous reproduction of Douglas fir, yet the occurrence of well-stocked stands of young fir is scattering and patchy in nature. The mature forests which will arise from these young stands will not be as continuous and uniformly distributed as the present mature forest, and consequently the forest area of the future will not yield as much saw-log material. This prediction is based on the fact that large areas of young forests are being periodically burned, and, when the young growth is killed by fire, little or no young growth of commercial trees comes in to take its place. The reasons for this will be discussed in the section on the influence of fire upon forest reproduction.

Hemlock Stands in which hemlock predominated, covering large
Predominant areas, were much less frequent than those in which
 fir predominated. Young hemlock stands were plentiful, but they occur in relatively small groups, usually on the better soils of depressions and flats.

TABLE II

NUMBER OF YOUNG TREES PER ACRE, ACCORDING TO AGE BY DECADES, BASED UPON
11 ACRES OF SAMPLE STRIPS

Age, by decades	Hemlock	Douglas fir	Cedar	Total trees
Less than 10 years.....	44,900	5,000	4,900	54,800
10 to 20 years.....	7,770	400	170	8,340
20 to 30 years.....	6,170	180	100	6,450
30 to 40 years.....	3,900	100	160	4,160

PERCENTAGE OF YOUNG TREES PER ACRE, ACCORDING TO DECADES, AS ABOVE

Age, by decades	Hemlock, Per cent	Douglas fir, Per cent	Cedar, Per cent
Less than 10 years.....	82	9	9.0
10 to 20 years.....	93	5	2.0
20 to 30 years.....	95	3	1.4
30 to 40 years.....	94	2	4.0

As in the case of the fir, some of the young stands were much more dense than is indicated by the averages, as given in the table above. For example, a small plot in a four-year-old stand disclosed seedlings at the rate of 2,800,000 to the acre. By comparing this table (Table II) with that of the fir (Table I), one will see that there are many more hemlock trees per acre than there were fir trees for the corresponding ages, with the exception of the first age class. In other words, the death rate of the hemlock is not so great as that of the fir, since 82 per cent of the hemlock had died in the second decade, 86 in the third, and 90 per cent in the fourth decade. Whereas, in the case of the fir, less than one in a hundred of the original seedlings was represented in the stands at the end of 39 years; in case of the hemlock ten times as many were represented, that is 10 out of a hundred. The same thing is indicated in the percentage table, where it will be seen the relative proportion of hemlock in the stands does not decrease materially as the trees grow older. All this shows again that the hemlock can endure more crowding and shading than the fir, for it is evident that there would be more shade on an acre containing 4,160 than 790 trees of the same age.

**Cedars are
Short-lived**

As shown in the tables on the preceding pages, cedar is a common associate of both fir and hemlock. On the average the greatest extent of this association is about one-eighth of the stand, but it sometimes ran as high as one-

third. On seaward slopes cedar seedlings and saplings frequently occurred as an under-story beneath well advanced second growth fir in such abundance that, if all the individuals were counted, the cedar would surpass the fir in number. The best cedar reproduction was found beneath alder and it will be discussed later under the section on the effect of various agencies upon reproduction. In other situations, such as on logged and burned areas, no young growth cedar over 10 years old was found, except in small patches, although seedlings from one to five years old occurred in large quantities everywhere and small plots containing a few square yards sometimes ran as high as at the rate of over 3,000,000 plants to the acre. They were found mostly about stumps, on decayed logs and under the protection of fallen trees. Why they do not fulfil their prophecy of a future forest is not known. It may be that they can not endure the dry summers.

EFFECT OF VARIOUS AGENCIES UPON FOREST REPRODUCTION

Logging Without Burning

Logged-over areas which have not been burned with at least a ground fire within four years after the logging operations were rather hard to find in the region explored. So far as the number of seed trees left after logging is concerned, the opportunities for the reproduction of the forest are good. No trees less than 18 inches in diameter are cut for saw-logs as a rule, and there is usually a goodly number of these in every stand. Sample strips to determine the number of trees six inches or more in diameter, left after logging, these being considered capable of bearing seed, total only five acres. On these, the seed trees averaged 44 hemlock, 22 fir, and 13 cedar per acre, 79 in all. The death rate of these in after years, if not burned, would probably not be sufficiently large to eliminate the possibility of good seeding of the ground. Of course, there are many areas, such as skidding yards and clearings about camps and mills, where no seed trees are left, but these, as a rule, are not too large to prevent seeding from the sides.

The reproduction of the forest after logging without burning is rather difficult of attainment. The removal of the over-shading trees greatly stimulates the growth of the under-vegetation, such as salal, bracken fern, huckleberry, Oregon grape, and salmon berry. These grow abundantly and luxuriantly, and, together with the slash, make such a dense shade that the little fir seedlings which may spring up soon die. Cedar especially germinates abundantly under these conditions, but as stated before, does not last long. The shade is apparently too dense in such cases, even for the hemlock. One finds abundant seedlings up to four or five years old, but not such extensive dense stands as the number of seedlings would seem to suggest. It is

not a contradiction of the last statement to say that hemlock is the most abundant reproduction on the unburned logged areas. It apparently originates, however, not from seed distributed after the logging, but from the small trees which already existed beneath the mature fir stands before the logging. One can demonstrate this by counting the annual growth rings of the hemlock, when he will find that the trees are much older than the logging operations. It is also to be noticed that the growth rings become materially wider, the same year or the year after the logging operations, showing that the growth conditions for the hemlock were improved at that time, that is, by the removal of the overtopping fir trees. Some typical examples of the condition of hemlock reproduction after logging may be given. On an area logged four years ago, there were 416 hemlock saplings 16 years old and only 24 hemlock seedlings four years old, or less, on an acre. An area logged six years ago disclosed 730 hemlock saplings 18 years old on an acre and only 50 seedlings younger than the age of the logging. On an area logged 12 years ago, an acre showed 1,450 hemlock trees 24 years old and 200 seedlings which had come in since the logging.

The young growth hemlock on the unburned logged-over areas occurs in dense groups in the more moist soils and as scattered individuals on the drier soils, so that the trees as they grow older form a broken crown cover. The more open places may eventually fill up with fir. This is indicated by the presence of scattered fir seedlings about stumps and along the length of fallen trees. Although the exact history of the areas is not definitely known, it is probable that the older age classes of the hemlock, represented in Table II, originated on unburned logged-over areas. It will be seen that the proportion of fir is small, indicating that the conditions for the reproduction of hemlock were very much better than those of the fir.

Logging with Burning As already intimated, much the greater portion of the cut-over areas has been burned at least once since logging and most of the studies of forest reproduction were made on areas of this kind. In fact, extensive areas of commercial forest burned before logging were not found in the region explored. Moreover, the impression was gained that the large-sized and medium-sized trees were not seriously injured by one fire, although a succession of fires gradually weakens the trees until they become sickly and finally die. The forests not quite ready for the axe, however, and the small-sized forests of the higher slopes are readily killed by fire; extensive burns of this kind were encountered.

It is probable that light ground fires even stimulate the reproduction of hemlock, for the very best stands were found where fire had

extended a short distance beneath the green forest. Evidence in many cases seems to indicate that the under-story of hemlock so common beneath old stands of fir was established as the result of ground fires. The root system of hemlock seedlings is shallower than that of fir. This means that hemlock must have soils moister near the surface than is necessary for the fir, a condition supplied by the cover of the older trees checking evaporation. Another condition, however, is perhaps more important, and this is the cover of moss which usually follows surface fires beneath old stands. The moss cover conserves the moisture of the surface soil and forms an ideal germinating medium for the hemlock. Fir also germinates in these moss beds, but it soon dies out on account of the shade, while the hemlock, capable of enduring more shade than the fir, persists. Where moss is lacking the bracken fern or salal forms the protecting cover. One also finds abundant reproduction of hemlock, as represented by seedlings, on burned-over areas along the margins of dense undergrowth which has escaped the fire. This undergrowth furnishes protection from strong light and keeps the surface soil moist, while the adjacent burned places have too much light and are too dry for the hemlock.

The most extensive Douglas fir reproduction was found on burned areas. In fact, it is believed that moderate burning is necessary to establish pure stands of fir. The young seedlings, to grow vigorously, must have considerable overhead light, a condition secured by burning away the slash and the dense growth of under-vegetation. On approximately half of the area covered by adequate reproduction the trees were either four years or 16 years old, with the two ages about equally divided, and nearly one-fourth was eight or twelve years old, and again the two age classes were about equally divided. Reproduction of these four ages was met with on every area where detailed studies were made, and general observation showed them to be prevalent over the entire region. That these stands originated as the result of fire is indicated by the fact that fire scars of the same age or one year older were found in every case on adjacent trees. The next most frequent stands were 24 and 30 years of age. Other ages of fir which had evidently risen after burning, were 10, 26, 34, 40, 44 and 50. Besides these are the two age classes mentioned on p. 217, namely, 70 years and 100 years. These, too, were accompanied by fire scars, of approximately the same age, on standing older trees. All this indicates that fires have been frequent and that they have been particularly extensive within the past 20 years, the period of the great development of the lumber industry and of settlement in the region. The average interval between widespread fires during this period is five years. Stands 30, 70 and 100 years old, evidently fol-

lowing fire, were also found in all the places of detailed study. Thus, in the 80 years previous to the period beginning 20 years ago, the average interval between extensive fires was 27 years. If the study of the life history of the forest at Powell river may be taken as a standard, the average interval between fires from 100 years to 360 years ago was 86 years.

From his investigations of the areas logged and burned within the past 20 years, the writer is convinced that young fir stands sufficiently uniform and dense to reproduce the original commercial forests are found on only about one-half of such areas. The reason for this is the occurrence of two or more fires on the balance of these areas. The disastrous effect of repeated fires is two-fold, through the killing of seed trees and through the destruction of the young forests already established. In regard to the killing of seed trees, it may be said that the first fire which brings the reproduction of fir into existence materially reduces the number of seed trees. Sample strips, totalling ten acres were made in areas burned once after logging and the average number of seed trees per acre was found to be as follows: Fir, 20; hemlock, 10; and cedar, 5; total, 35. Comparing this with the number given on p. 222 for the logged areas not burned, we find that, on the average, the total number of trees has been reduced by more than one-half. It would appear that hemlock and cedar suffer most. Sample strips, totalling 13 acres, were made on areas burned twice since logging and the average acre was found to contain 5 fir, 0.2 hemlock, and 0.5 cedar seed trees, a total of less than 6. This is only about one-sixth of the number on areas burned only once, and one-thirteenth of the number on logged areas not burned. At this rate the third fire would kill them all. The figures for the areas burned twice are descriptive only of the very best conditions, for sample strips were not made in the numerous large areas burned twice on which there were no seed trees, such areas sometimes being a mile square. Even six seed trees per acre would not be enough to seed an area in adequate numbers, since some of them are weakened by fire and will eventually die and others will be wind-thrown. Making allowance for the usual death rate, the number of trees left after the first burning is about the minimum to insure adequate seeding, even when the condition of the ground is favourable for germination.

A still more disastrous effect of a second burning, however, lies in the fact that it kills the young forests which are to be the forests of the future. Since the second fire, as shown above, has reduced the number of seed trees below the point of efficiency, no natural means are at hand to start the process of forest reproduction over again. Reproduction from the edge of the green forest may



THIS AREA HAD 2,000 YOUNG TREES PER ACRE UNTIL IT WAS BURNED A SECOND TIME. Now it has only 20 living trees. The green forest, shown dimly in the background, is too far away to re-establish the forest on this area by seeding.



BURNED SEVERAL TIMES

The reproduction which followed the first fire has been killed. No seed trees are left to make another crop. Planting is the only method by which the commercial forest can be re-established on areas like this.

gradually work its way across the areas on which the young trees have been killed, but the time consumed in doing this will be very long, therefore such areas will remain waste land for many years so far as the raising of timber in commercial quantities is concerned.

Moreover, good evidence exists for the belief that the dense stands of Douglas fir which follow the first fire come not from one crop of seeds, but from several crops that have accumulated on the ground, where they await a favourable opportunity for germination, that is, the removal of the over-shading trees and undergrowth. This has been clearly demonstrated by Dr. Hofman, on the Columbia national forest in the state of Washington. A large area was so severely burned in 1902 that practically all the seed trees were killed. In 1913, dense stands of young fir, not over eleven years old, were found two and three miles from any seed trees, and no relationship could be established between the amount of reproduction and the distance from the seed trees, the reproduction often being more dense far from seed trees than near them. This would seem to indicate that seed was not blown to the areas of reproduction by the wind. If, on the other hand, the reproduction started from seed of trees escaping the fire, but dying since, then unburned cones or cone-scales should have been found on the ground beneath the stands. As a matter of fact, diligent search failed to discover any unburned cones or cone-scales, but they were always found in charred condition.

While most of the trees were eleven years old, indicating that they germinated the season following the fire which took place in the fall, some representatives occurred in every year down to five years old in 1913. Since the seed from which the trees sprang was not blown in by the wind, it must have lain in the litter and retained its capacity for germination for one to six years after the fire passed over. From the results of these and similar investigations, Dr. Hofman believes that the seeds of Douglas fir and hemlock can lie on the ground and retain their vitality for at least six years. This gives an opportunity for the accumulation of several seed crops from which the dense stands arise. In this connection it should be pointed out that, if the fire is sufficiently hot to burn the litter clean to the mineral soil, most of the seeds lying in the partially decayed vegetable matter would probably be destroyed and reproduction would fail. This is indicated by the fact that little or no reproduction followed on the area of the investigations where the fire was very severe.

No dense stands of reproduction were found by the writer as far as two or three miles from seed trees, but such stands were found one-half mile to three-fourths mile from them. These stands were just as dense, about 20,000 trees 16 years old to the acre, three-fourths

mile from seed trees as adjacent to them. It seems hardly possible that wind could distribute the seeds so evenly in one season, since practically all of the trees were of the same age. Moreover, several measurements were made to determine the distances to which seeds of fir were normally carried by the wind. The result of one of these may be given as a typical example. The area had been burned twice, eleven years and four years ago, and was uniformly covered with a light stand of bracken fern. A line was run approaching the green forest from a point one-fourth mile (20 chains) away and the seedlings counted on a strip 33 feet wide. Twenty to fifteen chains from seed trees, the seedlings occurred at the rate of 12 per acre; 15 to 10 chains, 50 seedlings per acre; 10 to 5 chains, 500 seedlings to the acre, 5 chains to the edge of the forest, 3,000 seedlings per acre. None of the seedlings were over four years old. If this be taken as typical, really efficient seeding of the ground does not take place at a distance of more than five chains (20 rods) from seed trees. These were medium-sized healthy trees on the margin of a forest well exposed to the light, the area seeded was in the leeward direction of the prevailing winds, the condition of the soil and soil cover furnished favourable conditions for germination, yet with several seed crops the trees could not raise more than 3,000 seedlings per acre at a distance of twenty rods, whereas the stands mentioned above had over six times as many trees at a distance twelve times as far from seed trees.

These facts, and the results of the investigations in the state of Washington, denote the probability of the dense stands of Douglas fir reproduction arising from several seed crops accumulated in the soil. The important point of these investigations is this: *Where the seed trees have been killed by the first or second fire, the dense stands of young trees killed by fire cannot be replaced by natural methods.* As stated above, one-half of the area logged over in the past twenty years is not now supporting adequate reproduction of commercial species because it has been burned at least twice.

**Under-
vegetation**

Alder—The presence of alder, so commonly distributed on the seaward-facing slopes, usually acts as a deterrent and often excludes the reproduction of Douglas fir. Only once was fir found to be reproducing itself in potentially commercial quantities beneath alder, and this at the rate of 1,600 small trees on an acre, although the alder formed a complete crown cover. Fir is frequently associated with alder, however, but it occurs in groups or singly in the more open places. The fir is always conspicuous in this association, for, although it may be the same age, in the older stands it much surpasses the alder in height; also, as the

dark green of the fir foliage contrasts sharply with the lighter green of the alder foliage, it can be seen from long distances.

As stated above, the best reproduction of cedar was found under the protection of alder stands. A few of the sample plots may be described. Beneath alder twelve years old, cedar occurred at the rate of 2,000, fir and hemlock each at the rate of 160 per acre. A strip was run from the bottom to the top of an alder-covered slope, the alder being sixteen years old. At the bottom it formed a complete crown cover, and there were beneath it 3,700 cedar on an acre. About half way up the slope, where there were frequent open patches in the crown cover, cedar occurred at the rate of 1,260 per acre, fir 1,000, and hemlock 240 on an acre. Near the top of the slope the alder formed not more than one-half the crown cover and there were 1,400 fir, 940 cedar and 20 hemlock on an acre. As the alder disappeared the fir became more abundant, until finally it reached 2,200 per acre. In another place beneath a complete crown cover of alder 24 years old, were found 86 cedar, 28 hemlock and 8 fir on an acre. These were sixteen years old. The area also contained 24 fir trees, the same age as the alder, which surpassed it in height by twenty feet. One often found more than twice as many dead as living cedar trees beneath the alder, indicating that the shade was too heavy.

No sample plots were made in the younger stages of hemlock reproduction beneath alder, but their presence was frequently noted. In a stand twenty years old hemlock occurred at the rate of 800, balsam 200, and fir 60 per acre. Beneath another stand of alder 25 years old there were 1,600 hemlock, 1,280 cedar, 40 fir and 10 spruce saplings on the average acre.

On flats not far above tide-water and along streams alder stands, with their under-vegetation, occur in such density and luxuriance of growth as entirely to exclude the reproduction of commercial trees. Often a secondary cover of vine maple and a third layer of bracken fern or salmon berry shut off most of the light which gets through the crown cover of the alder.

Salal—An undergrowth of salal is found almost everywhere in the more open forests; it does not occur as a rule beneath the dense second growth stands, and it does not usually form a complete cover on areas severely burned. It seems to grow most luxuriantly in conditions of medium shade. Light ground fires seem to stimulate its development and heavy fires to retard it. When not much more than a foot high, and when there are spots of bare soil or patches of moss, it makes favourable conditions for the germination of all the commercial trees. For example, a square yard plot containing 150 shoots of salal had

thirteen fir seedlings four years old, while on an adjacent plot under the same conditions, with salal waist high, no fir seedlings could be found, but there were six cedar seedlings. Numerous plots of this kind were made with like results. Cedar, hemlock and fir seedlings, however, were found in the dense larger salal stands where a fallen tree had crushed down the brush. The most luxuriant stands of salal on logged areas were on those not burned and often they were so dense as to make walking through them difficult. There was no adequate reproduction of commercial species on such areas.

Bracken Fern—The bracken fern, although very commonly distributed in nearly all conditions of shade and soil, forms the most extensive thickets on the burned areas, but it reaches its most luxuriant growth in pockets and depressions and upon moist flats, where there may be as many as 30 stalks on a square yard. These cast too much shade for the reproduction of fir, but not for that of cedar and hemlock. As generally distributed on old burns, it is not sufficiently dense to prevent the establishment of fir beneath it. In fact, with its divided leaves making about half-shade conditions, the plant makes favourable conditions for young fir. Where there were as many as 20 stalks to the square yard, fir seedlings four years old were found at the rate of 25,000 on an acre.

RECOMMENDATIONS

From a consideration of the statements on the preceding pages, it is evident that light burning of the slash and the dense undergrowth gives the best reproduction of Douglas fir. The two extremes, namely, too severe burning and no burning at all, should be avoided. This condition of affairs leads to two recommendations, namely, the regulated burning of the slash and of the dense under-vegetation, and a more rigid fire protection on the areas already covered with young growth.

Against the necessity of regulated burning of slash, it may be argued that in spite of the unregulated burning of the past, sufficient reproduction of fir to meet the requirements of the future has resulted. It appears so to the casual observer, especially if he observes only along the routes of travel, but to the investigator who studies conditions throughout the larger burned areas comes the conviction that the greater portion of such areas do not support adequate reproduction. The good reproduction is not uniform, being very patchy in its distribution. Not more than one-half of the cut-over and burned-over areas studied by the writer supports reproduction of the densities indicated in the tables on pages 219 and 221, the amount necessary to establish the commercial forest.



SLASH LEFT ON THE GROUND AFTER LOGGING

The slash not only increases the fire hazard but it makes conditions unfavourable for the reproduction of Douglas fir.



YOUNG FIR TREES ON AN AREA LOGGED AND BURNED ONCE

They are sixteen years old and occur at the rate of 2,000 to the acre.

There is little doubt of the necessity of burning the slash and under-vegetation in order to get an adequate and uniformly distributed reproduction of fir on the logged lands. The ways and means of carrying out such operations, however, present serious difficulty. Under the depressed market conditions which have prevailed in British Columbia for several years past it seems inadvisable, even if it were possible, to add the cost of brush burning to the operating expenses of the limit-holder. Until the present over-production is relieved by enlarged markets, and until the margin of profit for the lumberman is increased, some temporary co-operative arrangement between the limit-holder and the Provincial Forest Branch might be advantageously made, the officers of the branch to conduct the slash burning and the limit-holders to furnish men. Since the object of the burning is as much to remove the luxuriant under-vegetation as to destroy the slash, broadcast burning is the proper method. Practically the only expense in this is the labour necessary to prevent the fire spreading beyond bounds. The numerous hauling lanes made by the steam logging operations almost universally employed on the coast, the spurs of the logging railways, moist flats and creeks furnish many natural fire breaks, conditions which lend themselves to comparatively safe broadcast burning. In addition, because of the heavy stands of timber, the area cut over in any operation in a year is comparatively small. Under proper conditions of dryness one year's logging operation could be burned over in a day or two, and a few men could control it. Therefore, the cost of slash burning would be comparatively small. In British Columbia small areas of Engelmann spruce and lodgepole pine have been burned experimentally at a cost of two and one-half cents per thousand feet. In the mixed coniferous forests of California, the burning of slash after it has been piled, costs three cents per thousand feet. According to Leavitt, broadcast burning has been done for twenty-five cents an acre, but, in most cases, it would probably cost from five to ten cents per thousand feet of lumber cut.

The second recommendation, namely, the better protection of the reproduction of fir already established, is based on the fact that second and subsequent fires have already destroyed about one-half of the fir reproduction originally established. The largest number of fires on such areas have occurred in the past twenty years. It is clearly evident that this cannot be allowed to continue, if a future supply is to be obtained from the present young growth.

While the forest protection service of the Provincial Forest Branch is very well organized and very efficiently administered, it has not, at present, the men or the money to give the young growth the protection which it deserves. In fact, from the standpoint of conservation, it

would prove a better investment, in the long run, if necessary, to withdraw some of the protection from the mature timber and concentrate it upon the young growth. Fire in young growth is much more disastrous than in old growth. The large mature fir trees are so fire-resistant that only a fire of exceptional intensity kills the majority of the trees. Even if commercial timber is destroyed, the forest-productiveness of the land is not destroyed, for, as we have seen, the first burning stimulates rather than retards the reproduction of Douglas fir. On the other hand, an ordinary fire kills the majority of the trees in a young stand. For reasons stated above, when young growth is once killed, it does not re-establish itself in commercial quantities on the same area and the result is idle non-productive land. Therefore, from the standpoint of the future forest-productiveness of the province, it would be better to concentrate the energies of fire protection on the areas of young growth.

The third recommendation is in reference to growth studies upon young fir. These are necessary in order to forecast future yields, and, as yet, very little work of this kind has been done upon trees below the present commercial size. The rate of growth is apparently remarkably rapid in certain situations and as remarkably slow in others. Studies should be made to determine the cause of this. The object could doubtless be best attained by establishing permanent sample plots, and investigating the various factors through a series of years. A related problem is that of the influence of density upon growth. Some of the stands of reproduction are evidently too dense to get the best commercial results in the future. Different degrees of thinning could be made upon permanent sample plots and the proper density for the best growth in this way determined.

The fourth recommendation is in regard to publicity as to the value of young growth and the necessity for its protection. The Forest Branch is to be highly commended for its publicity work in regard to forest protection and for the resultant attitude of the people toward forest fires. It is in striking contrast to the stolid indifference generally exhibited in the matter by the people of eastern Canada. This public demand for protection, however, as a rule is applied only to the mature timber. It should be extended to the young growth. By means of literature and placards similar to those already in use, the Forest Branch should educate public opinion to appreciate the value of the young growth.

PART VI

Forestry on Dominion Lands

BY

J. H. WHITE, M.A., B.Sc.F.

Faculty of Forestry, University of Toronto

INTRODUCTION

THIS report, the result of a study made during the summer of 1913, has been prepared in order to emphasize the need for the adoption of the following fire protective measures:

1. Careful consideration of the question of slash disposal is necessary in connection with all cutting operations on Dominion timber lands, with the enforcement of such regulations as may be found suitable in each case. This refers not only to forest reserves, which are under the jurisdiction of the Forestry Branch, but also to all timber limits, including those inside forest reserves and parks, and operations on lands outside forest reserves and parks, all of which are under the jurisdiction of the Timber and Grazing Branch. There is no provision for this at the present time in connection with operations on licensed timber berths, which are under the jurisdiction of the Timber and Grazing Branch. It is, however, wholly possible to take such action without additional legislation, since the licenses all provide that "the licensee . . . shall dispose of the tops and branches and other *debris* of lumbering operations in such a way as to prevent as far as possible the danger of fire, in accordance with the directions of the proper officers of the Department of the Interior." Further, the licenses are renewed annually, and are made subject to the terms and conditions fixed by the regulations in effect at the time renewal is made. These regulations at the present time require that, "to prevent the spread of prairie or bush fires, the refuse (*i.e.*, the tops and branches unfit either for rails or firewood) shall be piled together in a heap and not left scattered through the bush." Thus, the situation is adequately provided for, with the exception that there is no policy calling for the enforcement of these specific requirements, and no organization of personnel at the present time adequate to

handle this feature of the work. (See appendix I, Regulations 17b, 17c, and 47).

2. Provision should be made for clearing up old slashings which constitute unusually serious fire hazards. This is especially true as to the Dominion parks, where the scenic beauty is, in some cases, greatly endangered by logging slash on old operations. In some cases, where operations have been completed, or limits abandoned, the cost of this work must, presumably, now be borne by the Government.

3. In order to ensure the perpetuation of the forest, through the adequate retention of seed trees, some additional provision is necessary to secure proper enforcement of cutting regulations on timber limits, both inside and outside of the forest reserves. These areas are under the jurisdiction of the Timber and Grazing Branch. (See Regulation 17a, appendix I).

4. For the future, timber should only be disposed of through timber sales, with a fixed, definite time for the removal of the crop, subject to well-considered and well-understood logging regulations, designed to ensure the perpetuation of the forest. This means the discontinuance of the policy of disposing of timber under the license system, which favours speculative holding and discourages effective control of logging methods.

5. Forest fire protective organizations should be placed under civil service regulations, to ensure an efficient personnel. This is especially necessary as to the Dominion Forestry Branch.

6. A revision is necessary as to the forest fire laws of Alberta, Saskatchewan and Manitoba.

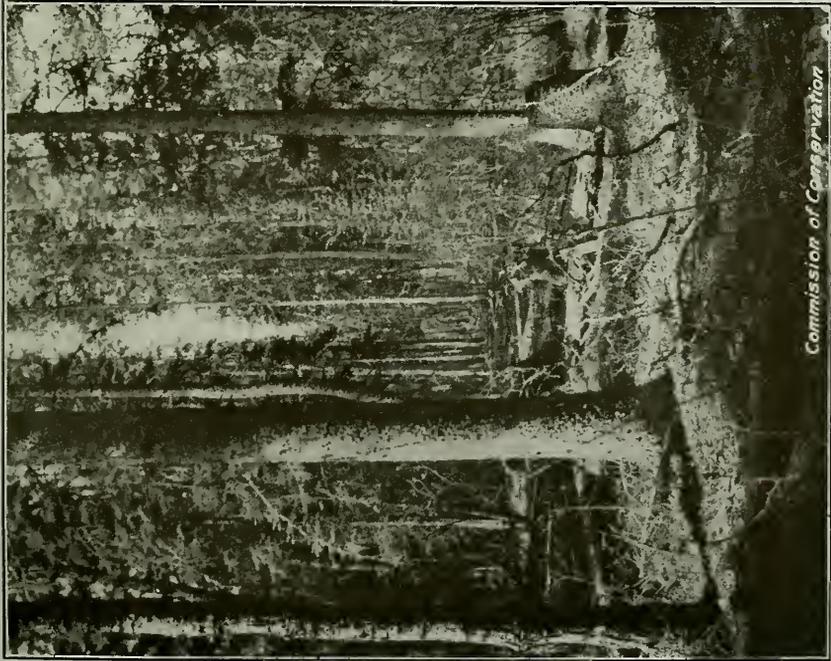
DOMINION FORESTS

Dominion Lands

On the organization of Manitoba, Saskatchewan and Alberta as provinces, the Federal government retained the public lands in each case. Hence, with the exception of sales, grants to settlers under various methods of entry, land subsidies to railway companies and to the Hudson's Bay Company, swamp lands in Manitoba, etc., the Dominion owns and administers all land in the Prairie provinces. The alienated portion is naturally, as yet, confined to the southern prairie region. This amounts to some 120,000,000 acres, out of a combined land area of approximately 466,068,798 acres for the three provinces.

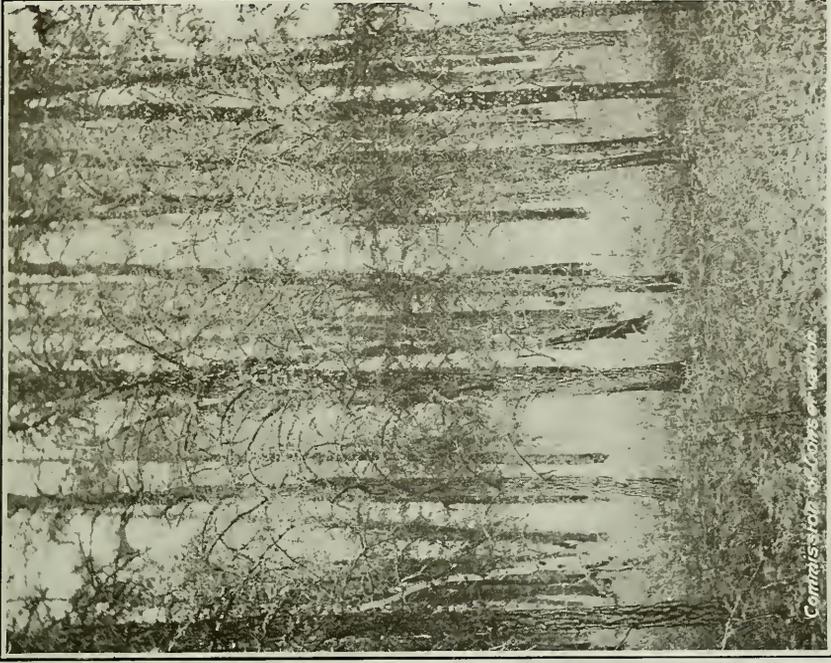
In addition, the province of British Columbia, in consideration of the building of the Canadian Pacific railway, granted the Dominion a belt 40 miles wide along the railway and the Peace River block, 3,500,000 acres. Comparatively little of this is alienated.

The lands still remaining the property of the Crown constitute



Commission of Conservation

MATURE SPRUCE-ASPEN TYPE OF NORTHERN MANITOBA,
SASKATCHEWAN AND ALBERTA



Commission of Conservation

THE SANDY AREAS OF THE NORTH ARE OCCUPIED BY THE
JACKPINE TYPE

what are known as Dominion lands in the west. Of these, 23,034,640 acres are in forest reserves, 4,657,743 acres are held under license, and 621,299 acres under permit to cut timber.*

Forest Regions Lying between the Laurentian region surrounding Hudson bay and the Rocky Mountain system is a large interior plain of relatively recent geological age. The northern portion of this plain drains to the Arctic ocean, while the remainder in a general way slopes eastward from the Rockies, with the drainage largely into Hudson bay. This great plain is of a comparatively level, rolling nature, with the surface becoming more irregular as one proceeds westward. Only in a few places are there elevations of sufficient height above the surrounding country to deserve the name of mountains. Most prominent of these is the escarpment running north-westerly through Manitoba from the Pembina mountains. This gives rise to the Riding, Duck and Porcupine mountains.

The southern portion of this plain forms the well-known agricultural prairies of western Canada, extending from the open grassland of the south, through mixed grassland and woodland, to the forested region of the north. It rises in three fairly distinct levels, each of these in turn gradually increasing in elevation westward, from an elevation of about 750 feet above sea-level in the Red River valley, to some 4,000 feet along the borders of the Rocky mountains. This prairie region forms, roughly, a wedge-shaped block adjoining the international boundary, with a width, north and south, of approximately 110 miles in south-eastern Manitoba, and gradually widening through Saskatchewan to 360 miles in western Alberta. This area embraces practically the settled portion of the three Prairie provinces.

Bordering the prairie is usually a wide belt of woodland of nearly pure aspen, which in turn gives way to the northern or sub-arctic forest. This latter is in general a spruce type (white and black), with aspen, balsam poplar, white birch, and balsam fir, as associates. Tamarack and jack pine also occur, the latter occupying the sandy and rocky areas. Much of the area is muskeg.

On the west the prairies are bounded by a forested region of another type, as distinct from the northern spruce forest. This is the lodgepole pine-spruce forest, occurring on the east slope of the Rocky mountains, and which supplies a part of Alberta's lumber cut.

These two forest areas, the one extending across the northern portion of the three provinces, and the other through western Alberta,

*For the location of forest reserves, licensed timber berths and alienated lands, see maps of Alberta, Saskatchewan, Manitoba, and the Railway Belt of British Columbia, issued by the Railway Lands Branch of the Department of the Interior.

together with the railway belt, which is largely forested, constitute, in brief, the region with which this report is concerned. The two latter forests are described later.

Lumbering Industry Although the Prairie provinces are usually associated in one's mind with but one pursuit, namely, farming, the forested portions give rise to a lumbering industry of importance, and, while inferior in development to that of British Columbia or the eastern provinces, are of great value to the immigrant settlement in the west. In 1913 some 188 mills in Manitoba, Saskatchewan and Alberta sawed approximately 250 million feet of lumber, valued at the point of manufacture at over \$4,260,000. Of this quantity, Saskatchewan forests produced approximately two-thirds, Alberta one-fifth, and Manitoba the balance. The prairie market consumes about 1,434 million feet of lumber annually. Over one-half of this comes from British Columbia (in part from the Railway Belt portion), and the remainder is supplied from north-western Ontario, the United States, and the home forests.

The lumber production of these provinces necessarily comes very largely from timber land held under license from the Dominion government. The following table shows the distribution of the lumber cut on Dominion lands in 1912-13*:

Crown timber agency	Manufactured from licensed berths. Feet, B.M.	Manufactured from permit berths. Feet, B.M.	Number of mills operating under license	Number of portable mills operating
Winnipeg, Man.	63,390,156	5,369,438	27	31
Prince Albert, Sask.	121,786,667	2,628,994	4	16
Edmonton, Alta.	14,871,777	11,998,172	24	46
Calgary, Alta.	23,602,764	4,406,796	19	21
Kamloops, B.C.	82,123,038	7,512,175	7	..
New Westminster, B.C. ...	23,695,365	14,344,060	11	..
Total	329,469,767	46,259,635	92	114

In addition to this 375,729,000 feet of lumber, there were manufactured some 508,000 ties, 50,000,000 lath and 69,000,000 shingles.

That the demand on the Dominion forests is a steady and growing one, and of considerable proportions, is shown by the following two sets of tables:

*These figures, as well as many others in this report, are taken from the *Annual Reports of the Department of the Interior*.

MANUFACTURED FROM LICENSED BERTHS

Year	Feet lumber	No. lath	No. ties	No. shingles
1913	329,469,767	48,372,389	342,138	49,876,315
1912	240,863,681	18,343,253	390,215	49,801,000
1911	203,239,661	18,957,193	200,989	37,948,000

MANUFACTURED UNDER PERMIT.

Year	Feet lumber	No. lath	No. ties	No. shingles
1913	46,259,635	1,916,548	165,908	18,844,750
1912	53,984,974	4,624,014	138,581	558,500
1911	27,347,629	478,741	18,520	630,000

Besides the preceding figures of the lumber industry, the following additional timber material was cut, under the permit system, principally by homestead settlers:

Material	1913	1912	1911
Lumber and logs, ft., b.m.	51,486,216	44,617,680	65,408,595
Roof poles, pcs,	1,346,995	1,638,660	1,446,595
Fence posts, pcs.	1,905,735	2,438,659	2,704,721
Fence rails, pcs.	5,157,420	6,416,326	5,102,625
Cordwood, cords.	169,011	196,530	186,838
Mine props, lineal feet	848,800	264,539	35,000
Shingles, pcs.	8,000	25,065,000	30,852,000
Ties, pcs.	1,485,952	2,019,916	1,015,150
Telephone poles, pcs.	35,031	54,052	23,038
Lath, pcs. ....	.....	1,047,900	.....
Piling.	224,430	.....	.....

In the last 40 years the receipts on account of Dominion lands have amounted to approximately \$40,000,000. Of the various sources of this revenue, that of sales of land naturally has been the largest, but this source must eventually give out. The forests rank third, the timber dues, etc., in that time totaling about \$6,000,000. These exceeded \$463,000 in 1912-13, and have averaged over \$390,000 annually for the last ten years.

The above considerations go to show the importance to the community of the forests on Dominion lands in the west, an importance which demands their conservation, by adequate protection from fire and by regulatory control of logging operations after modern methods.

FOREST CONDITIONS ON DOMINION LANDS IN MANITOBA

The province of Manitoba contains approximately 147,000,000 acres of land. Of this, some 27,000,000 acres in the south have been surveyed, to meet the demands of settlement, and the bulk of this has passed into private ownership. The alienated portion occupies, in a general way, the area north from the international boundary for about 110 miles on the east, gradually widening to about 225 miles at the western boundary of the province. The northward extension of settlement is at present largely taking place in the region lying between lake Manitoba and lake Winnipeg.

The remaining unsurveyed acreage belongs mainly to the Dominion government. The region is imperfectly known, as regards its possible industrial uses, but it is expected that not more than one-sixth of it will prove suitable for agriculture, and to that extent it will in time be alienated from the Crown. The larger portion of the province consequently is unsuitable for farming. Of this an unknown proportion is suitable only for supplying wood products, and will undoubtedly in time be set aside for that purpose. The present discussion, however, is concerned only with the forest reserves and timber berths already in existence.

Timber Berths The timber berths in 1912 covered an area of 1,235 square miles under license and 365 square miles under permit regulations, a total of 1,024,000 acres. These berths are situated, mainly, on the Winnipeg river, around the shores of southern lake Winnipeg, the northern portion of lake Winnipegosis and the series of lakes north of it (Cedar, Moose, Cormorant and Goose lakes), and within the Porcupine Hills reserve and the southern half of the Duck Mountain reserve. Lumbering in Manitoba has been in operation since a very early date, and the cut now is relatively small, being only around 50,000,000 feet annually. The lumber is practically all white spruce (to the extent of 90 per cent), with small quantities of poplar, tamarack, jack pine and white pine. The market is local.

Forest Reserves Some 20 years ago the Department of the Interior decided upon the advisability of setting aside areas of non-agricultural land as sources of future timber supply in the west. Naturally this policy was first carried out in Manitoba, and in 1895 the Riding Mountain, Spruce Woods and Turtle Mountain reserves were set aside. The policy was continued until now the

reserved areas aggregate 4,108.5 square miles (2,629,440 acres). The complete list is as follows:

Riding Mountain reserve.....	1,535	square miles
Duck Mountain No. 1 reserve.....	1,462.25	“ “
Porcupine No. 1 reserve.....	777.5	“ “
Turtle Mountain reserve.....	109.25	“ “
Spruce Woods reserve.....	224.50	“ “
	<hr/>	
	4,108.5	square miles

The more important of these are the first three, situated along the rough, abrupt escarpment in western Manitoba.

Riding Mountain Reserve Next to the Rocky Mountains and Lesser Slave Lake reserves, this is the largest so far created, comprising nearly 1,000,000 acres. It is a rolling plateau-like region, rising in its highest portion about 1,000 feet above the surrounding country, and giving rise to numerous rivers flowing north, east and south. On account of the rough topography and boulder-strewn nature of the soil, the area is unsuited to agricultural use.

The reserve has been logged over and has also suffered severely from fires in the past, so that to-day less than 25 per cent of the area can be described as timbered.* Some two-thirds of the reserve has been overrun by fire once or oftener. As a result the prevailing type is poplar, mostly aspen (white poplar), with balsam poplar (black poplar) where drainage is slower. The poplar stands are of all age-classes, in accordance with the dates of the fires they followed. In many cases, due to repeated fires, the stands are too open to produce anything better than fuel; but in close stand the trees at maturity reach a height of from 70 to 90 feet, with a diameter of 12 to 18 inches, and free from limbs. Many stands are over-mature, since the lumber industry does not as yet utilize poplar to any extent; these older stands occur mostly along the eastern side of the reserve. Both species of poplar are much subject to fungus defect, a large percentage of trees on approaching maturity showing evidence of attack by the false tinder fungus.

Where the fires have been less severe white spruce is found, mixed with the poplar, or else scattered throughout in small pure stands. These latter areas are the only ones suitable for logging, however, and aggregate but a small percentage of the total.

The poplar and poplar-spruce types occupy the richer and better drained soils. The poorly drained muskegs, covering over 15 per cent of the reserve, carry a stunted growth of black spruce and tamarack,

*The figures here used are taken from *Bulletin 6* of the Forestry Branch, which gives a detailed description of the reserve.

fit only for fuel. The few sterile, sandy stretches are occupied by jack pine; most of it has been burned over, so the present stands are young.

In addition to the species already mentioned, there is a minor mixture of white birch along with the aspen and spruce, and of balsam fir in the wetter spruce stands. There is also a sparse occurrence of bur oak, green ash, American elm and Manitoba maple. Small open grassland areas occur, where fires have been most frequent.

The present stand of saw timber on the reserve is estimated at about 200,000,000 feet, board measure. Over one-half of this is poplar (largely aspen), with spruce next in order, and the other species each forming but a small percentage of the total. Logging operations on licensed berths in the past have been confined to spruce, and this is pretty well exhausted. The cut from these berths for the last two years aggregated but 2,500,000 feet. Practically all the commercial spruce remaining on the reserve is under license. So far there has been very little market for poplar lumber. The tamarack, on account of its small size, is of most value as fuelwood.

While the reserve has little value at present as a source of general saw-mill supplies, it is of vast importance locally for building and fencing material, fuel, etc. This is shown by the following statement of material cut from the reserve under settlers' permits:

Material	1912	1911	1910
Lumber, feet, b.m.....	3,794,613	2,268,663	2,871,110
Building logs, lineal feet	15,590	10,466	22,755
Cordwood, cords	4,515	3,704	2,878
Fence posts, pcs.....	17,550	25,030	43,400
Fence rails, pcs	17,320	9,600	} 41,600
Roof poles, pcs	8,000	4,700	

This was roughly 5,000,000 board feet of material in all, average per year, apart from the lumber removed under license. The material was probably three-quarters spruce.

Other Reserves North of the Riding Mountain reserve lie the Duck and Porcupine reserves. These have a forest cover similar to that just described, but have probably suffered less from fire and have a greater proportion of spruce stands. A considerable area in each is still under license.

About 15 miles east of Brandon is a small reserve known as the Spruce Woods. This is a light sand area, with a scattered growth of spruce, except for a small low-lying portion with tamarack. Considerable work has been done on this reserve in reforestation.



CORDWOOD PERMIT OPERATIONS (JACKPINE) IN NORTHERN SASKATCHEWAN
The regulations regarding brush disposal were enforced.



AN ADJOINING OPERATION
In this permit area the regulations were not enforced.

The Turtle Mountain reserve consists of a block of some 70,000 acres, lying south of Boissevain, along the international boundary. Owing to excessive cutting and repeated fires practically no mature timber remains. The whole reserve has been burned over, with a resultant reproduction of poplar and birch, and a scattering of the other Manitoba hardwoods. No conifers occur. At present it affords fuel and hay to local permittees, and stock grazing is permitted on certain portions. The reserve is also used as a summer resort.

**Suggested
Management**

In the utilization of the aspen and the regeneration of the more valuable spruce must lie the future of the Riding Mountain reserve and those to the north of it. As already said, poplar lumber is but little in demand, yet there were 4,700,000 feet of it sawed in 1911 in the provinces of Manitoba, Saskatchewan and Alberta. With the gradual exhaustion of spruce supplies in the middle west, attention will be turned to poplar as a saw timber. But it is not as useful a species. In the log it is a poor floater, the wood is soft, weak and very perishable in exposed situations. The lumber warps and checks badly and cannot be obtained in large sizes. However, owing to its great abundance in the west, poplar will eventually have great value for certain uses, in which its inferior qualities and small size do not matter. It is an excellent fuelwood, is satisfactory as boxboard material, and its toughness makes it suitable for stable and barn lumber. In north-eastern America it is chiefly used for excelsior and paper pulp, in the latter use ranking next to spruce and hemlock.

The aspen makes an excellent nurse tree for the young, more slowly growing spruce. Its light foliage protects the young growth, and the tree must play an important part in improving the quality of these forests in the future. In the interests of the reserves, all encouragement should be given the spruce by restrictions on cutting; at least, settlers should be prohibited from cutting the remaining spruce under permit, since poplar will meet most of their needs. The yearly cost of administration of these reserves would not be increased by the adoption of a policy to gradually alter them from poplar forests to spruce.

FOREST CONDITIONS ON DOMINION LANDS IN SASKATCHEWAN

The province of Saskatchewan not only leads the Prairie provinces in the production of wheat and oats, but also of lumber. Its lumber cut in the north much exceeds that of the other two provinces combined, 23 mills in 1912 reporting a total cut of 157,255,000 feet board measure, worth \$2,535,600 at the mill. This was nearly all spruce.

Some jack pine is cut, and this is usually thrown in with spruce. A little tamarack is also cut, for stable flooring, inside finish, and door frames, but as a rule the trees are too small to be sawn.

**Timber
Berths**

The area under license in 1911-12 was 2,145 square miles, and under permit 310 square miles. The licensed berths lie, roughly, in two regions. One of these is the territory for the first 75 miles of the Canadian Northern railway west from the Manitoba boundary, extending south of the line some 45 miles and north to the Saskatchewan river. The remaining berths lie largely in a belt of country 50 miles wide, stretching northwest from Prince Albert 100 miles. Very few berths under license are within the forest reserves, these containing little merchantable timber. The timber is of the northern spruce type already described.

**Forest
Reserves**

In the province of Saskatchewan eight reserves, totaling 1,800 square miles, have been created. Of these, Duck Mountain No. 2 and Porcupine No. 2 are the portions of the rough, hilly region of western Manitoba lying outside that province; these have been already described. Moose Mountain and Beaver Hills are two small reserves with much slough land, in the south-eastern portion of the province. Both have the usual history, —stripped of timber and overrun by fire, and now carrying a reproduction of poplar, mostly immature. Their value is local, for fuel, fencing material, and such like. Planting will be necessary for conversion to conifers.

Of the remaining reserves, three large ones are situated around Prince Albert. These are the Nisbet, bordering the North Saskatchewan river; the Pines, southwest from the city, between the North and South Saskatchewan rivers; and Fort à La Corne, extending eastward from the junction of the same two branches.

These three reserves are very similar in character of soil and tree growth, and of a type very different from the Manitoba reserves. They are in general sandy tracts, with much swamp and muskeg interspersed. This sand has a very thin layer of humus, only locally exceeding an inch in depth, which would be readily exhausted by two or three crops, and so is unsuitable for farming except under continued fertilizing. Wherever the sod is broken the tendency to become blow sand is very evident.

The characteristic tree is jack pine, here near its centre of optimum development, and reaching good tie size at maturity. It occurs mostly in pure even-aged stands, and many mature blocks of limited area occur, especially on the Fort à La Corne and Nisbet reserves. The

majority of the stands, however, are immature. Fires have swept over a large proportion of the dry sandy sites and have done much damage. However, as the species reproduces well on burns, the forest condition is satisfactory, except where repeatedly fire-swept. Under such circumstances park-like stands result, with limby, damaged trees, useful only for fuel; in extreme cases open grassland is formed.

The older trees are very widely attacked by a parasitic dwarf mistletoe (*Arceuthobium americanum*), whose presence is indicated by the formation of abnormal bushy masses of branches known as "witches' brooms." These interfere very seriously with wood production, and may in time kill the tree. To prevent the spread of the disease it is necessary to eradicate the affected trees. To this end it is highly desirable that the removal of such trees under settlers' permits be favoured by reduced dues. The younger trees suffered unusual destruction by rabbits during the winter of 1912-13.

The better soil areas are, of course, occupied by aspen, with white spruce and balsam poplar in the moister places. The occurrence of these, however, is secondary. The drier swampy areas carry black spruce and tamarack, mostly of small size; this is reduced to a border growth in the case of the wetter ones.

These reserves have been largely cut over for tie timber, and for the present they will be of value mostly as a source of local fuel supply, especially in the case of those near Prince Albert. If fires are kept out, the future of the forest growth is assured, on account of the persistence of the jack pine. The Pines and the Nisbet, well supplied with trails and surrounded by settlements, whose poplar groves are being rapidly cleared up, present scope for improvement cuttings; while the burns which are not restocking offer very favourable opportunity for successful planting.

FOREST CONDITIONS ON DOMINION LANDS IN ALBERTA

The spruce forest of Manitoba and Saskatchewan continues across the northern end of the prairie region of Alberta, finally mingling with the Rocky Mountain forest of the western portion of the province. In both these forest regions timber berths and forest reserves are in existence.

Timber Berths

Licensed lands in 1912 totaled 2,174 square miles, and lands held under permit, 40 square miles. Probably one-third of the licensed area lies within the Rocky Mountains reserve described below. The other berths are scattered along the North Saskatchewan and its tributaries below Rocky Mountain House, along Athabaska waters, and on Peace River tributaries

southwest of Lesser Slave lake. These are similar in composition to those in northern Saskatchewan, except for the more westerly situated ones, which have more or less of an inclusion of Rocky Mountain species. The lumber cut, largely from Dominion lands, approached 50,000,000 feet in 1912, with 90 per cent of it spruce. Small quantities of pine, poplar, Douglas fir and tamarack comprised the balance.

Rocky Mountains Forest Reserve The forest reserves of Alberta cover 26,112 square miles, or nearly three-quarters of the total area set aside as Dominion reserves. The largest and most important of all is the Rocky Mountains reserve. This immense reserve, of over 13,000,000 acres, recently created, is situated along the east slope of the Rocky mountains, extending in a north-westerly line from the International boundary some 450 miles. It includes the land which, owing to the character of the topography and soil and to its elevation, is unsuitable for any form of agriculture beyond local interior grazing areas. In a general way the eastern boundary follows a line in the foothills at about 4,000 feet elevation, the line being raised or lowered according to regional conditions. South of the Crowsnest branch of the Canadian Pacific railway the width of the reserve is only some 10 or 15 miles. Northward it widens more or less, gradually reaching a maximum breadth of about 85 miles south of Jasper park, and again narrowing down as the Peace River drainage is reached.

Within the reserve certain areas have been proclaimed park and game preserves, notably Rocky Mountains park, comprising a tract of 1,740 square miles, north and south of the Canadian Pacific Railway line, and Jasper park, 1,200 square miles*, along the Grand Trunk Pacific railway.

The remainder of the reserve, for forest administrative purposes, is divided into five units, known as the Crowsnest, Bow River, Clearwater, Brazeau and Athabasca forests. The first two of these include the mountain sources of the South Saskatchewan river; the Clearwater and a portion of the Brazeau, those of the North Saskatchewan; while the remaining forests include headwaters of the Athabaska and Peace rivers. Thus the reserved slope is the source of the great Saskatchewan system of the prairies, draining to Hudson bay, as well as of a portion of the Mackenzie system which drains into the Arctic.

The Saskatchewan drainage system, in its entirety totaling some 154,500 square miles, embraces the major portion of the settled area.

*Enlarged in June, 1914, to 4,400 square miles.

of the Prairie provinces. The importance of preserving the forest cover at the source of supply, to ensure an even flow during the year throughout this vast region, can scarcely be overestimated. The two westerly provinces are not endowed with a liberal water supply, and the denudation of the east slope of the Rockies, with consequent rapid run-off, would undoubtedly necessitate the construction of huge storage reservoirs.

In addition, the east slope is largely underlain with coal deposits, estimated by the Geological Survey at over 22,000 million tons. In the development of these areas the forest will play a very important part, to say nothing of the future supply of lumber products in general.

The reserve in the past has been extensively and severely burned at different periods*. The survey party engaged in determining the eastern boundary, from the Elbow river south, during 1910, estimated that at least 60 per cent of their territory had been fire-swept within the past 60 years. The party working north arrived at a figure of 75 per cent burned between the Elbow and North Saskatchewan rivers. A study in 1908 of the Crowsnest River valley, between the Livingstone range and the continental divide, showed but 16 per cent of the 212 square miles involved as unburned; and of the burned area nearly one-half was not restocking. South of the Crowsnest river little timber has escaped fire, outside of the valley bottoms.

North of the Crowsnest, to the Bow river, the reserve suffered very severely in 1910; this was prior to its organization. In the Porcupine hills an area of some 50 square miles was devastated. The valley of the north fork of the Oldman river (Livingstone) was all burned, with the exception of the headwaters of the west branch. The valley of the Highwood river was burned to the extent of some 150 square miles, and some 50,000,000 feet of fine spruce timber killed. The Elbow River valley was cleaned out entirely, as well as the adjacent prairie country. The Kananaskis valley was largely burned, and at the headwaters of the Little Red Deer river a tract of about 110 square miles was overrun. It is estimated that the fires of 1910 ran over at least half a million acres of the reserve south of the Red Deer river, and destroyed some 200,000,000 feet of merchantable timber.

Although north of the Red Deer comparatively little was burned in 1910, except east of the reserve, very extensive fires, mostly dating 25 to 50 years back, have occurred throughout the region. From the James river to the Clearwater river all has been burned over in the vicinity of the eastern boundary. The Saskatchewan valley has been

*The following fire data are taken from various Forestry Branch bulletins and reports, together with information supplied by the district inspector for Alberta.

burned as far west as Mire creek. The Clearwater forest appears to have suffered less than the others, due no doubt to its remoteness from civilization. The Brazeau and Athabaska forests have also experienced large fires, but to what extent is imperfectly known.

Three-fourths of the forest area of the reserve, it is estimated, has been burned over at various times, mostly within the last 60 years, so that the majority of the stands are "second growth," below timber size. These are almost always lodgepole pine, and as this species forms more than one-half of the mature stands as well, it may be said to characterize the east slope.

(1) *Mature Stands.*—The mature stands of timber occur largely as isolated areas which have escaped fire. Along the margin of the foothill country and occasionally in the interior, stands of Douglas fir occur, but these have been so reduced by fires from the adjoining prairie as to be relatively unimportant. The majority of the mature stands consist almost altogether of three species—lodgepole pine, Engelmann spruce, and white spruce—all of commercial importance. They occur either as pure or mixed stands. North of the Bow river the mature timber is very largely pine.

The mature pure spruce stands occupy the valley bottoms and lower slopes, while the pure pine stands are largely restricted to the upper and steeper slopes. The intermediate slopes are covered with mixtures of pine and spruce in varying proportions. This altitudinal distribution is related to the depth of soil and drainage, the spruce requiring a moist, well-drained soil, whereas the pine can thrive on a drier situation. Tree growth ceases at about 7,000 feet, due to lack of soil and other physical conditions obtaining, rather than to the climatic conditions.

On the upper slopes the soil is too poor for the production of large trees, and the merchantable timber is confined to the lower slopes and the deeper soils of the intermediate slopes. The accessible stands are virtually all under license at present. Originally the best spruce probably occurred in the Highwood and Crownsnest River valleys, where a maximum size of three feet in diameter and over 100 feet in height was attained. The present stands consist of trees mostly 10 to 18 inches in diameter. Pine, on the best sites among spruce, reaches a diameter of two feet, but in pure stand it only averages 8 to 14 inches. Logging has so far been carried on mostly for spruce, on account of its larger size, the average log from government returns showing a content of 50 board feet. Both species of spruce produce lumber of identical qualities. The pine, though shorter than the spruce, possesses a less tapering stem, with a greater clear length, and, since it also produces a clearer lumber, with a more pleasing grain, it will in time

receive due attention. The timber in the northern portion of the reserve is of slower growth, and in general reaches a smaller development at maturity.

(2) *Immature Stands*.—The immature stands, originating after fires, as already stated, constitute three-quarters of the forest growth on the east slope. These stands are practically always lodgepole pine. Only under exceptional circumstances has a reproduction of spruce followed the fire; on the prairie border poplar usually results.

This predominance of lodgepole pine over spruce in the reproduction following a fire is due largely to the difference in fruiting character of the two species. The cones of lodgepole pine remain on the tree for many years, opening slowly to discharge the seeds, while those of spruce open at maturity and shed the seeds within a short time. In addition, lodgepole pine seeds retain their germinating power for a longer period. A ground fire, therefore, which destroys the spruce seed, merely serves to release the accumulated seed supply present on the pine trees, since the heat opens the cones. Also, spruce trees are more readily killed by fire than lodgepole pine, and so their chances of escape to function as seed trees are less. In general, spruce reproduction follows only in the case of very light burning, and where neighbouring seed trees are left; the light burning does not destroy the litter and humus and lay bare the mineral soil, and pine does not germinate as well as spruce with such seed bed conditions.

The second growth stands of lodgepole pine are characterized by their great density, and by their evenness of age, each dating from a particular fire. Owing to the severity of the fires, a bare seed bed is prepared on which the stored-up crop of seeds rapidly falls. The result is a direct stocking up with altogether too dense a growth of seedlings. The young trees hinder the development of one another, so that a longer time is needed to reach merchantable size.

**Lesser
Slave Lake
Reserve*** This is a newly-created reserve, of some 5,000 square miles, situated mostly south of Lesser Slave lake. In general, it presents a rough broken topography, with large, poorly-drained areas aggregating over one-quarter of the whole.

The reserve embraces a variety of forest types, of which the lodgepole pine type is the most important from the standpoint of area. Although it covers over a million acres of the valley slopes of the Swan hills, the bulk of the forest is of a dense spindly growth, which will never reach more than pulpwood size.

Almost as large an area is represented in the poplar type, mostly as a result of fires. In this type aspen predominates, with a mixture

*The following description is based on *Bulletin 29*, Forestry Branch.

of balsam poplar, along with a scattering of the other northern species. Both poplars are very defective, materially reducing the yield of pulpwood.

The remaining forest types cover relatively small areas. Jack pine, as usual, appears on the sand ridges, the majority of the stands being immature. The merchantable white spruce occurs in localized patches, as the remnants of larger fire-swept areas. The undrained locations carry the usual stunted black spruce and tamarack.

While the present stand of mature timber on the reserve is small, being estimated at some 350,000,000 feet of saw timber, 4,000,000 ties, and 33,000,000 cords of pulpwood, the potential crop is important as a source of supply for the future neighbouring settlement, which will undoubtedly develop. In addition, the forest growth is essential for the proper regulation of waterflow in the main drainage streams; these are navigable streams, upon which this region is dependent for intercommunication. At present no management is feasible beyond protection from fire.

Other Reserves The Cooking Lake reserve is a small area of very broken land, with much muskeg, situated about 40 miles east of Edmonton. It has suffered extremely from fire, so that practically all the original conifers are gone. The usual poplar reproduction prevails, but considerable areas will need to be replanted. The northern portion is set aside as Elk park.

The Cypress Hills, another small reserve, lies in south-eastern Alberta, extending into Saskatchewan. The eastern portion is forested, but the western portion has been reduced to grassland by fires. It is the most important elevation in a region where irrigation farming is practised, and hence is very important in the conservation of water supply. As the only source of local wood supply, it has likewise great value.

FOREST CONDITIONS ON DOMINION LANDS IN BRITISH COLUMBIA

Dominion lands in British Columbia comprise a strip of land 20 miles wide on either side of the main line of the Canadian Pacific railway (known as the railway belt), the Peace River block of 3,500,000 acres, and some 50,000 acres of coal lands in the Crowsnest region. These were provincial grants to the Federal government, associated with early railway construction.

The Railway Belt The railway belt, in its stretch of over 500 miles, may be said in a broad way to traverse an interior mountainous plateau, lying between the Rocky mountains on the east and the Coast range on the west. The region is one character-



TYPICAL SLASH AFTER A LUMBERING OPERATION

In Rocky Mountains National Park, within a few miles of Banff. Fire started in this would quickly be beyond human control.



AREA LUMBERED 12 YEARS AGO

Owing to the dry climate it will be another decade or more before the slash will have decayed and the fire hazard be thus removed. Spruce-pine type. Rocky Mountains Reserve.

ized by a very rugged and diversified topography, being, in fact, a vast complex group of ridges and mountains. Probably less than ten per cent of the railway belt is adapted to agricultural use of any kind.

Owing to its unsuitableness for agriculture, but a comparatively small portion of the railway belt has been alienated by the Dominion government. There were some alienations by the Province prior to the transfer. Outside of straggling areas along the railway line, and in many of the river valleys, the lands disposed of fall roughly into two regional blocks, aggregating some 150 miles in an east and west direction. One of these comprises the country between Sicamous and Kamloops, largely south of the line of railway; while the other is found from Agassiz westward. In the central dry region some 400,000 acres are under grazing lease.

The country is essentially a forested one, with the tree flora exhibiting many species largely absent east of the continental divide. Characteristic among these may be mentioned the Douglas fir, and the western species of cedar, hemlock, white pine, yellow pine, tamarack (local), together with some others restricted to the vicinity of the coast.

Climatically, the railway belt may be roughly divided into three regions, on the basis of precipitation. The coast region is characterized by a humid atmosphere and heavy rainfall, and again in the Gold and Selkirk ranges an abundant fall of rain and snow occurs. Between these lies a sub-arid region, locally known as the "dry belt."

The types of forest growth present are related very largely to this difference in annual precipitation, those tree species requiring at least a fair amount of moisture being absent from the intervening dry region. Within each broad regional type much variation is, of course, encountered, in keeping with the effect of the varied topography on moisture conditions.

Regional Types.—The lodgepole pine-spruce type of the east slope continues on the seaward side of the divide, with both species here reaching a greater development. Westward, gradually an inclusion of Douglas fir, hemlock, cedar and western white pine appears, but these are of minor importance till the summit of the Selkirks is reached.

From the Selkirk divide to somewhat west of Adams and Shuswap lakes the so-called "wet belt" extends, with a precipitation of 56 inches at Glacier in the Selkirks, and 35 inches at Griffin lake in the Gold range, as compared with 25 inches at Donald. Here, for the first time, typically, western white pine appears commonly, and cedar, hemlock and Douglas fir attain commercial importance. These are all species whose development is favoured by a plentiful supply of

moisture. Lodgepole pine and spruce, especially the latter, are still abundant. Usually the valley bottoms and lower slopes carry spruce, cedar, hemlock, western white pine and Douglas fir, with the first three predominating. The higher slopes are generally clothed with white pine, Douglas fir, lodgepole pine and spruce, with lodgepole pine probably the commonest. The timber line consists of spruce, alpine fir, whitebark pine and alpine larch. The occurrence of spruce throughout is noticeable.

Westward, from about Shuswap lake, an arid belt, with a precipitation of only 10 inches at Kamloops, is encountered for some 175 miles, to the vicinity of North Bend. The tree species are much reduced in number, the characteristic tree being the western yellow pine or bull pine. It occupies the lower elevations, and in many localities forms very open non-commercial stands. Altitudinally it is succeeded by Douglas fir, a species adapted to a variety of soils and climate, but here of proportionately poorer development. A belt of lodgepole pine is usually to be found above the fir, or occasionally spruce.

The forest of the remaining portion of the railway belt is of the well-known lower coast type, Douglas fir, hemlock and cedar being the main species. With abundant moisture, both soil and atmospheric, all three reach their maximum size, resulting in very heavy stands of timber. In addition, some new species enter the flora, notably tideland spruce, lowland fir and lovely fir, likewise important timber trees.

Timber Berths.—Outside the arid section, the railway belt shows a large number of timber berths under license, these comprising about 1,800 square miles. They are located largely on the Columbia river and its tributaries, in the Shuswap Lake region, and from the vicinity of Harrison lake westward to the coast. A map showing the timber berths practically depicts the accessible stands of mature timber. Despite the large area, less than 75,000,000 feet of lumber was manufactured in 1911-12 from these licensed berths. This was increased probably by about one-third last season, owing to the necessity of utilizing burned timber. The licensees operate mainly in provincial timber. The reason would appear to be the low ground rent charged by the Federal government, as contrasted with that of the province, this favouring the holding of timber for speculative purposes.

Forest Reserves.—Reservation of forest land began in 1888, with the setting aside of Glacier park, followed by Yoho park in 1901, and the Long Lake reserve in 1902. In 1906, six more reserves were created, and during the present year (1913) four others, with additions to some of those already formed. At present the thirteen forest reserves comprise a total of 3,782 square miles.

With the exception of the two parks in the eastern portion of the railway belt, the forest reserves are located in the interior dry region. This has received first attention from the forestry officials, owing to the relatively great importance of water supplies. The reserves form two east and west belts, north and south of the railway line respectively, exclusive of the valley bottom lands. Agriculture in the district requires irrigation for success, the supply coming from the small mountain streams. In the conservation of this supply by the forest cover on the watersheds of these streams lies the main value of the reserves at present. The timber, in comparison with that outside the "dry belt," is now unimportant, and practically no logging operations are being carried on within the reserves. Improvement, with a view to increasing the efficiency of protection from fire, must constitute the main managerial care for some time.

Squatting.—Owing to the scarcity of agricultural land, and the general reservation, for some years, from homestead entry of Dominion lands except within the sub-arid region (pending contemplated changes of land policy), the squatting evil exists throughout the railway belt in a somewhat marked degree. This has an important bearing in connection with forest conservation. It is the old-time story of the clash between the interests of the lumberman and those of the settler. The lumberman is charged with holding, for speculative purposes, timber on agricultural soil, or holding under license logged-over lands which should be opened for settlement. On the other hand, the settler is charged with squatting on land chiefly valuable for its timber, and endangering timber limits by his careless use of fire in clearing land. Apart from the aspect of the defiance of law, the most undesirable feature of squatting in a forested region like the railway belt, lies in the increased difficulty of protecting timber from fire. Settlers as a whole do not give a forest protection policy their strongest support while they feel that the presence of timber on agricultural lands prevents its opening for settlement.

The condition of affairs may be remedied by increasing the land available for entry. This could be done by requiring operation on such licensed areas as are agricultural soil and adjacent to settlement. This would require to be done after due notice, in order not to disarrange business interests. Logged-over limit areas should be examined systematically, as operations are finished, for classification as to agricultural or forest lands, and in the former case opened for homesteading as the demand necessitates. With sufficient agricultural land made available for settlement, the government could enforce the regulations forbidding squatting on timber berths, and reduce the fire risk accordingly.

FOREST PROTECTION ON DOMINION LANDS

The extremely important duty of protecting the forests on all Dominion lands from fire, with the exception of Dominion parks, lies with the Forestry Branch of the Department of the Interior. Two separate organizations, enforcing different regulations, are in charge of the work, one guarding the forest reserves and the other all Dominion forest land outside the reserves. In both organizations the method in use is that of a patrol system.

Within Forest Reserves. The protection of the reserves depends upon the forest rangers, who perform this work in conjunction with their other duties. To each forest is allotted a certain number of rangers, each of whom is in charge of a specified territory, and responsible for the same to the superior officer administering the business of the forest. The size of the district varies according to the fire risk and accessibility to movements of the general public. The duties of the rangers consist in a patrol of the district, to enforce the regulations made under the Dominion Forest Reserves and Parks Act, and to put out fires. In wet weather they are engaged on permanent improvement work, such as building roads, trails, telephone lines, and ranger cabins. The wages are \$75 to \$100 per month. Licensed and unlicensed portions of a reserve receive the same attention.

The forest reserve regulations relating to fire protection are very complete. On the reserves, a closed season for fires exists from April 15 to October 31, and this period may be extended, if deemed advisable, in the case of a summer of special danger. During this season no fires, except camp fires, may be set, unless a permit be obtained from a forest officer. Also, the regulations and penalties of the province in which the reserve is located are applicable to the reserve. Full precautions are taken with reference to railway lines being operated within reserves. Most of the railway companies whose lines pass through reserves are already under the authority of the Board of Railway Commissioners for Canada, which requires special patrol by the companies where material fire danger exists. Those not under its jurisdiction are subject to a similar reserve regulation requiring patrol as specified by the department.

These provisions are ample, consequently the efficiency of protection is a matter of personnel. This will be discussed later.

Outside Reserves An enormous area of Dominion lands exists in Manitoba, Saskatchewan, and Alberta the northern portion of these three provinces which is not included within any reserve. It is not all timbered, to be sure, much muskeg occurring, but the forested areas are numerous and valuable, including many licensed timber

berths. It is a frontier country, bordered by the advance line of settlement, busy clearing land by fire, with railway and highway construction in progress, and constantly travelled by prospectors, freighters, trappers, surveyors and campers. The task of protecting it from fire is correspondingly difficult.

The whole territory, under the administration of a Dominion inspector of fire ranging, is divided into nine districts. These are organized, as regards location and intensity of patrol, according to the nature of the country and the fire risk, as indicated by man's activities. Each district has a staff of fire rangers, in charge of a chief ranger, who has no other duties. The rangers are engaged in patrol work exclusively from May till November, temporary men being taken on during the more dangerous periods. About 115 men, exclusive of chiefs, were employed in 1913.

During the past season, in Manitoba, the south-eastern portion of the province with the north half of the peninsula between lakes Manitoba and Winnipeg, formed one district, the water routes, from the foot of lake Winnipeg to Hudson bay, another district, and the country around The Pas, including Hudson Bay railway right-of-way patrol, a third. Approximately 35 rangers were employed in these three districts. In Saskatchewan, the region protected was in a general way that along the Canadian Northern railway, extending on the north side to Saskatchewan river, Montreal lake and Beaver river. This was subdivided into three districts, with Hudson Bay Junction, Prince Albert, and Battleford as centres. The ranger staff about equalled that in Manitoba. In Alberta, attention was centred on the large territory from Red Deer and Rocky Mountain House north into the Peace River country, and the northward route of travel down the Athabaska river from Athabaska Landing. A patrol boat was used for the portion between Athabaska Landing and Grand Rapids. A total of some 45 rangers was required in Alberta.

In these sparsely settled districts little can be done in the way of fighting fire, as aid is not available. The prevention of fires is all the more important, and the rangers are thus called upon to do much patient work in educating the people as to fire damage and the law. The fire act at their disposal is that of the province in which their district lies. Manitoba has one act, Saskatchewan and Alberta another, and the Dominion government simply enforces the provincial fire laws.

Unfortunately, these fire laws are inadequate, as legislation, to prevent forest fires. Both are old legislative measures, that of Saskatchewan and Alberta dating back 15 years, and that of Manitoba 18 years. At those dates settlement was restricted to the south, away from the forested parts, and the fire legislation was designed primarily

for the prevention of prairie fires, which frequently swept over the country, destroying the homesteaders' buildings and crops. Since that time the occupation of land has been pushed forward to the border of the northern forest, through which travel has increased greatly and the fire danger likewise. It is but natural that the old provisions, made for open prairie conditions, should not be the most effective for preventing forest fires. This prevention, with a mere handful of men, is difficult enough, even when backed by favourable laws. All modern legislation recognizes the principle of the closed season, during which a permit to set fires is necessary; further, since securing a conviction is so difficult, the present tendency is to put the onus of proof on the defendant that he has complied with the law. As to these points, the fire laws of the prairie provinces are deficient. Forest fire legislation in Canada has made rapid strides in the last decade, and the Prairie provinces cannot afford to lag behind. New forest fire acts, framed to meet the sources of danger, and having relevance to the northern portion, are urgently needed.

Another important branch of the forest protection system, and separate from the patrol organization just discussed, lies in the inspection of the protective work done by the railway companies under regulations issued by the Board of Railway Commissioners by virtue of the authority of the Railway Act of Canada.

In brief, these regulations relate to the use of fire protective appliances on locomotives, the regulation of fuel, the construction of fire guards, the clearing of rights-of-way, and the establishment of a special patrol of the railway line from April 1 to November 1, as specified by the chief fire inspector of the Board. The burden of proof is placed upon railway companies to extinguish fires starting within 300 feet of the track, unless the company can show that the fire was not caused by the railway, and all regular employees are required to report the discovery of all fires on or near the right-of-way, and to take steps to extinguish them. The principle throughout is that the railway companies themselves must undertake the work of protecting the public against damage by railway fires. The legislation is easily the most efficient in America, and affects all railways in operation or under construction which are under the jurisdiction of the Board of Railway Commissioners.

The inspection looking to the enforcement of the regulations is in charge of the fire inspection department of the Board. This department is assisted by the appointment of certain outside forestry officials as officers of the Board, without additional pay, to supervise the detailed field inspection. This work in Manitoba, Saskatchewan, and Alberta, outside the forest reserves and parks, is in charge of the Dominion inspector of fire ranging, assisted by district inspectors.

The railway companies as a whole are co-operating in good spirit, with the result that fire losses from this source have materially decreased during the past two seasons.

Some few lines, however, in these three provinces, are not under the jurisdiction of the Board, and on that account the enactment of provincial legislation along similar lines is highly desirable, such as has been done in British Columbia and Quebec.

The Dominion lands (outside the reserves) in the **Railway Belt of British Columbia** railway belt are organized, for fire protection purposes, into the Revelstoke, Salmon Arm, and Coast districts. These are in charge of three chief fire rangers, one responsible to the Crown timber agent at New Westminster, the others to the district inspector of forest reserves at Kamloops. Working under the chiefs are some 50 fire rangers, engaged for the summer months, at \$5 per day. The work consists in the enforcement of the provisions of the British Columbia Forest Act relating to fire prevention. Since these provisions are most modern, the fire ranging service is carried on under very favourable conditions. In addition, the province had a staff of ten rangers on duty in the railway belt.

The inspection in connection with the order of the Railway Board, already mentioned, is, in the railway belt, outside of Dominion parks, in charge of the district inspector of forest reserves, assisted by divisional inspectors. For the lines within the Dominion parks the inspection is in charge of the chief superintendent of Dominion parks, assisted by the superintendents of the different parks, as divisional inspectors.

To protect city property from fire there is not **Provisions for Slash Disposal** only provision to extinguish promptly such fires as may be started, but the material conditions obtaining are required to be such as will reduce the chances of a fire assuming uncontrollable proportions. The same two measures are necessary to protect forest property. The presence of a fire-fighting force, and the construction of trails, lookout stations and telephone lines, are merely measures to facilitate the rapid control of fires which start. The supplemental feature lies in the condition of the forest floor as regards inflammability. The smaller the quantity of dry material on the ground, the better is the chance of control; in addition, the fire is not so hot, and less damage is done to the trees and soil.

In all forests there is normally a certain amount of *débris* originating by the natural death of the trees and parts of trees. This is augmented by local windfalls. But the most dangerous component is

the slash resulting from logging operations. A forest when lumbered over is a forest littered with very combustible material; it remains in this condition, year after year, a veritable fire-trap, until the *débris* decays; this is a matter of at least a decade, and frequently two decades or more, except in warm, moist climates. In the past, so universally has fire followed a lumbering operation within a few years that it is generally looked upon as inevitable. In studying the reproduction on logged-over areas this summer (1913), the writer experienced difficulty in finding old cuttings which had not been burned. Since the next tree crop on the lumbered tract is dependent on the seedlings already started, and the trees left uncut, the outlook for this crop is a very uncertain one under present conditions.

There are various methods in use for disposing of lumbering slash, varying in cost and effectiveness. The one aim is, at the least expense, to get rid of the brush as often as needful, not allowing it to accumulate, and, of course, the sooner it is done after logging the better. No uniform system can be followed. The method used must take into consideration particularly the injury to the remaining trees, and whether the conditions following the manner of disposal are favourable to the seedling crop desired. Methods involving more complete disposal should be adopted in the more dangerous situations, and these are the more costly. In each case, the method decided on should be the one which will eliminate the fire danger, or at least shorten its duration, with the smallest expense, and, at the same time not be detrimental to the next crop, since it is largely in the interests of this that the operation is being conducted.

The best results have been obtained by either burning the slash or lopping the tops. The burning may be done in piles or broadcast. When piled it may be burned as the logging proceeds, if in the winter; in the case of summer operations, the burning must be postponed till weather conditions allow. Burning broadcast is cheaper where the slash is heavy, but is harder to control, and is applicable only in clear cutting operations and where the growth conditions left behind are favourable to the tree species wanted.

Lopping the tops has in view the bringing of the material in contact with the soil to hasten decay, and thus shorten the danger period. In this respect, scattering the branches afterwards is an advantage. The pieces must be cut smaller than if burning is practised, and the whole operation is of little use unless done carefully, to get the material actually on the ground. The lopping method is cheaper, of course, than piling and burning, and in a given case the choice resolves itself into a question whether the fire risk is worth the increased outlay. Under certain conditions lopping and scattering is even the better

method, owing to the shelter given to the young seedlings. As far as Dominion forests are concerned, with the exception of certain portions of the railway belt, lopping would be of very doubtful value, since decay takes places very slowly, owing to the dry climate. A financial compromise is often made by broadcast burning of fire lines around the sides most likely to be reached by fire, and lopping in the interior.

The cost of brush disposal varies widely with difference in forest type and locality, as does every other part of a lumbering operation. It can be seen that the outlay depends upon the species lumbered, the method of disposal, the climatic and topographic conditions, the style of lumbering, the quality of labour, and the skill and experience in the work. It is therefore impossible to give average figures of cost, but the following actual figures (mostly secured through the courtesy of the United States forest service) will give some indication of the expense to be expected. They include the range, as also the *highest* cost data to hand.

ACTUAL COSTS OF BRUSH DISPOSAL *

Locality	Forest type	Operation	Cost per M feet. Cents	Remarks
Bitterroot Forest, Montana....	Western yellow pine	Piling.....	42	37 million feet
		Burning later	7	
Bitterroot Forest, Montana....	Western yellow pine	Piling.....	40	52 million feet
		Burning later	6	off 3,300 acres
Blackfeet Forest, Montana....	Larch-Douglas fir..	Piling.....	42	
Cœur d'Alene Forest, Idaho ..	Western white pine.	Piling and burning....	40	Windrows
Minnesota	White and red pine.	Piling.....	25	Contract price
		Burning.....	6	
Idaho,Utah andNevada district	Lodgepole pine, Douglas fir, yellow pine, Engelmann spruce	Lopping and scattering ..	5-10	Range in different cases
Idaho,Utah andNevada district	do. do.	Piling.....	15-25	
Idaho,Utah andNevada district	do. do.	Burning later	20-50	
Idaho,Utah andNevada district	do. do.	Burning later	8	7 million feet
Idaho and Montana	Lodgepole pine	Piling.....	50-60	
		Burning later	2-7	
Idaho and Montana	Yellow pine and Douglas fir-larch types	Piling.....	25-50	
		Burning later	2-6	
Idaho and Montana	Western white pine.	Piling.....	40-60	
		Burning later	3-6	
Idaho and Montana	Western white pine.	Burning broadcast ..	10	
Crowsnest, B.C	Engelmann spruce-lodgepole pine (25 per cent).	Burning broadcast ..	2½	Experiment with 300 acres; stand 15 to 20 M per acre

*The slash disposal problem has not yet (1913) been taken up systematically in connection with Dominion forests. The subject is returned to in the last chapter.

ADMINISTRATION OF DOMINION FORESTS

In 1869 Ruperts Land and the Northwest Territories became the property of the Dominion of Canada, on arrangements being made for the extinguishment of the rights of the Hudson's Bay Company. In the same year an act was passed making provision for the temporary government of this area, and in the following session the province of Manitoba was formed, with its own constitutional government, and withdrawn from the operation of the foregoing act. Later, the provinces of Saskatchewan and Alberta were organized, each with its local legislature.

The control and management of this vast territory in the northwest was confided, March 1, 1871, to the Secretary of State for Canada, a Dominion Lands Branch, in charge of a Surveyor General, being established for that work. On the erection of a Department of the Interior in 1873, the Dominion Lands Branch passed to that department, which has from that date administered these western lands. During the 40 years since, several secondary branches have been created to cope with the increasing volume of the business of administration. This, of course, relates only to unalienated lands.

Timber Branch To understand the present methods of administration, in so far as it relates to Dominion forests, it will be convenient to briefly sketch its development. The western lumber industry began early to develop, and in 1880, a Timber, Mines and Grazing Branch was formed at the head office, to have charge of this field of administration. The business on the ground was in charge of a Crown timber agent, the work having to do with the collection of ground rent and dues, scaling of timber, inspection of sawmills as to capacity, control of trespass, etc. New timber agencies were established in quick succession, and by 1884 there were Crown timber agents at Winnipeg, Edmonton, Calgary and Prince Albert. Working under the direction of these agents were some seven forest rangers, whose duties consisted in seizing illegally cut timber, reporting on sawmills, and carrying out other departmental business in the field. During 1884 and 1885 an exploration of the resources of the railway belt was made, and in the following year a Crown timber office was opened in New Westminster.

At present there are six timber agencies, with offices at Winnipeg, Prince Albert, Edmonton, Calgary, Kamloops and New Westminster, in most of these the one official acting in the dual capacity of land agent and timber agent. In the smaller places the land agent performs minor timber agent duties in his district. The field inspection as to the carrying out of the timber regulations is done by Crown timber

inspectors, one or more being attached to each agency. Here again, this work is in some cases combined with the duties of land inspection. Over all there is an inspector of agencies, who supervises the administration of each office.

**Forestry
Branch** From a comparatively early date the officials of the Department of the Interior were aware of the importance to the west of an adequate timber supply. As has been the case in other countries, tree planting engaged the minds of men before the question of protection from fire. Thus, as early as 1875, we find the Surveyor General urging "the expediency of encouraging tree planting in Manitoba and the Northwest Territories." Indeed, in 1884, a special commission was appointed "to examine into and make a report upon the subject of the protection of the forests of the Dominion and the planting of trees on an extensive scale." Annual reports were made for several years, but no action resulted. Fires were severe and widespread, and already in many localities fuel and building logs could not be procured. Finally, the fear of a timber famine in the west led the department in 1893 to embark on a policy of setting aside certain non-agricultural Crown lands adjacent to settlement as sources of future timber supply, and for the equalization of water flow as well. Before this, in 1885 and 1886, certain mountain park lands had been reserved to the Crown under the provisions of the Dominion Lands Act, the impetus having been given by the discovery of hot mineral springs near Banff, Alberta. The formal constitution as reserves, however, took place later. The parks, of course, were set aside on account of their scenic qualities. The timber reservation policy began with the creation of Moose Mountain reserve, by departmental order, in 1894, followed the next year by Riding Mountain, Turtle Mountain, and Spruce Woods reserves.

So far, in the administration of the Dominion forest land, attention had been given almost wholly to facilitating the cutting of timber and perfecting the system of revenue collection. There were some local fire guardians, appointed under territorial ordinance, to look after prairie fires, but disastrous fires swept the country every dry season. The reserved areas were virtually without any system of protection, beyond the cutting of a few fire guards through timber on two of the reserves. The seriousness of the fire damage was realized, however, by some of the officials. Thus, the chief clerk of the Timber Branch, in his report for 1887, speaks of "the necessity of providing some better means than at present exist to prevent the destruction annually by fires of millions of feet of timber throughout Manitoba and the Northwest Territories." Periodically, for years, we find the field officials, in their reports, pointing out the necessity of greater fire protection,

the need of rangers on the timber reservations, of more control of trespass, of conserving timber along streams from the Rockies, and of prairie planting.

At last, on August 15, 1899, a "chief inspector of timber and forestry" was appointed, and this marks the beginning of a branch to organize a system of fire protection. The plan adopted was that of a local selection of fire rangers, working under the direction of the Crown timber agent for the district, or his sub-officers. The agent prescribed the patrol area, and notified the ranger when to commence and when to quit, according to the nature of the season. Each year saw this organization extended into new regions, so that the force with 22 rangers in 1903, numbered in 1912 some 165 men (outside of reserves). The work of supervision has grown beyond the capacity of the Crown agents, with their other affairs, and chief rangers, with no other duties, and with an inspector over all, are in charge.

The forest reserves likewise began to receive some attention as the result of this new step. A system of fire-guard construction along boundaries adjoining open prairie was begun, and forest rangers brought about a more desirable state of affairs as regards fire and timber theft within the reserves. The work of examining non-agricultural areas and creating new reservations went steadily ahead. The Forestry Branch is still the only agency for the classification of Dominion lands.

The long-discussed matter of prairie planting was settled in 1901 by the creation of a tree-planting division, and the establishment of a nursery at Indian Head, Saskatchewan. The object has been to supply settlers with trees for farm planting as shelter belts and small woodlots. Up to 1913, some 25,000,000 trees have been supplied to applicants, with highly successful results. Stock has also been grown for experimental planting on some of the reserves. It must be borne in mind that the project is not intended to have any relation to the problem of general timber supply.

An important stage was reached in 1906, by the passing of the Dominion Forest Reserves Act, which placed the control and management of the reserves under the Forestry Branch, with provision for the making of regulations for their handling. At the same time a large number of new reserves were created. The licensed berths within reserve boundaries, however, were exempted from reserve regulations, an anomalous action, which removed practically all the mature timber and all the logging operations from the application of forestry practice.

In the present organization, for administration of the reserves in the field, the whole area is divided into four inspection districts, corresponding with provincial boundaries. These are in charge of district

inspectors, with offices at Winnipeg, Prince Albert, Calgary and Kamloops. The inspectors, with one exception, have had a technical training in forestry, and are responsible to the head office at Ottawa for the initiation and supervision of all the work in their respective districts. In short, the inspector is the business manager of the reserves in his care. Each district is subdivided into administrative units, each in charge of a forest supervisor. These units correspond with individual reserves, where size permits; large reserves, such as the Rocky Mountains reserve, are, however, divided up, and small ones are grouped together under one supervisor. As far as possible, supervisors are chosen who are technically trained men. Assisting the supervisor are one or more forest assistants, graduates of forestry schools. Each reserve is in turn laid off into ranger districts, to which are assigned the necessary number of forest rangers. At the close of the season in 1913 the permanent field force comprised some 4 inspectors, 10 supervisors, 6 forest assistants and 50 rangers.

Parks Branch The Forest Reserves and Parks Act of 1911 made provision for the designation of suitable reserved areas as Dominion parks. Notable among these are Rocky Mountains, Jasper, Buffalo and Waterton Lakes parks in Alberta, and Yoho and Glacier parks in British Columbia. These are administered by a Parks Branch at Ottawa, in charge of a commissioner of Dominion parks. The outside service consists of a chief superintendent, located at Edmonton, and a separate organization of rangers in each park under a superintendent. The work consists of protection of the forests and game, and the carrying out of improvements in keeping with the purposes for which the parks were created.

DISPOSAL OF DOMINION TIMBER

Early License Regulations The forest resources of the Dominion lands early attracted the attention of lumbermen. For instance, a sale of timber berths on lake Winnipegosis was held on November 1, 1879, at which fifteen limits, totaling 605½ square miles, were disposed of for a total bonus of \$22,665. The sales were subject to the cost of survey, a ground rent of two dollars per square mile per annum, and five per cent royalty on the sales of products of the berths. Slightly later sales carried a rental of five dollars per mile, and the trees under 10 inches were reserved. These earlier disposals of timber berths took the form of leases, made under various conditions. However, the Dominion Lands Act of 1879 provided for the yearly license system, and the regulations of March 8, 1883, would appear to be the first governing the granting of licenses to cut timber on Dominion lands.

The essential features of these regulations were: The limitation of the area of the berth to 50 square miles; a yearly ground rent of five dollars per square mile, and a royalty of five per cent on the sale of all products; the requiring of the construction of a mill of 10,000 feet daily capacity, to run at least six months in the year; provision for renewal of license for another year if the area was not needed for settlement; and provision for inviting bonus tenders in the case of conflicting applications. Thus the public auction system was early foreshadowed, and two years later the Department discontinued granting timber berths except by public competition.

The above regulations governed the disposal of timber on Dominion lands, not only in Manitoba and the Northwest Territories, but also in the railway belt of British Columbia, as far west as the 120th meridian (about 25 miles east of Kamloops). This point was chosen as being the district west of which all timber cut was likely to find its way to the Pacific for export, rather than eastward. West of the 120th meridian, the regulations were framed to harmonize very largely with the British Columbia provincial timber laws, which were drawn up with a view to meeting the exigencies of the export trade to South America. There were two sets of these.*

On Dominion lands west of 120° and north of latitude 49° 34' (Yale), the license carried no restrictions as regards area or time limit; \$50 yearly rental; royalty 30 cents per tree felled and 75 cents per thousand board feet (neglecting small timber for skids, rafting timber, etc.); no logs to be sawn until scaled by Crown timber agent by Scribner log rule and dues paid; and trespass was punishable by a fine of \$3 per tree.

For lands west of 121° and south of 49° 34' (Yale to Vancouver) the regulations differed in that the area was limited to 1,000 acres;† rental \$10; royalty 15 cents per tree and 20 cents per thousand board feet; and trespass dues \$1 per tree. The license form, in the case of both regions, "reserved for Her Majesty for all time any and all exceptionally large trees on the tract," and stated specifically that the regulations "shall not apply to the cutting of trees known as hemlock."

Thus, at this period there were three sets of regulations governing the granting of yearly licenses; one set applying to Manitoba, the Northwest Territories, and the railway belt as far west almost as Kamloops, another to the railway belt from this point to Yale, and a third set from Yale to the coast.

*See regulations dated April 20 and July 16, 1885.

†Owing to the owners increasing the capacity of their mills this was amended on November 2, 1886, to increase the area up to 2,000 acres for each 25,000 feet B.M. of daily mill capacity, and a time limit of four years set.

On September 17, 1887, the boundary of the application of the regulations obtaining in the Northwest Territories was shifted eastward from the 120 meridian to Eagle pass at the summit of the Gold range, a few miles west of Revelstoke.

This multiplicity of regulations was simplified on September 17, 1889, by an order in council, by which the regulations governing the disposal of timber in Manitoba and the Northwest Territories were made to apply to the entire railway belt, except that west of Eagle pass the yearly rental was to be \$32 instead of \$5 per square mile (the rent charged in Manitoba and the Northwest Territories), and further, that a rebate of one-half the royalty, amounting to about 25 cents per thousand feet, would be allowed upon lumber exported to foreign countries. These two exceptions were in conformity with the provincial regulations. The rebate provision was cancelled in the following year, on the ground that towage to Vancouver on timber cut from Dominion lands was much lower than on timber from provincial lands. At the same time, licensees were given the option of paying the five per cent royalty either on the value of the lumber in the log, or at the period at which the manufactured lumber was sold. This amendment was found necessary owing to the impossibility of those holding licenses for both Dominion and provincial lands to separate the lumber manufactured from timber cut on the different berths.

Throughout these years the policy had been to promote the establishment of sawmills for the convenience of settlers remote from railways and lumber centres. To this end the licenses had carried a provision for the erection of a mill within a specified period. On January 20, 1892, this was changed so that the lumberman was no longer required to construct a mill until notified by the department to do so, on the ground that facilities for settlers to purchase lumber were, for the present, ample in almost all settlements. This, of course, was conducive to the taking up of berths for speculative purposes, and the regulation is still in force.

Present License Regulations Finally, on July 1, 1898, the regulations were once more overhauled, and these, with some later amendments,* constitute those at present in force. These, on their fiscal side, are virtually the same as those of 1883. The yearly

*January 23, 1900. The rental of berths between Eagle pass and Yale was reduced from \$32 per square mile to \$5 per square mile per annum.

April 9, 1901. One-half cost of guarding the timber berth from fire to be defrayed by licensee.

July 30, 1901. All timber cut under license in railway belt to be manufactured in the Dominion.

September 24, 1901. Rebate of 40c per thousand on export lumber cancelled.

March 31, 1908. Upset price fixed before sale of berth and berth cannot be sold below this.

ground rent is still five dollars per square mile (640 acres), except for lands situated to the west of Yale, in which case the rent is \$32. The dues are practically the same as then, being 50 cents per thousand feet of sawn timber, $1\frac{1}{2}$ and $1\frac{3}{4}$ cents for railway ties eight and nine feet long respectively, 25 cents per cord of shingle bolts, and five per cent on the sale of all other products. On burnt timber the dues are reduced one-half.

Other important features are:

1. The disposal of licenses by public auction, with an upset price.
2. A diameter limit of 10 inches at the stump.
3. Provision for the leaving of seed trees to provide for reproduction.
4. Provision for the elimination of waste.
5. Provision for the disposal of logging *débris*.
6. Provision for dealing with trespass.
7. A clause to the effect that one-half the cost incurred by the Crown for guarding the timber berth from fire shall be defrayed by the licensee.
8. Explicit understanding that the license is a yearly one, renewable "subject to the payment of such rental and dues, and to such terms and conditions as are fixed by the regulations in force at the time renewal is made."

Efficiency of License Regulations *Fiscal Regulations.*—It may be pointed out that the ground rent and lumber dues on Dominion licensed berths have remained practically stationary for thirty years, despite the rise in lumber values, which has led the provincial governments to materially increase their rates in the case of provincially owned timber. Yet, excepting Manitoba, the average mill sale price of spruce (the species most widely cut on Dominion lands) is on the whole lower in these eastern provinces.*

Besides the yearly ground rent, the licensee pays dues of 50 cents per thousand feet board measure, when the timber is sawn. On referring to the rate on spruce in other parts of Canada, we note that in Ontario the dues are \$1, in New Brunswick \$1, and in Quebec \$1.05; in British Columbia it is 50 cents, but this is influenced by the high ground rent charged.

The licensee also pays one-half the cost of fire-guarding the timber berth, the government paying the other half. From the last annual report of the department we find that the total revenue from this source was \$22,856.17. Since there were some 8,065 square miles under license, this averages a charge of about \$2.85 per square mile to

*See table 12 in *Bulletin 40*, Forestry Branch.



MATURE STAND OF LODGEPOLE PINE AND ENGELMANN SPRUCE
This type characterizes the Rocky Mountain Reserve of 13,000,000 acres.



INTERIOR OF THE SAME
At maturity the lodgepole pine averages about 12 inches in diameter.

be met by the lumberman. In British Columbia the fire tax is \$9.60 per mile, and in Ontario and Quebec the licensee bears the whole cost.

The annual ground rent is five dollars per square mile—less than one cent an acre—except for lands situated to the west of Yale in British Columbia, in which case it is \$32. In contrast with these rates provincial timber land in British Columbia carries a yearly rental of \$115 east of, and \$140 west of the Coast range. On the other side, ground rent in Ontario and Quebec is five dollars, and in New Brunswick eight dollars per mile. It must be clearly understood that ground rent has, theoretically, no relation to the timber,—it is a charge for land rights.

The result of the low rentals charged by the Federal government, coupled with the fact that operation is unnecessary until notification by the Department, has been the entrance into the lumber business, more or less, of speculation in berths. This is evident by a comparison, through the years, of the area under license with the total lumber cut. For some years the practice was followed of increasing the rental, usually doubling it, in the case of berths held five years without operation. No serious dropping of licenses appears to have occurred, but the policy was given up. While the non-operation of timber berths is satisfactory from the standpoint of conservation of forest wealth, yet the nation is entitled to its share of the increasing value of the country's timber resource. Especially is this the case when it is taken into consideration that the great bulk of the accessible merchantable timber on Dominion lands is already under license. On the other hand, a too high rental forces operation, regardless of market conditions, in this era of overproduction of lumber.

A just mean may be found, in a sliding scale of timber royalties, which does not injure the interests of either party, giving the public its share and rewarding foresight in the lumber industry. This principle of participation in increment has been virtually recognized of late years, and the timbered provinces have periodically revised their license charges, these to remain fixed for a certain period of years to ensure stability to investment.

Cutting Regulations.—Of much more importance than the question of equitable rental and dues is that of the control of logging operations, for on the condition of the forest after lumbering depends the amount and quality of the future forest. Dependence for the next crop is to be placed upon natural regeneration, since planting is at present considered to involve too high an immediate outlay. Provision must, therefore, be made, through the regulation of logging, for the natural reseeding of the area by the desired tree species.

In reference to this question of reproducing the forest, the most apparent point is the incongruity of uniform cutting regulations to apply to vastly different forest types and market conditions. The same regulations govern the lumbering of the white spruce-aspen type of northern Manitoba and Saskatchewan, the lodgepole pine-Engelmann spruce type of western Alberta, and the wet, dry and coast regional types of the railway belt. Logging in these different types necessarily results in a wide variation of conditions for seed germination and seedling growth, and as each tree species has its own inherent biological requirements, it is evident that uniform logging treatment cannot result beneficially.

The idea of the imposition of a diameter limit, below which trees are not to be felled, is to leave seed trees to prevent the extinction of the merchantable species. The lumberman naturally has no interest in the future forest on land that does not belong to him, and his tendency in logging is to cut all that is marketable with profit. This is ordinary business. The initial improvements, in the shape of buildings and roads necessary to log a certain tract, form a fixed overhead charge, and the more timber taken off the area, the lower is the expense per thousand feet, as far as this item is concerned.

The diameter limit on Dominion berths is 10 inches. In operations a decade ago the market offered no inducement to cut below the limit. But, year by year, with disappearing supplies, the lumbering standards are becoming less fastidious, and in the smaller timber there is a temptation to cut below the legal limit, and conduct what amounts to a clean-cutting operation. Moreover, a stump diameter limit means nothing, since stumps vary in height. The size of tree taken with a 10-inch stump is a matter of how far down in the root swelling, present on all trees, the cut is made. The limit should at least be stated in terms of the diameter at a certain height.

An arbitrary diameter limit very seldom brings about the perpetuation of the desired forest. Unless the stand contains a wide range of sizes, too few trees are left to seed up the area, and, in the case of spruce, the isolated trees are very apt to be wind-thrown. In addition, the trees remaining are not spaced to the best advantage to distribute the seed. Even if the above requirements are accidentally met, as sometimes happens, the openings made by cutting to a rigid limit may or may not be favourable to the growth of the seedlings desired.

As a general statement, the above factors characterize the conditions to be observed on logging operations on Dominion lands. The present lumbering methods result usually in leaving an insufficient number of seed trees, and in consequence the forest is yearly deteriorating. In this connection it is of interest to note that in the leading

centres of spruce production the limit is much higher. In Quebec it is "12 inches measured two feet above the ground," and in New Brunswick "no spruce tree shall be cut which will not make a log at least 16 feet in length and nine inches at the small end."

The remedy for the defects of an arbitrary diameter limit consists in designating the trees to be felled, even if a diameter limit be kept as the general basis of selection. This permits control of cutting so as to provide proper seed trees. Marking in this manner adds to the cost a maximum of five cents per thousand feet marked.

Besides the restriction as regards size of trees that may be cut, the licenses contain a clause "that the licensee shall not have the right to cut any trees that may be designated as required to provide a supply of seed for the reproduction of the forest." This is an extremely important condition to be inserted in a license, as it provides for full control of the operation through the marking system. Obviously the trees must be designated before the sale, otherwise the purchaser is unable to estimate his logging cost and so decide on the bonus he can afford to bid. So far as is known advantage has not been taken of this seed tree provision.

Likewise, there is engagement on the part of the licensee to dispose of the lumbering *débris* as directed by the department, but it cannot be said that as yet any systematic effort has been made to cope with the slash evil.*

Another clause deals with undue waste. At present, wasteful methods are to be seen only in the case of some small operators and some contract logging. All the large operators realize the loss to themselves and usually have special men attached to the camps to keep waste down to a minimum. Jobbers are usually paid by the thousand feet and are therefore interested in getting out only the large logs of a tree.

Trespass is usually punished by double dues. Where the timber has been removed beyond seizure a maximum fine of three dollars per tree is provided for. The activity of the timber inspectors in this connection is seen in the seizures and fines for 1912, amounting to \$31,245. Owing to the numerous sides to some berths the difficulty of controlling trespass is accentuated.

On the whole, the present regulations would provide fairly well for the next crop, if provision were made for taking advantage of them. But this is impossible with the few men engaged in inspection work.

*The Forestry Branch has since made a beginning at brush disposal on permit areas in forest reserves. This, however, does not affect licensed timber berths or lands outside forest reserves.

Permits (Outside Reserves) *Early Regulations.*—From the beginning, in the administration of interior Canada, the policy was followed of allowing the homesteader to cut from Dominion lands, free of charge, such building and fencing material as he required for his own use; and in addition, provision was made for the cutting of sawlogs, building logs, cordwood, ties, fence posts and poles, locally, from Dominion lands, on the payment of certain dues. These privileges are known as permits, as distinct from licenses.

In the early 'seventies various regulations were already in force governing permits to cut timber in the different districts.* On account of the lack of uniformity a consolidation of these took place by order in council dated October 10, 1881.

By these new regulations homesteaders were allowed for their own use, free of dues, 1,800 feet of building logs, 400 roof poles, 2,000 fence rails, and 30 cords of dry wood. In addition, provision was made for the issuance of permits, under payment of dues, as follows: Square timber and sawlogs of oak, elm, ash and maple, \$3.00 per thousand board feet, of poplar \$2.00, and of all other species \$2.50; cordwood, 25 cents per cord; fence posts, 8 feet 6 inches long, 1 cent each; poles, 22 feet long, 5 cents each; ties, 8 feet long, 3 cents each; rails, 12 feet long, and stakes, 8 feet long, \$2.00 per thousand pieces; shingles, 60 cents per thousand; and all other products 10 per cent ad valorem. All permits carried an office fee of 50 cents.

These regulations were superseded five years later by another set, which aimed at securing utilization for farm use of the smaller sized timber, and as much of it poplar as possible, instead of spruce and pine. The maximum size of fence rails and posts was stipulated, and the dues on all rails other than poplar were raised to \$5 per thousand. New provisions allowed for the sale of building logs of poplar at one-half cent per lineal foot, and logs of other species at one to one and one-half cents. Dues on dry or fallen cordwood were reduced from 25 cents to 10 cents per cord, for own use, and on shingles from 60 cents to 40 cents. A notable feature of these regulations was a new clause to the effect that "the permittee shall cut up the whole of the tree felled, in such a way that there shall be no waste, and, to prevent the spread of prairie or bush fires, the refuse shall be piled together in a heap and not left scattered through the bush."

Since 1886 there have been various amendments of the regulations, but mostly minor ones relating to quantity of timber and rate of dues.

Present Regulations.—Under the present regulations there is pro-

*See those referring to Manitoba, dated January 13, 1873, and January 17, 1876; to Keewatin, dated June 25, 1875; to Northwest Territories, dated March 20, 1878.

vision for various classes of permits. A homesteader is allowed one free permit covering allowance of timber for building, fencing and fuel purposes, to the extent of 3,000 lineal feet of logs (roughly 9,000 feet of sawn lumber), 400 roof poles, 500 fence posts, and 2,000 fence rails. In case of loss of buildings by fire he is allowed a second permit. Also if he have no timber supply of his own he is allowed to cut dry, *i.e.*, dead, timber for his own use for fuel and fencing, free of dues. All other permits to cut timber on Dominion lands are subject to payment of dues.

Owners of mills may be granted permits covering up to 640 acres, at \$100 per mile, and subject to the same dues as licensees of timber berths. Permits are also given to cut timber as cordwood, fence posts, telegraph poles, ties and mining timbers, covering areas up to 160 acres, upon payment of \$25 and specified dues. These dues are: Cordwood, 25 cents; fence rails and roof poles, 2 cents; fence posts, 1 cent; building logs, $\frac{1}{2}$ cent to $1\frac{1}{2}$ cents per lineal foot; according to species, telegraph poles 5 cents up, ties 3 cents, and sawlogs \$1.50 per thousand feet board measure. These mile and quarter-mile permits are intended to cover special circumstances, where timber is specially and locally required, is fire-killed, or exists in isolated blocks. The rental charge is on the basis of being granted without competition (owing to the expense attached), in this differing from a license.

Settlers may also be granted permits to cut the above products for their own use, at the same prices. Operators of coal lands may cut their mining timbers on payment of one-eighth to one-half cent per lineal foot, according to diameter. Provision is also made for permits covering cordwood for sale, up to 100 cords, at 25 cents, or $12\frac{1}{2}$ cents if dry; shingle bolts in the railway belt, up to 100 cords, at 50 cents; fire-killed timber in the railway belt; and timber needed for construction of public works. In the Peace River district portable sawmill owners may be granted permits covering up to one square mile and up to 200,000 board feet, subject to dues at 75 cents per thousand feet.

All permits carry an office fee of 25 cents, and are issued at the Crown timber offices. Each permittee is subject to cutting regulations after the same manner as the licensee of a timber berth. There are clauses forbidding waste, and requiring the piling of all *débris*. Likewise, one-half the cost of fire-guarding the timber must be paid by the permit holder of the berth.

The permit system is very widely made use of in the middle west. In 1911-12 some 12,000 permits were issued, the bulk of which were probably free of dues. The majority were issued by Edmonton, Dauphin, Moose Jaw, Winnipeg and Prince Albert offices, the railway belt doing a comparatively small permit business. An idea of the large

amount of timber involved may be gained from the tables already given on pages 234-235.

A distinction must be noted between the larger operations and those of the settler. The former, on the mile and quarter-mile berths, are concerned with the manufacture of lumber, cordwood, ties and other wood products, for the trade, and are in reality small licenses. The policy behind is the utilization of timber locally. In the case of the settler the permit system has in mind assistance on the prairie, where wood is scarce, a substitution for the woodlot conditions usual on eastern farms.

Wherever possible portable mills should accompany all tie and piling operations, to saw up the tops, which are usually left in the woods. In one case which came under observation, involving 5,000 ties, the lumber so manufactured from the tops amounted to nearly 30 per cent of the total, counting 30 board feet to a tie. This would mean a considerable saving in wood product, and also increase the revenue to the Crown from the operation. The fixed rate of permit dues at \$1.50 per thousand feet of lumber, however, is too high to allow manufacture of tree tops, while the ordinary sawlog industry pays 50 cents.

From the standpoint of administration, the troublesome feature about the permit system is the difficulty of control of the cutting, owing to the large number of small operations. The supervision is divided, those on forest reserves being under the Forestry Branch, and those outside the reserves under the Timber Branch. The main considerations requiring attention in connection with cutting under permit are wasteful cutting, piling of slash, and theft. The Forestry Branch, with a large field force of rangers, has a better chance of control of these in its territory than has the Timber Branch, with its small staff of inspectors, and as a matter of fact the latter's attempts to do so are confined to the large operations, and the majority of permit cuttings are without supervision. In the case of the reserves, the system of allowing portable millmen to locate inside, and log sufficient to cover the lumber permits of the settlers of the district, makes control easier by the centralization of the operations. Various abuses of the principle of the permit system, of course, are in existence.

Disposal Within Reserves	It must be clearly understood that not all the reserved forest land is subject to the regulations relating to forest reserves. Within the reserves there are park areas, which are administered by a separate branch, since the management of forest land for park purposes is naturally different than if for timber. Also, as already noted, there are licensed berths, which include the bulk of the accessible mature timber. These latter operations are subject to the regulations which have been given in the section dealing
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with licenses (see p. 261); the enforcement of these regulations is in the hands of the Timber Branch. The Forestry Branch, which has control of the forest reserves, has no administrative connection with the licensed land within reserve boundaries, beyond protecting it from fire. The forest reserve regulations, framed along modern forestry lines, are applicable only to the unlicensed portions of each reserve. It is with these only that we are here dealing.

Free Permits.—These cover 25 cords of dry wood, to any applicant, for his own use; also, to homesteaders, free building material, as in the case of Dominion lands in general use (see p. 267), except that the application for such a permit must be made within five years of the date of homestead entry. This reduces the chance of fraud.

Paid Permits.—These are issued to a variety of users, as follows: To settlers resident within 50 miles of a reserve, for their own improvement uses; to miners and prospectors for development work; for municipal or public works, and for rural schools and churches; for the use of occupants, permittees and lessees of lands within the reserves; for non-commercial irrigation works; for right-of-way construction, and for railway construction. The principle underlying this policy is that the reserves exist for the use of the public in building up the country. The reserve regulations state the maximum quantities obtainable under permit for each particular class of user; and the minimum rate of dues for each form of wood product practically corresponds with that charged in the case of Dominion lands outside of reserves (see p. 267). All permit operations on reserves are under the control of the forest officers, and among other conditions stumps are limited to 18 inches in height and all *débris* must be piled for burning. The system of issuance of the permits by another office, however, does not facilitate supervision.

Sales.—The reserve regulations provide for sales of timber by tender up to 5,000,000 feet, under contract approved of by the director of forestry. The removal is limited to five years, thus preventing speculation. The other conditions of the agreement are fixed to suit each case after thorough examination of the tract. These will include specific designation of what trees may be cut, the price to be paid per unit of product, as determined by the ease of logging and market, the scale to be used, the method of brush disposal, and the penalty for cutting unmarked trees. This method of selling timber is a distinct advance on the old license system, with its uniform regulations for all conditions, since its elasticity permits of provisions being inserted in the contract in the interests of the next crop. By this method each sale is a separate contract, the conditions of which may be made to suit the case in hand; in addition, the Government gets full value for

its timber, at the same time preventing depreciation of the property, while the lumberman knows exactly what he is buying and tenders accordingly. It may be added that the timber sale policy, as it is known, has been but recently adopted in reserve management.

There is also provision for the sale, without competition, of small quantities of building material to residents of towns and villages for private use, and of cordwood at 25 cents a cord, up to 400 cords.

Disposal A few old licenses to cut timber within the Dominion
Within parks are in existence, but little logging is going
Parks on, and of late the policy has been to do away with
lumbering within park boundaries.

At present, permits are granted allowing removal of dead or fallen timber only. Three classes of permits are issued. Residents are allowed, free of dues, for their own use, 15 cords of wood, from an area limited to three acres, to be cut within three months. Also, yearly permits are granted without competition, covering one-quarter square mile, on payment of \$6.25, plus dues of 12½ cents a cord on all cordwood over 50 cords; if timber other than cordwood is cut all dues above \$6.25 are charged at the rates in the third class of permit. This latter is a yearly permit, granted by public competition, covering up to two square miles, with a rental of \$30 per mile, and renewable for five years. The dues are, for mining props, posts and rails, from one-sixteenth to one-quarter cent per lineal foot, and for cordwood twelve and one-half cents per cord; if such dues equal or exceed the rental the excess is applied on account of the dues.

All permit operations are under the control of the superintendent of the park concerned. Precautions must be taken to avoid the destruction of growing timber, and the starting of forest fires. *Débris* must be disposed of as directed.

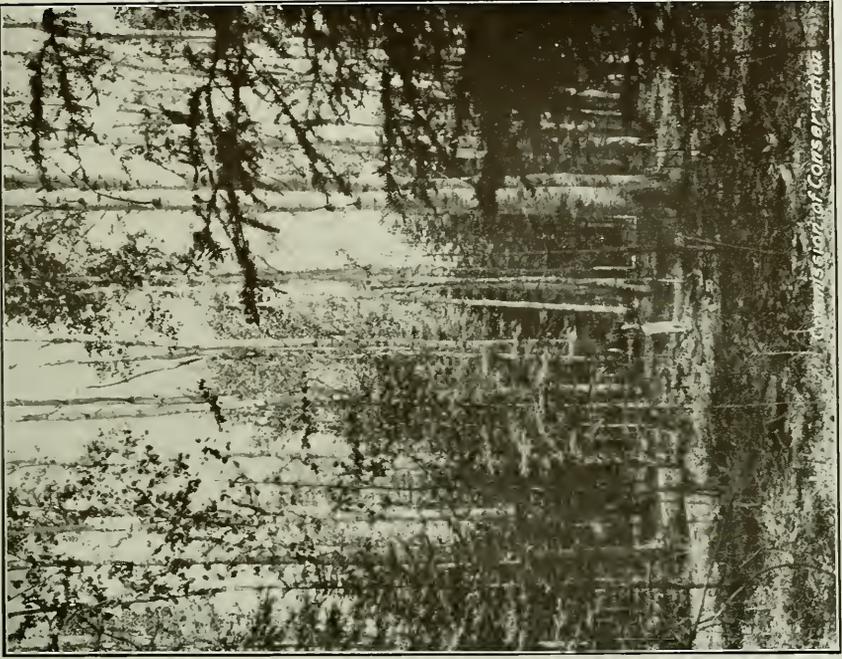
SUMMARY

From the foregoing pages we may briefly summarize the essential features. The Dominion government owns as yet the major portion of Manitoba, Saskatchewan, Alberta and the railway belt. A large share of the property is forest, and on land which will always be of use for lumber production only. The management of this should accordingly aim at continuity of crop for revenue purposes. With this in view some changes are desirable in the handling of this resource.

The portions of the Dominion forests which have been dealt with embrace mainly the timber berths and the forest reserves. The former include the bulk of the accessible mature timber (partly within, and partly without the reserves), while the reserves are largely covered



SPRUCE REPRODUCTION UNDER POPLAR
If fires are controlled in the northern prairie provinces the forest will gradually revert to spruce.



FIFTEEN YEARS LATER
It has escaped the fires and is a very promising stand.

with immature stands or inferior species, from which no material revenue can be expected for some time. As we have seen, these are administered separately and by two distinct organizations, the one concerned with the business incident to licenses, the other mainly a field force in charge of reserves—an undesirable division of authority.

The protection of all Dominion forest lands is in the hands of the Forestry Branch,* with one force for the reserves and another for the lands outside reserves, the latter enforcing provincial fire regulations. From the standpoint of legislative authority the reserves force is backed by efficient regulations, as is also the other staff so far as the railway belt is concerned. It has been pointed out, though, that the rangers protecting timber outside reserves in Manitoba, Saskatchewan and Alberta are working under ancient legislation, designed to control prairie, not forest fires.

The greatest menace to the safety of timber, namely, the slash evil, is, however, beyond the reach of the protective force. In the case of settlers' slash, this is because of inadequate fire laws in the prairie provinces. In the case of lumbering slash, it is owing to the operations on licensed berths being without their jurisdiction.

This matter of slash disposal is one of pressing importance, but only comes to notice periodically with the advent of an unusually dry season, such as 1910. Then, small fires, by reaching old cuttings, attain uncontrollable size. Long as this relationship has been realized, it is only of recent years that steps have been taken to meet the situation. The lead was taken by the United States Government, and now all their timber sale contracts contain an agreement on the part of the purchaser to dispose of the *debris* after the method designated. This is also the case in the province of British Columbia, in all recent sales. Many coast lumbermen in British Columbia, operating under old licenses, burn their slash of their own volition. It is becoming more and more recognized that slash disposal is an integral part of the logging business.

The different methods of disposal, with their advantages and objections, have been already outlined (pp. 254-256). The strongest objection is the cost, and Canadian lumbermen must compete with outside manufacturers. At present the disposal of all lumbering slash on Dominion berths can not be advocated. It is in many cases unnecessary, and in others too expensive. But there is no necessity to continue in our old-time ways and keep the fire risk as high as possible. A start must be made in the locations of greater hazard; these will be among the operations closest to civilization (*i.e.*, transportation), and such have a financial advantage over more remote ones

*The only exception is the New Westminster timber agency.

Even with the most perfect patrol force fires will start, and this contingency must be provided against by reducing inflammable conditions. At first the work will need to be done by co-operation between the lumbermen and officers of the department. Experiment with different methods to suit different conditions will be necessary. Brush disposal is an art in itself, and success can only be reached through experience. Beforehand "knowledge" of what can *not* be done is the commonest hindrance to progress.

The question of the relationship between lumbering methods and the next revenue-producing crop on Dominion lands has been discussed in the section on licenses (see pp. 263-265). This next crop will be inferior in quality as it is, owing to the preponderance, among the trees left behind, of other seeding tree species which cannot be cut because of lack of market. This unfavourable feature cannot be helped. But the present logging operations in general leave fewer trees of the commercial species than are desirable to provide seed for the succeeding stand. This can be remedied with least interference to the lumbering industry through the application of the clause in licenses providing for "the leaving of such seed trees as may be designated by the department."

The decision as to whether the management of Dominion timber lands, in so far as it relates to cutting methods, is to follow along time-honoured paths, or is to take advantage of the world's progressing knowledge in silviculture, at once confronts the lumberman's brief of vested rights. Undoubtedly there is some foundation for this claim, resulting in large part from the allowing of transfer of licenses, as if they were property and not scrip. A license is the right to cut for one year, under certain conditions, but this has been tacitly ignored, and the power to regulate cutting has thus been correspondingly weakened.

On the other hand, license conditions agreed to each year provide for renewal "subject to the payment of such rental and dues and to such terms and conditions as are fixed by the regulations in force at the time renewal is made." This is a yearly warning, and changes have been made from time to time in the conditions attached to Dominion licenses. The enforcement of cutting regulations in the interest of the next crop would be no hardship, considering Dominion timber charges in comparison with other parts of Canada (see pp. 262-263), and the increased value of stumpage since purchase. Besides, in the case of berths held for increment in value, the operator, through the natural growth, becomes the owner of wood product which was not on the berth at the time of purchase, and which was not represented in the original bonus he paid. Paying ground rent for a long

period of years can give no claim to the increased value of the timber, any more than in the case of the lessee of any other kind of property.

Be the pros and cons what they may, the simple fact remains that a continuance of the present methods of handling our mature timber means its exhaustion, and the consequent passing of an important industry in the west. And this on soil of value for nothing else, and in the face of the experience of such regions as the New England and Great Lakes states. Only a nation of fatalists can go on in the old traditional methods till actual depletion of our forest wealth is at hand. The situation must be faced, and knottier problems have been solved on the basis of compromise. The Government is financially interested from the standpoint of future revenue, while the lumberman must be rewarded for his foresight and enterprise by a portion of the increment. The form in which the Crown takes its share is by regulating logging in the interest of the next crop.

What may be done is necessarily a financial compromise between what is best for the forest and the market conditions of the lumbering industry. At the outset no changes are needed in the license conditions. All that is necessary is to take advantage of them. The modern viewpoint in timberland administration is a working for continuity of crop, and the Dominion timber regulations make ample provision for this, as was shown in the discussion of the license clauses. But the carrying out of cutting regulations requires an adequate trained force in the woods, and not a handful of men with multitudinous office duties as well.

All true forest land, whether reserved or unreserved, whether licensed or unlicensed, must take the same place eventually in Canada's economic development, and so federal stewardship entails management of all on the same basic principle of continuity. In the nature of things such a system of management depends to an unusual degree on the efficiency of the field force, as can be seen to-day in different timberland administrations in America. The whole success of such a policy is bound up in the calibre of the men in the field. They are the fingers of a business organization to see that the orders from higher up, as expressions of a certain policy, are carried out. Upon their capabilities and sincerity of purpose rests success or failure, and their inability to respond nullifies the wisest plans of the technical staff. On account of this relation, men for such work must be chosen solely on the basis of their qualifications for what they are paid to do. Political interference with a field force not only results in a weak organization, but has a more or less demoralizing effect on the superior staff. The system will not disappear in a day, but the United States timber administration service affords a stimulating example of what is possible.

With the adjustment of existing licenses the decks will be cleared for conservative management of Dominion forests. For all future sales the individual timber sale policy should be adopted (see p. 269). The amount of timber already under license, however, is far in excess of market requirements. It will be unnecessary for some years to dispose of timber other than on fire-killed areas, isolated blocks adjoining operations in progress, and stands on agricultural soil needed for settlement. It takes but a very simple calculation to see that stumpage values have only to rise in most cases a cent or two a year per thousand feet of lumber to meet the expense of holding by the Government—that is, to balance the loss of ground rent, fire tax and interest on bonus, compounded yearly.

This field of management of forests for continuity of crop passes under the name of forestry. Forestry is merely the business of handling timberlands in an improved way for perpetual revenue. It is often considered antagonistic to the lumbering business, but this is erroneous, because forestry is completely dependent on lumbering. Its intensity of practice is in direct co-ordination with the status of that industry. It is regulated lumbering, lumbering so regulated with the aid of technical knowledge that the forest may produce revenue forever.

In Canada this idea is but slowly making progress. Yet the fact that practically all the forest land, both federal and provincial, is vested in the Crown expresses one of the most important considerations, for forestry is a long-time public business, requiring stability of policy. In addition, it deals with matters affecting the prosperity of every Canadian—continued supply of forest products and conservation of water resources. Probably four-fifths of Canada is suited to tree growth only, and the Federal government has a national responsibility in taking the lead in utilization of forest soils.

APPENDIX

Regulations

Governing the Granting of Yearly Licenses and Permits to Cut Timber on Dominion Lands in Manitoba, Saskatchewan, Alberta, the Northwest Territories, within 20 miles on either side of the Canadian Pacific Railway in the Province of British Columbia, and the Tract of Three and One-half Million Acres to be located by the Government of the Dominion in the Peace River District in the Province of British Columbia. Approved by Order in Council of the 1st July, 1898, and subsequent Orders in Council.

EXTRACTS FROM FORM OF TIMBER LICENSE (REG. 17)

(a) That the licensee shall not have the right thereunder to cut timber of a less diameter than 10 inches at the stump except such as may be actually necessary for the construction of roads and other works to facilitate the taking out of merchantable timber, and shall not have the right to cut any trees that may be designated by the proper officer of the Department of the Interior as required to provide a supply of seed for the reproduction of the forest.

(b) The licensee shall be entitled to a renewal of his license from year to year while there is on the berth timber of the kind and dimensions described in the license in sufficient quantity to be commercially valuable if the terms and conditions of the license and the provisions of the Dominion Lands Act and of the regulations affecting the same have been fulfilled:

Provided that such renewal shall be subject to the payment of such rental and dues and to such terms and conditions as are fixed by the regulations in force at the time renewal is made.

(e) That the licensee shall take from every tree he cuts down all timber fit for use and manufacture the same into sawn lumber or some such saleable product, and shall dispose of the tops and branches and other débris of lumbering operations in such a way as to prevent as far as possible the danger of fire in accordance with the directions of the proper officers of the Department of the Interior.

(f) That the licensee shall prevent all unnecessary destruction of growing timber on the part of his men and exercise strict and constant supervision to prevent the origin or spread of fires.

(i) That the licensee shall pay, in addition to the said ground rent, dues in the manner prescribed in section 20 of the Timber Regulations, and also one-half of the cost incurred by the Crown in guarding the timber from fire, the government paying the other half. A statement will be furnished the licensee showing his share of the cost incurred

APPENDIX

and payment thereof shall be made to the Crown within thirty days thereafter.

TIMBER PERMITS AND DUES

47. The permittee shall cut up the whole of the trees felled in such a way that there shall be no waste, and to prevent the spread of prairie or bush fires, the refuse (*i.e.*, the tops and branches unfit either for rails or firewood), shall be piled together in a heap and not left scattered through the bush.

Permits issued to holders of berths shall contain a clause to the effect that one-half the cost of fire-guarding the timber shall be defrayed by the holders thereof, the Crown defraying the other half.

Regulations for Dominion Forest Reserves

Made under the Authority of Orders in Council of August 8, 1913, and September 24, 1913, in accordance with the Provisions of the Dominion Forest Reserves and Parks Act, 1-2 George V, Chap. 10, for the Maintenance, Protection, Care, Management and Utilization of all Forest Reserves Set Aside and Established as Dominion Forest Reserves by the said Act, of the Timber and Minerals in any of such Reserves, and for Prevention of Trespass thereon.

EXTRACTS FROM GENERAL CONDITIONS GOVERNING PERMITS

26. All timber cutting upon the reserves shall be done under the control of the forest ranger or other officer and subject to his instructions, and shall be subject to the following conditions:

- (a) Only such timber shall be cut as is designated by the forest officer.
- (b) No unnecessary damage shall be done to the young growth or to trees left standing.
- (c) All merchantable portions shall be taken from the trees cut and there shall be no unnecessary waste of timber.
- (d) Stumps shall not be cut higher than 18 inches without special permission from the forest officer.
- (e) All the débris of operations shall be piled for burning unless written permission to the contrary is given by the forest officer.

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