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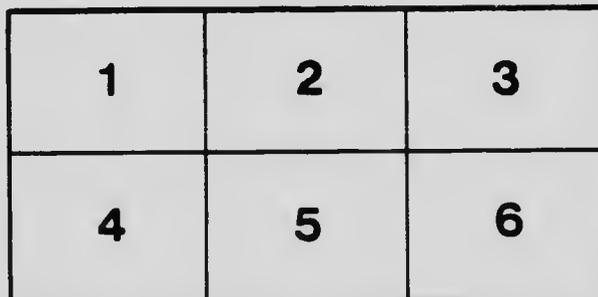
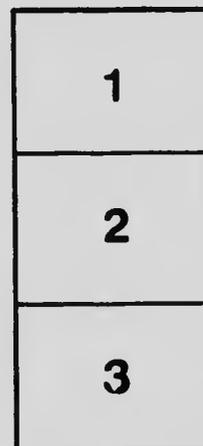
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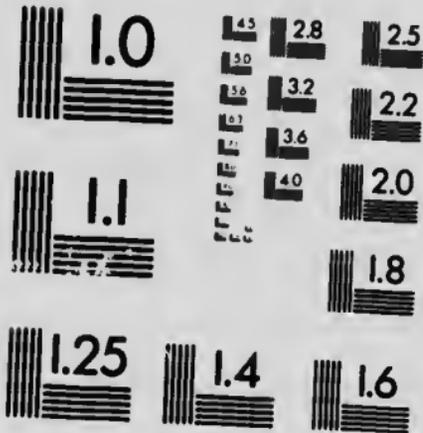
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DEPARTMENT OF THE INTERIOR, CANADA
Hon. FRANK OLIVER, Minister; W. W. COY, Deputy Minister
FORESTRY BRANCH—BULLETIN No. 5
E. H. CAMPBELL, Superintendent of Forestry



FOREST CONDITIONS

IN THE

CROW'S NEST VALLEY ALBERTA



BY

H. R. MACMILLAN, B.S.A., M.F.,
Ast. Inspector of Forest Reserves

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Frontispiece.



Peak from the summit between Daisy and Gold Creeks.

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oak from the summit between Daisy and Gold Creeks.

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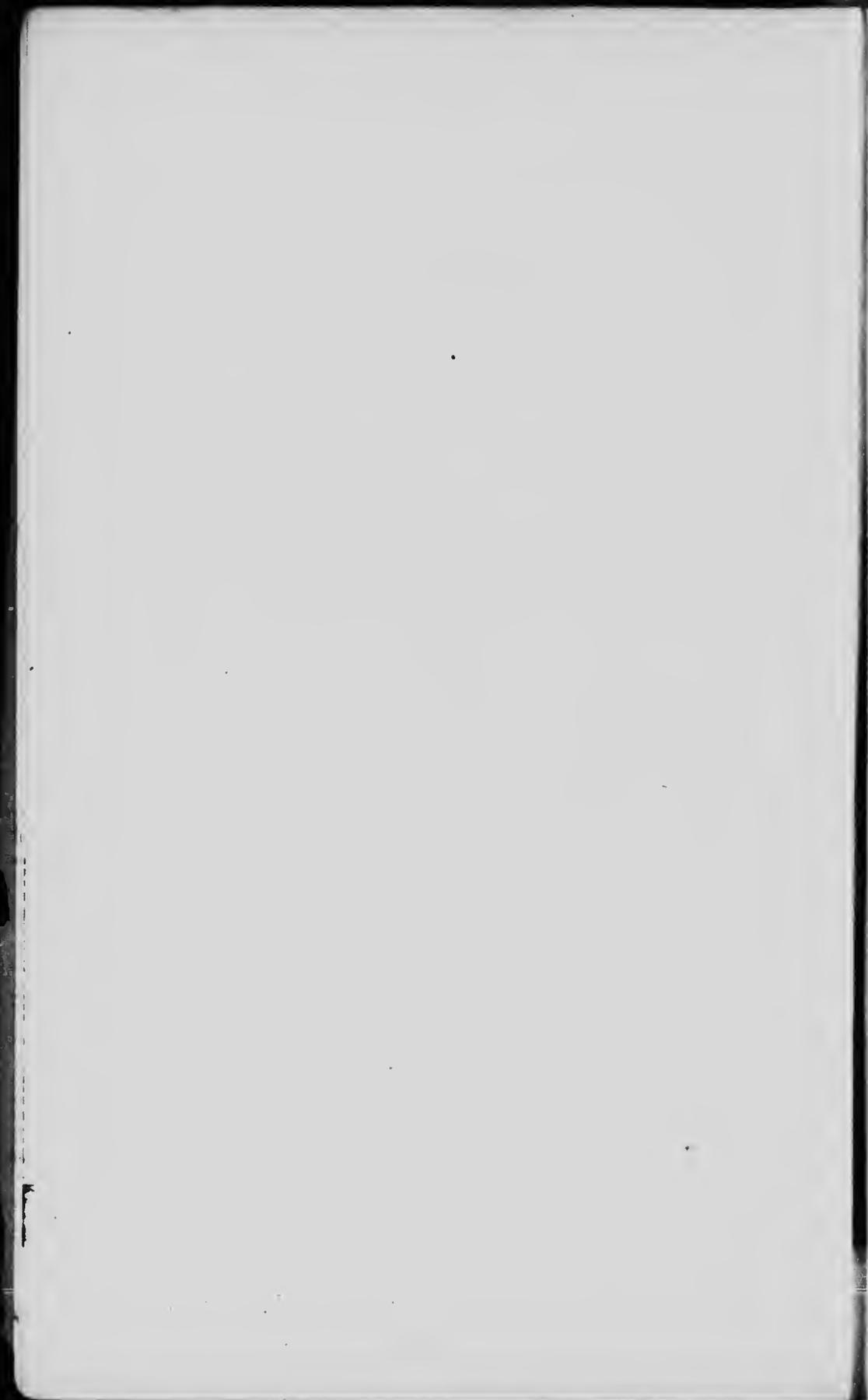
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CONTENTS

	Page
Forest Conditions in the Crow's Nest Pass	5
Topography	5
Rock and Soil	5
Elevation	6
Original Forest	6
Present Conditions	6
Unburned Timber	6
Burned-over Land	8
Dead Timber Standing	8
Minerals	9
Reproduction	11
Growth Rate of Engelmann Spruce	12
Growth Rate of Lodgepole Pine	13
Diameter Growth of Douglas Fir	13
Yield Table for Lodgepole Pine	14
Denuded Area	15
Value of Denuded Land	16
The Eastern Slope should be Forested	17
The West needs the Timber	17
The Forest is valuable for Protection	17
The Forest will produce Revenue	19
How Forest Management may begin	19
Fire Protection	19
Cutting Green Timber	20
Dead Timber	21
Agricultural Settlement	21
Reforestation	22
Further Surveys	22

ILLUSTRATIONS.

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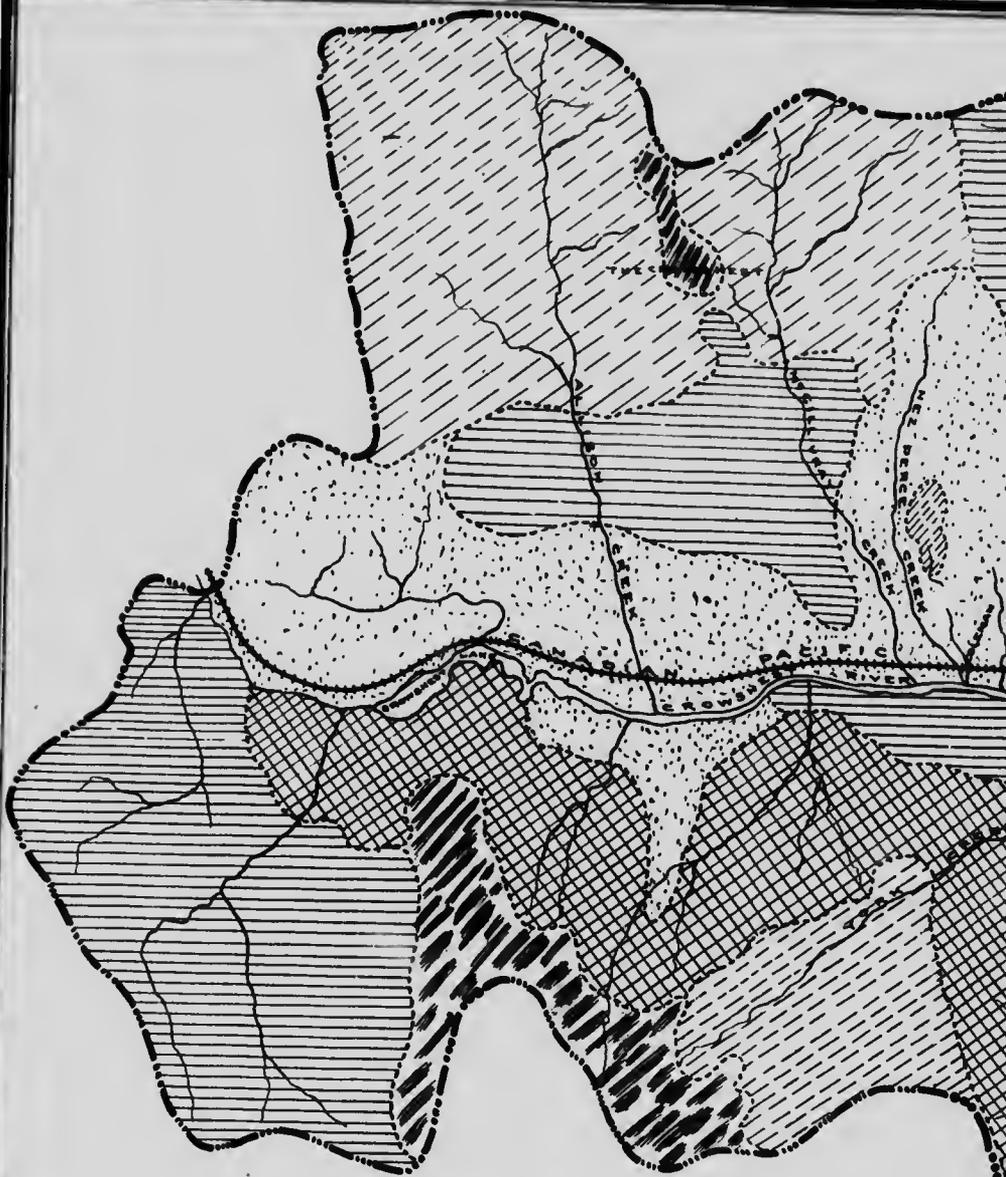
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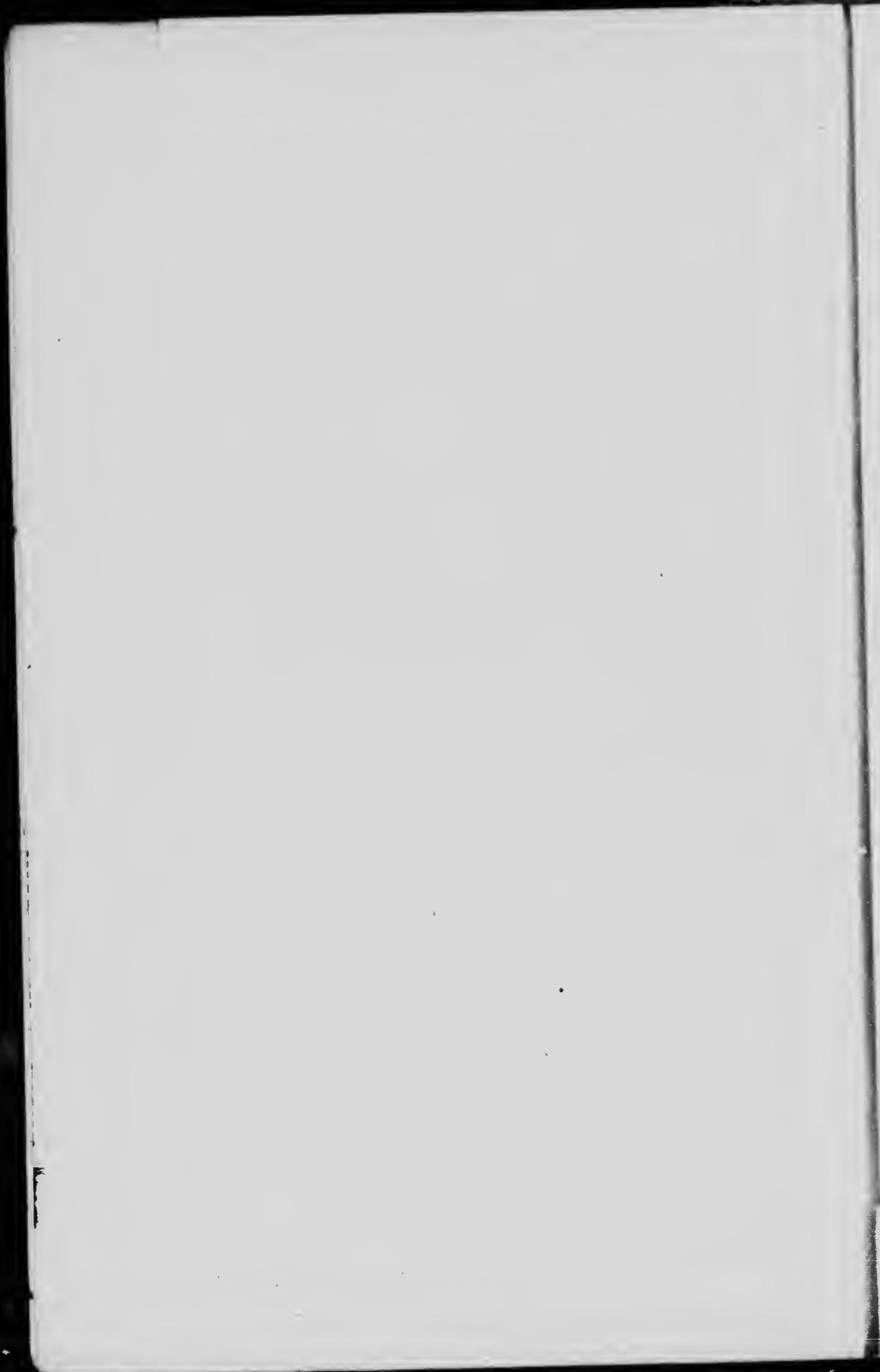


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-  UNBURNT FOREST
-  TIMBER BURN
-  EVERYTHING DESTROYED



BURNT FOREST.  FOREST DESTROYED BY REPEATED FIRES NOW PRAIRIE
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 EVERYTHING DESTROYED DENSE STAND OF YOUNG TREES COMING ON



FOREST CONDITIONS IN THE CROW'S NEST PASS, ALBERTA.

The natural influences affecting timber growth, climate, elevation, topography, exposure and soil are the same for the whole of the east slope of the Rocky mountains, from the main line of the Canadian Pacific Railway, south to the international boundary, as they are for the Crow's Nest valley, therefore a description of the forest of the Crow's Nest valley may be accepted as typical and representative of the eastern slope of the Rockies. In two particulars only will the forest of the Crow's Nest be found to differ from that of the other valleys of the east slope, viz., in its more complete destruction by fire, and its greater value, the natural results of its proximity to railroads and settlement.

Topography.

The Crow's Nest valley, as considered in this report is the valley of the Middle Fork of the Old Man river between the Livingstone range and the continental divide. The Livingstone range is a steep limestone ridge rising to an elevation of between 6,000 and 7,000 feet. East of its summit there is no timber, the abrupt slopes of the mountains being too precipitous and rocky to support tree growth, and the low rounded grassy hills extending from the base of the mountains to the prairie having been constantly kept clear by prairie fires.

The mountains within 'The Gap,' as the gorge is known through which the Crow's Nest river reaches the prairies, are of less rugged character than the Livingstone range. The rocks are of the soft cretaceous formation, consequently the forces of erosion have developed a broad open valley, characterized by wide grassy terraces. The Crow's Nest river between the Gap and the Crow's Nest lake flows quietly through extensive meadows. The streams tributary to the main valley arise and flow between long parallel ridges of harder rock extending to the north and south. The hills most conspicuous in the Crow's Nest valley between the Gap and the summit are the ends of a series of ridges, parallel to the Livingstone range, which have been cut through by the main river.

Rock and Soil.

The strata represented in the formation of the Rocky mountains have been so intricately folded and so deeply eroded that in the comparatively small area of the Crow's Nest valley there are many different rock exposures. The Flathead range and the Livingstone range, the western and eastern boundaries of the valley, are a hard cherty limestone. The intervening ridges, those which determine the north and south flow of the streams tributary to the Old Man river (McGillivray ridge, Willoughby ridge and others), owe their existence to tilted strata of silicious limestone which cross the valley. The remainder of the valley, which has been more deeply eroded consists of variously tilted strata of shale and coal, the latter of which is of great economic importance. Excepting on precipitous slopes, there is everywhere sufficient soil for the support of timber growth. Along the bottoms following the Old Man river there are meadows where the soil is a comparatively deep rich loam. On the benches and terraces along such rivers the soil is deep, but very gravelly and light. Along the smaller streams on the steep slopes of the north and south ridges and on the lower

slopes of the mountain the soil, though broken by frequent rock exposures, is always present in greater or less degrees, varying as to moisture and depth with the steepness of the slope, the formation of pockets and the elevation.

Elevation.

There is very little of the country which is unforested because of the elevation. Forest growth, merchantable and otherwise, forms a cover to a height of 6,000 feet.

The area which because of extreme elevation or precipitous rocky faces cannot support a forest cover is not more than 18 square miles or 8.5 per cent of the total area of 230 square miles comprised in the Crow's Nest valley.

Original Forest.

The evidence of early travellers is that the Crow's Nest valley was originally densely forested between the Livingstone range and the summit. There may still be seen sufficient remains of the forest to show that it existed. On the terraces, sunny slopes and along stream banks were dense stands of Douglas fir, individual trees of which reached a diameter breast high of 3 feet and a height of 110 feet. Broad valleys and lower mountain slopes were covered with a forest in which there was no break, consisting of Engelmann spruce and lodgepole pine, many trees of which measured 20 inches in diameter and reached a height of 90 feet.

PRESENT CONDITIONS.

The present conditions are vastly different. Fires, beginning with the use of the pass by travellers between the Kootenay valley and the prairie and continuing with the construction and operation of the railroad and the development of the mines, have destroyed a large percentage of the forest area and removed the greater portion of the timber. According as the areas have escaped fire, have been repeatedly burned, or have been affected by a ground fire only, several different types have been produced, the locations of which are shown on the accompanying map and the areas of which are given below.

	Square miles.
Unburned forest	33
Area covered with young growth	60
Dead standing timber	34
Sod covered denuded area	85
	212

Thus of a possible forest area of 212 square miles only 16 per cent remains unburned, 28 per cent has been burned over and is bearing another crop, 16 per cent is covered with timber which has been killed by fire and from 40 per cent or nearly half the total area the timber has been so completely removed by fire that a worthless grass cover or bare rock now takes its place.

Unburned Timber.

Unfortunately fire, as well as destroying the greater area of the timber, consumed the best quality. As shown by the accompanying map, the green timber is confined to the valleys at the head of Allison, Nez Perce and York creeks, sites which were protected by their distance from the railroad and by ridges which intervened between them and the main valley through which the fire swept.

The timber which remains consists of a dense stand of Engelmann spruce (*Picea Engelmanni*) and lodgepole pine (*Pinus Murrayana*). On a few ridges are small groups of Douglas fir (*Pseudotsuga mucronata*), but the greater quantity of this

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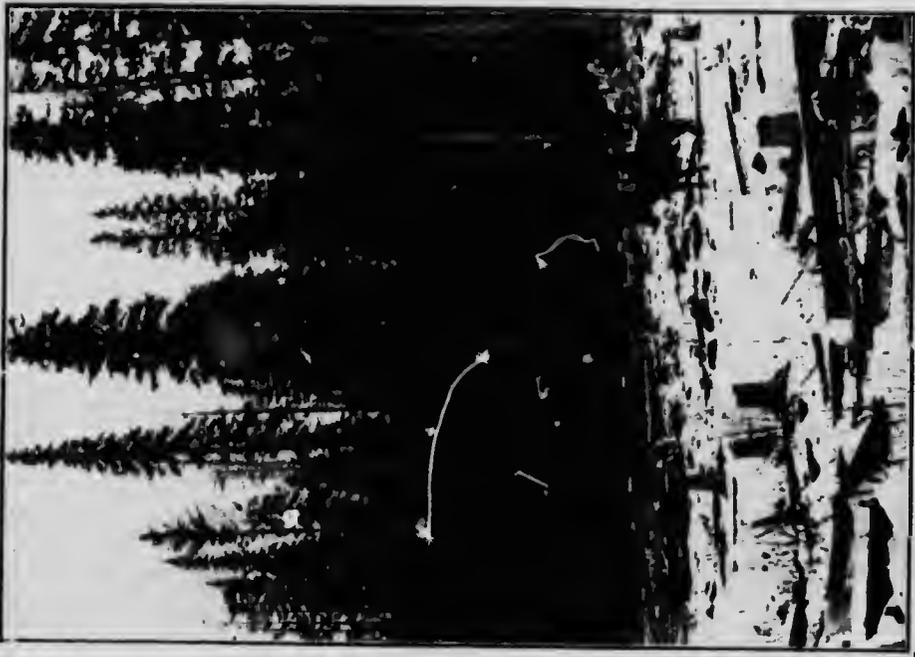
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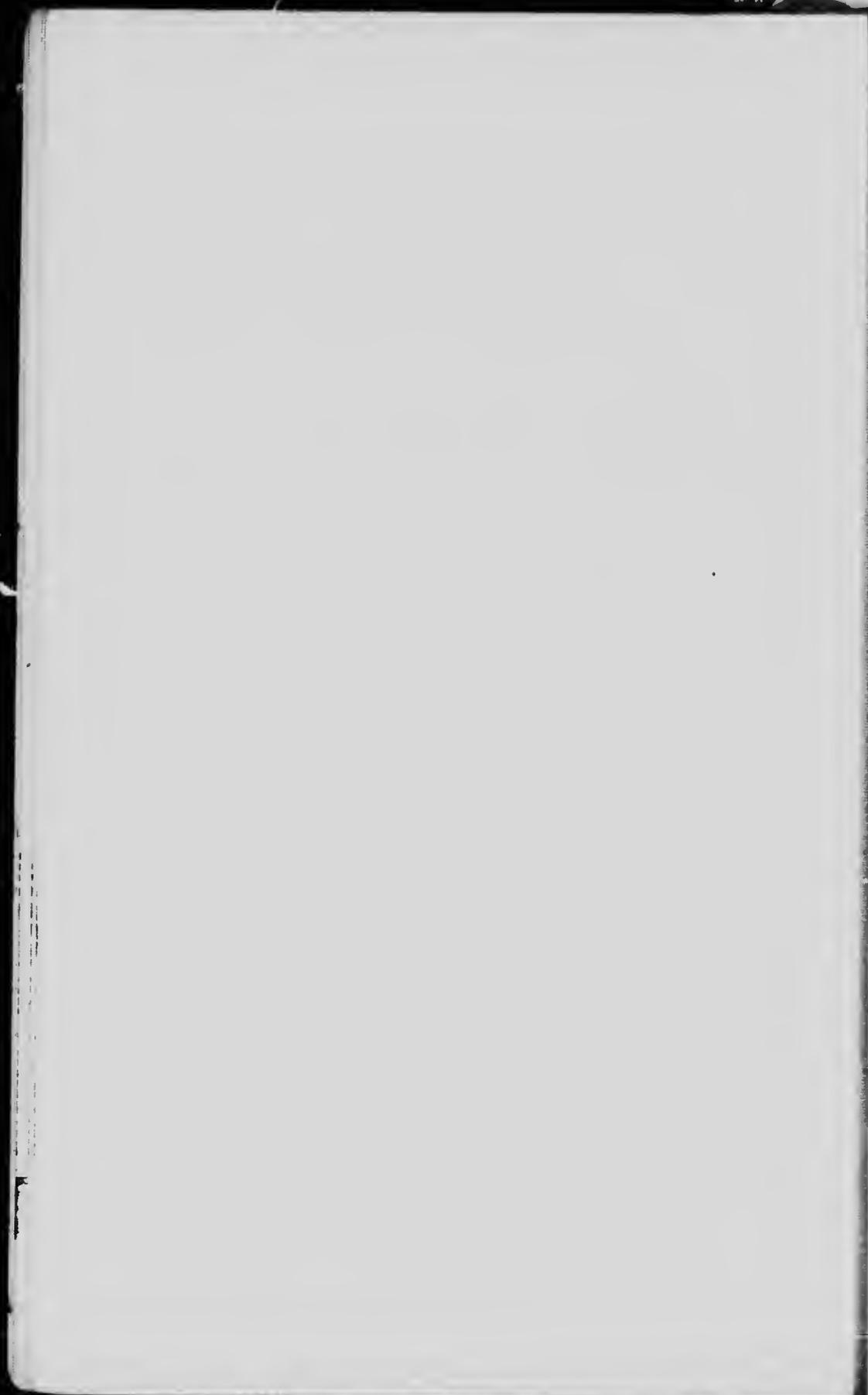
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Maximum Development of Engelmann Spruce in the Crow's Nest Valley.



Virgin Fir forest in the Crow's Nest Valley.



valuable species together with the heaviest stands of spruce and pine, was originally found in the main valley and on the terraces which have been swept by fire. Towards the upper limit of timber balsam fir (*Abies lasiocarpa*) occurs.

Engelmann spruce is the most important tree. In the lower valley it reached a diameter of 30 inches and a height of 100 feet. It is very straight and is clear of limbs for about 35 feet. In the timber still standing the spruce averages from 10 to 18 inches in diameter with a height of 60 to 70 feet. The average for a season's cut is three 16-foot logs to a tree. Occasional trees will cut four such logs. The timber is light, strong and remarkably free from defects. It is easily worked and seasons well. This spruce is the most common and popular lumber on the prairie.

Lodgepole pine is the next important tree in the mixture. Its maximum size in the Crow's Nest valley is a diameter breast high of 22 inches and a height of 80 feet. In the present body of green timber it occasionally occurs in mixture with spruce, where the largest specimens are found, but it more frequently occurs in dense pure stands, where it reaches an average diameter of from 8 to 14 inches and a height of 60 to 70 feet with a clear length of over 40 feet. It does not average as high in diameter as the spruce, but on account of its greater clear length and smaller taper it averages as many logs per tree. The wood is light and soft and is not so strong as the spruce. For a hard pine it is easily worked. It is widely used for ties, mining props, logging and small dimension timber.

The Douglas fir occurs in very small patches or as scattered specimens on gravelly slopes throughout the forest now standing. It forms a very small percentage of the timber cut. Fir is the largest tree on the east slope of the Rocky mountains. On terraces overlooking the Old Man river it reached a diameter of 40 inches and a height of 90 feet. In the present forest the diameter varies between 10 and 24 inches with a height of 60 to 70 feet. Because of its limbiness and great taper it rarely produces over three logs to the tree. Eastern slope fir is not of such a high quality as the coast fir. It is supposedly shorter in the grain. It is used for lumber and dimension timber, particularly in the mines.

Balsam is of very little importance commercially. It occurs in mixture with spruce above an elevation of 5,000 feet, along the streams and in the moist bottoms at the stream heads. Its chief importance is as a forest cover above the merchantable line, 5,500 feet elevation, from which to an elevation of over 6,000 feet it forms a dense forest cover. The largest specimens reach a diameter of 16 inches and a height of 65 feet. The wood is light, soft and weak and when cut is mixed with spruce which it resembles.

Nearly all the green timber now standing in the Crow's Nest Pass is held under license. On a few of the berths logging operations have been conducted since 1898 and during that period there have been cut 36,250,000 feet of lumber, 50,000 ties and 1,250,000 lineal feet of mining props.

The lumber has been delivered entirely to the prairie market at prices varying from \$13.50 to \$17 per M. The present price averages \$17. The ties were sold to the Crow's Nest railway at the time of its construction.

The present cut averages 48 board feet for every log manufactured. The average per log up to 1903, while cutting was carried on nearer the mill, at a lower elevation, in better timber, was 60 board feet for every log manufactured. This proves that fire has not only destroyed the greater area, but the best quality of the timber.

The timber standing at present is estimated to run about 4,000,000 feet to the mile or a little over 6,000 feet to the acre. Granting that the whole of the present standing timber in the Crow's Nest Pass would average this quantity, which is unlikely because of its elevation at the heads of the streams, there is still standing a total of 126,720,000 feet.

Disregarding future growth, which cannot be accurately estimated on the data at hand, this timber will at the present rate of cutting, five million per year, last 25 years. The inevitable demand coincident with the growth of the country will no doubt

shorten the term to less than 20 years, even if forest fires do not interfere to diminish the supply.

Burned-over Land.

There are 179 miles of land within the valley, originally timbered, but now cleared by fire. As explained before, this comprises most of the low-lying valley land which produced the heaviest stands and the best timber. If 19 square miles are allowed for land which did not bear timber, and 6,000 feet per acre is taken as the average, there have been 614,000,000 feet of timber where now there is nothing. If 44,000,000 feet is accepted as the amount which has been cut, 570,000,000 feet have been destroyed by fire. This figure is conservative rather than excessive and includes the burned timber within the Alberta side of the Crow's Nest valley only. The government revenue from this timber at the rate now prevailing, would have been \$285,000. If this timber had been logged, there would have been spent in the Crow's Nest valley, at prices now prevailing, \$5,130,000. The value of the manufactured lumber in the present market would be \$9,120,000.

Dead Timber Standing.

There are large areas over which fire has run only once or at most twice. All vegetation has been killed but only the smaller trees have been damaged in any way to unfit them for immediate use. The two fires which killed this timber, represented on the map as 'standing dead,' occurred, respectively, 14 and 5 years ago. The first was set by a contractor clearing the right of way for the railroad, and the second is alleged to have been caused by a railway locomotive.

A comparison between the area which has been burned and that which has never been burned shows a great difference in soil conditions. Over the burned area there had been a considerable amount of slash from the cutting, and a thick bed of needles and resinous duff. A very hot fire was the result. Where a very thin soil had accumulated over a rock exposure, it was all removed by the fire and the subsequent washing. Gravelly sterile soils which had been covered with two or three inches of rich humus are bare and unproductive.

The fire killed all vegetation over large areas and a ground cover has not yet been completely established. Grass is the most aggressive of the plants starting and where there is no production of timber, a thin sod cover will eventually result.

The greater part of the burned-over area, that which has been subject to only one fire, is coming up with a dense growth of lodgepole pine, dating from the year immediately after the fire. Where there has been a second fire, all such young growth has been killed and a bare area has been produced, which will, through lack of seed trees, be long in bearing another forest crop. It was observed that, though the original stand was spruce, with a mixture of pine, the reproduction after a fire is all pine, with no mixture of spruce.

The area of the dead standing timber tributary to the Old Man river is 30 square miles; of this about 20 square miles were burned 14 years ago and the remaining 10 square miles 5 years ago. The dead timber lost its bark soon after the fire and has been so well seasoned that it has suffered but little damage from decay. Upon the area burned over 14 years ago, about one-half of the timber, mostly smaller trees, has rotted through at the butt and fallen. Each year the percentage of butt-rot is increasing. The remainder still stands firm and sound, there being apparently no difference between the pine and the spruce in this regard. The Canadian American Coal Company, of Frank, cleared 160 acres of timber, fire killed 13 years before, took everything down to four inches in the top and cleaned up all the sound timber for mining props. They secured from the tract 592,702 lineal feet of props or 3,700 feet per acre. In the timber burned five years ago, several sample acres were measured and the average was found to be 70 trees to the acre, each tree containing 50 lineal feet of mining

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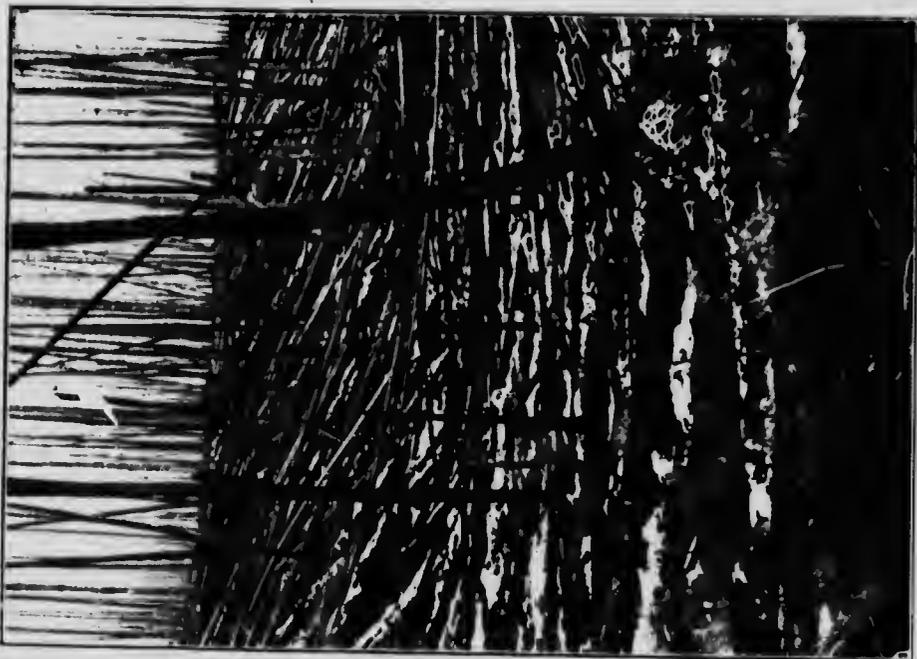
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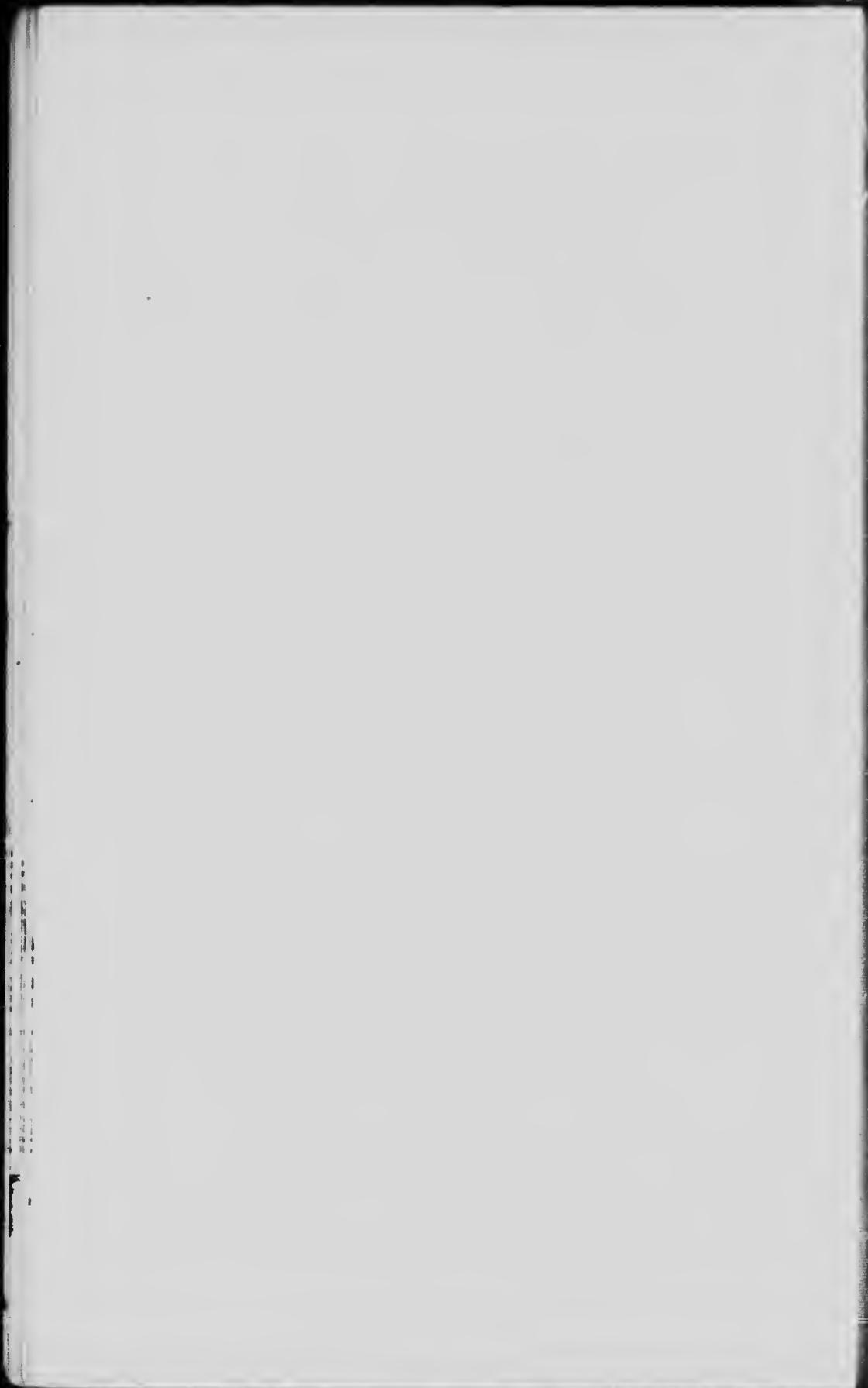
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Standing dead timber on land burned over fourteen years ago.



A Spruce forest burned over fourteen years ago and again five years ago. All reproduction killed.



props, a stand of 3,000 lineal feet per acre. Allowing for the areas which have been cut over and upon which there is no prop timber, and for the higher ridges upon which the timber is more open, 25 square miles would average 1,500 feet per acre, making a total of 24,000,000 feet of mining props now available in the Crow's Nest valley.

An effort has been made to utilize the dead timber (that which has been dead five years only) as saw timber. It is checked so badly that it cannot be cut into lumber, but may be used for dimension stuff. Hon. Peter McLaren cut 1,000,000 feet B.M., of logs last year as an experiment. The logs were of a larger average size than the green logs they ordinarily cut, yet the quantity of lumber produced, grading commons and better, was only 125,000 feet B.M., or 25 per cent of what they would secure from 1,000,000 feet B.M., of green logs. Moreover, the mills can sell the small proportion of culls produced in manufacturing green logs, but they have not yet succeeded in finding a market for the large amount of culls resulting from the manufacture of dead timber. They found it possible to manufacture saleable lumber only from dead logs over 20 inches in diameter. This they cannot do profitably because of the prohibitive cost of covering a large territory to secure the logs over 20 inches in diameter. All logs below this size are checked to the centre, the grain is usually spiral and it is impossible to saw them and avoid the checks. The management of Hon. Peter McLaren's business has decided that it is not practicable to manufacture the dead timber.

The dead timber, used in the round, is stronger than green timber of the same size and species. It is also lighter and more easily handled. That its very porous checked condition causes it to absorb moisture which results in a loss of strength and the entrance of fungi is not a disadvantage under the conditions in which this class of timber is used in the mines in the Crow's Nest valley.

Mining.

The general system of mining and using mining timbers is as follows:—

A main entry is run along the strike of the seam. This entry is permanent and requires to be kept timbered as long as the mine is in operation. The timbers are in 'sets' thirty inches from centre to centre along the whole length of the entry, which may be a mile or more. Each set consists of two posts eight to twelve feet long, twelve inches in diameter at the top, across which is placed a 'strut' twelve to fourteen feet long, to support the roof of the entry. The strut is usually between ten to twenty inches in diameter. Where the formation requires it, the struts and posts are roofed and walled with 'lagging,' consisting of poles two to three inches in diameter, cheap lumber or slabs.

Branching from the entries about every sixty feet, rooms are run along the dip of the seam. The roof of each room is supported with posts about six inches in diameter at the top.

Every forty feet from the main entry, counter entries are run parallel to it. The counter entries are timbered with sets of timbers just as in the main entry, except that the sets are four feet apart, and the timbers are smaller. In the mine taken as an example about 6,000 feet of counter entries are kept permanently timbered.

When the rooms have been projected to the extremity of the seam, they are widened until they meet and all the rooms are carried forward simultaneously from counter entry to counter entry. It is in this operation that the great number of props is used. As the coal is removed over a large area, the roof caves in, and, as the miners say, the 'squeeze comes on.' The props are put up as fast as coal is removed, so as to prevent fragments of rock from falling on the miners and to warn them when the formation is going to settle. Against the bottoms of these props are piled timbers, a 'battery,' to prevent rocks loosened by the squeeze, from rolling down upon the workmen. Planks are used to build the chutes down which the coal slides from the rooms to the main entry, and lumber is used to construct the 'brattices' through which air

is conducted along the entries and counter entries to the rooms. The above constitute the main uses of timber in mining, though large quantities are required for ties, trestle and tipple construction, and the maintenance of buildings and equipment.

The requisite for entry timbers is strength combined with a certain amount of durability. They are being constantly renewed, some locations where the 'squeeze' is severe requiring new timbers nearly every day, others where the pressure is not so great requiring renewals every twelve to eighteen months. In the latter situation great durability and resistance to the rot so prevalent in mine timbers might increase the continued strength of the timbers, but ordinarily, main entry timbers give way to the pressure before they are affected by rot. Nearly all the main entry timbers used in the Crow's Nest mines are green peeled Douglas fir from British Columbia; a comparatively small number are cut on berths 1290 and 1432, owned by mining companies. Still fewer are large fire-killed spruce and pine purchased from the McLaren Company. Where the green local timber can be procured as cheaply, it is quite as satisfactory as that from British Columbia, and the dead, where it can be purchased for the same price, can be just as safely used except where timbers over twelve inches in diameter are required.

Lagging requires only such an amount of strength as is possessed by slabs, cheap lumber and small poles. It does not require renewing frequently and is so cheap and easily handled as to render the question of durability an insignificant one. The Maple Leaf mine, and occasionally the West Canadian Colliery Company use young lodgepole pine, two to four inches in diameter, for lagging. This is the general practice in mining in Montana and in many regions where lumber and its bye products, slabs and edgings are expensive, but in the Crow's Nest, where several of the miners have small portable mills, and where slabs are burned at the mill unless they can be sold at fifty cents to one dollar a load, slabs and cheap lumber are used for lagging and are not considered an item of expense in mine timbering.

Room and counter entry props are the important mine timbers. They are carried long distances through the mines and are handled a great deal by the miners, so must be light. They are subject to great pressure and are inevitably crushed by that pressure, so strength and not durability is the requisite. These qualities, lightness and strength without durability, are possessed to a great degree by the fire-killed pine and spruce of the Crow's Nest valley. Props are required to be as long as the coal seam is thick and to have a diameter of one inch for every foot in length. Props used in the Crow's Nest Pass are eight to sixteen feet long, and six to ten inches in diameter. Those used in Lethbridge are four to six feet long, four to eight inches in diameter, the seam at the latter place being thinner.

Lumber used for chutes, brattices, construction and equipment is nearly all purchased from British Columbia for both the Crow's Nest and Lethbridge mines. Occasionally small purchases are made from local mills. The West Canadian Colliery had a small portable mill, since destroyed by fire, with which they manufactured their lumber from timber cut on berth 1432.

The Crow's Nest and Lethbridge mines during 1908 used 3,000,000 lineal feet of mining props and 2,500,000 feet B.M. of lumber and dimension timber. The estimated increase in output of mines now running will raise the annual demands of the mines to 5,500,000 lineal feet of props and 4,500,000 feet B.M. of lumber and dimension timber by 1913.

At present 1,940,000 feet of the props are cut from the burned over area and from the lands owned by the mining companies in the Crow's Nest Pass. The remainder of the props and all the lumber is brought from British Columbia. The mines buy their lumber from British Columbia where they can get fir, which is stronger and cut in larger dimensions. The mine owners get their props in the Crow's Nest valley when they can profitably do so. Of the present stand of props, estimated at 24,000,000 lineal feet, 75 per cent is held by Hon. Peter McLaren and the remaining 25 per cent by the coal companies. Coal companies not owning surface rights, have found

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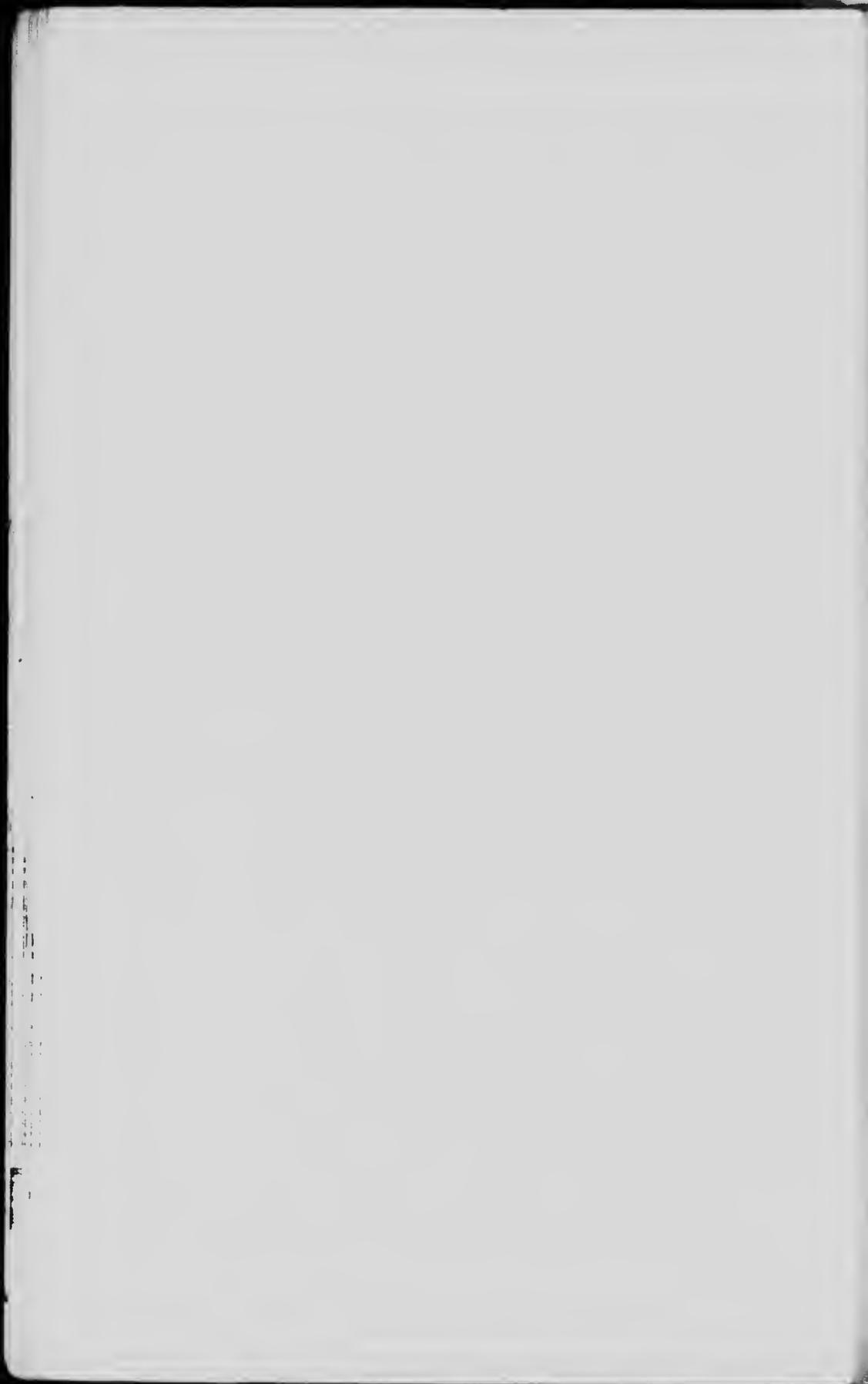
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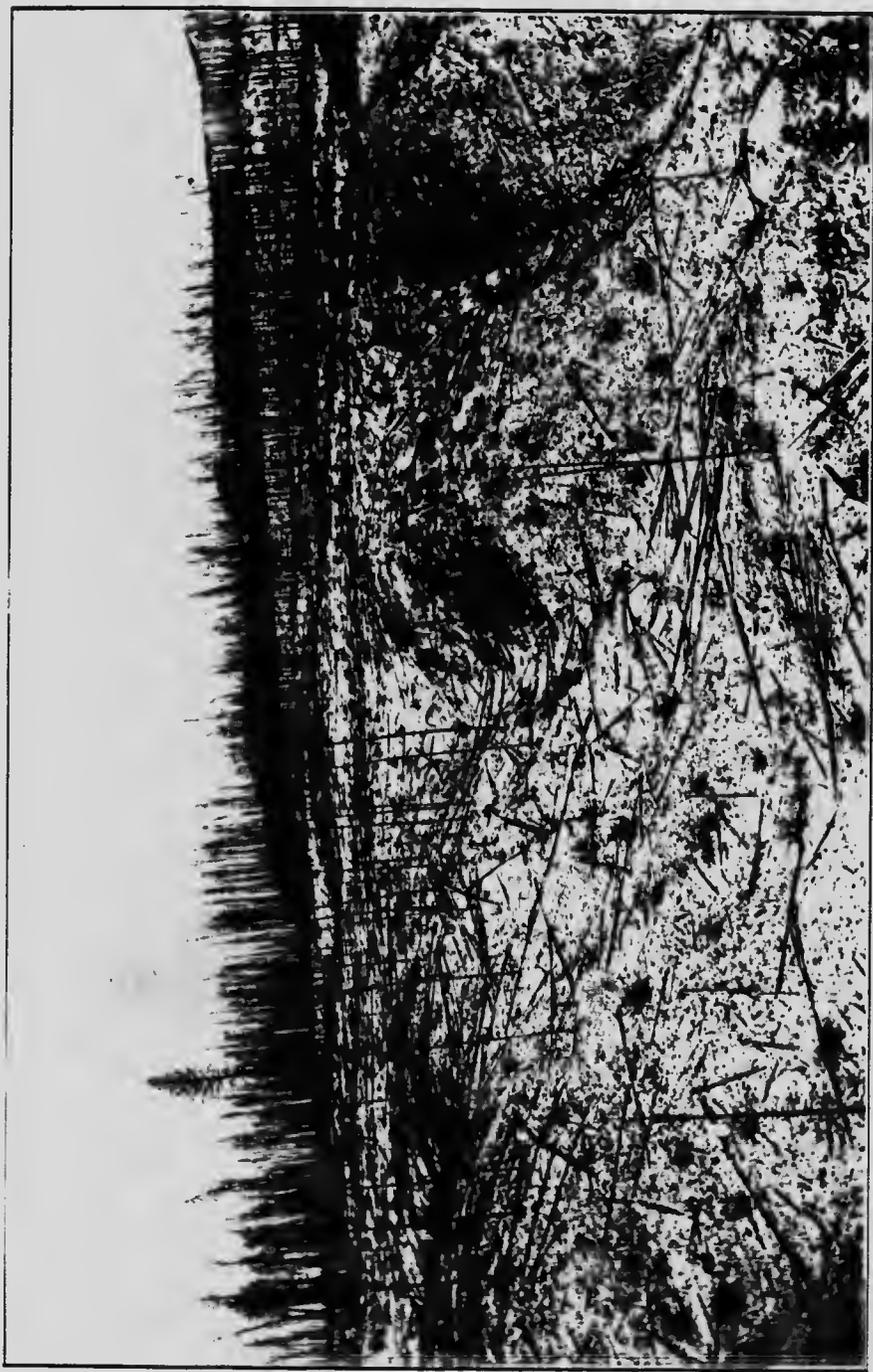
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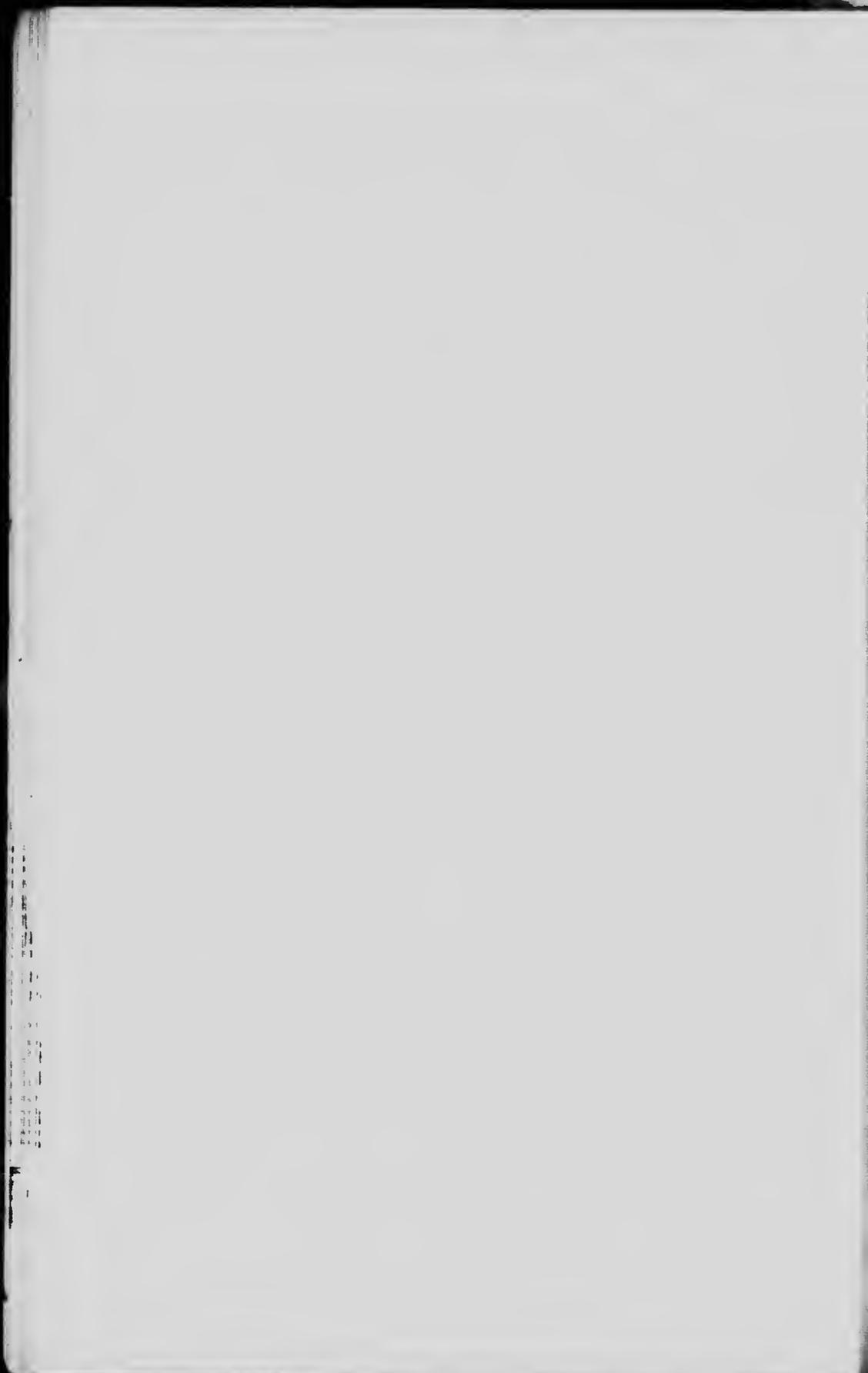


Young spruce seedling coming up under jack pine.





Wood reproduction in Lyon Creek Valley on land burned over fourteen years ago.



it as cheap and cheaper to buy props from British Columbia and Montana. Some of the companies buy props from Michel and Cranbrook, British Columbia, and Kalispell, Montana, having them delivered for from 1½ to 2 cents per lineal foot at Coleman, Frank and Lethbridge. The companies buying props in the Crow's Nest valley pay from 1½ to 3½ cents per lineal foot, delivered at the mines. In addition to this a Crown duty of 2½ cents ad valorem is levied. Thus, at present, local timber is more expensive than the imported.

The International Coal and Coko Company, whose seams underlie the dead timber, buy props standing on the ground over their workings, and hauling them very short distances, drop them down air shafts at the exact places where they are required. Though they are in this way spared labour and get their props more cheaply, they buy them from Mr. McLaren under protest, believing that his license does not give him title to dead timber under 10 inches in diameter, that the license should be cancelled on burned over land and that the area of mining timbers should be handled by the government. This belief is shared by other mine owners.

Mr. McLaren's manager, on the other hand, is convinced that the loss he suffered by the burning of the green timber should not be increased by the revoking of his license to cut the now profitable dead timber. He also bears in mind that the company has paid ground rent on the property, paid a cash bonus on the limit, and is yearly spending money on fire protection. He values the burned timber at \$2,000 to \$2,500 per square mile, is confident that he will sell it in five to eight years and thinks it is his duty to his employer to sell at the highest market price.

The statement of mining timber used given above takes into account the inevitable expansion of existing mines, but does not allow for development by companies now organized but not working. At the present rate of consumption the supply of mining props in the Crow's Nest valley will last 10 years, but at the increased rate which will be brought about by increased prices elsewhere, by increased mine development and by the timber owners' fear to hold the standing props too long they will last about 6 years.

Reproduction.

In addition to the burned over land, one-half of which is well stocked with young trees, there are sixty square miles of land within the Crow's Nest valley upon which a dense stand of forest reproduction replaces the timber which was killed by fire. The land covered with reproduction lies too high on the hillsides and is too rough, stoney and gravelly to be fit for agriculture or valuable for grazing. Repeated fires have consumed all the timber of the previous forest and have impoverished the soil to a certain extent, removing the humus and exposing the sterile, gravelly subsoil. There is now over a greater part of the area a light sod cover forming, which serves to keep the soil from washing. Reproduction covers the whole 60 square miles except for a few small openings. The stands are dense and even aged throughout, dating in every case from the exact year of the fire which destroyed the previous timber. There are areas of thousands of acres through which it is impossible to force a horse and difficult to travel on foot.

The trees stand so closely on the ground that they deprive one another of light, soil-food and moisture and a stagnation of growth will result, and until the stronger succeed in obtaining a start over, and crowding out, the weaker, growth will be very slow. The present stands are mostly five, fourteen and seventeen years old with heights of 2, 12 and 15 feet respectively.

It has been noted that though the original stand of timber in the valley was 70 per cent spruce, 25 per cent pine and 5 per cent fir, the reproduction which now occupies the ground is 90 per cent pine, 8 per cent spruce and 2 per cent fir. The reason for such a change in the composition of the forest becomes apparent when the growth habits of the different species are understood.

Engelmann spruce reaches its greatest development on a fresh or moist mineral soil such as is found along the creek bottoms, over the unburned mountain slopes and throughout the valleys at the heads of the streams.

It is very tolerant and grows in dense, uneven aged lands. The tree produces small quantities of seed every two to three years; the seeds and their best germinating ground where the mineral soil is exposed in moist situations in the partial light of an opening in the maturing stand. If the opening be too large and the soil dried out in consequence, though the seed may germinate, the young spruce will not thrive. It requires protection from the sun. If the shade and moisture conditions are right spruce seed will germinate and the seedlings thrive on the moss covered clay soil common under stands of Engelmann spruce in the Rockies, or on decayed and punky logs and stumps.

The natural development of a spruce forest is patchy. Openings are created by the fall of over-mature trees; in the openings on a moist soil shaded by the surrounding stand young spruces develop, which in turn seed up the neighbouring vacancies caused by the removal of mature timber.

Growth Rate of Engelmann Spruce—Crow's Nest Valley, Alberta.

A few measurements taken of the growth of Engelmann spruce furnish a foundation for the following table.

Age. — Years	Diameter Breast High. — Inches.	Height. — Feet.
10..
20..
30..	3-8	32
40..	5-1	42
50..	6-6	52
60..	8-1	62
70..	9-5	72
80..	10-7	77
90..	12.	86
100..	13-1	91
110..	14-1	95
120..	15-0	98
130..	15-7	102

Spruce is long lived and frequently reaches larger diameters than indicated above.

Lodgepole pine is a tree of quite different characteristics. It grows best on a fresh or moist mineral soil but will succeed on an impoverished, burned over, gravelly hillside or upon a steep mountain where soil can only be found in pockets and crevices in the rock.

Lodgepole pine is very intolerant in the seedling stage. It demands light and grows in dense even aged stands. It has many of the characteristics of the jack pine. After it reaches an age of eighteen to twenty years it produces seed every year in large quantities; the stony weather-proof cones remain on the trees for years. After a lumbering operation where most of the timber is removed, or after a fire, they germinate, and, particularly after a fire, find the seed-bed they need, a mineral soil exposed to the light. In such conditions the cones from a few scattered pine trees will speedily and densely seed up a large area. The seedlings immediately develop a strong persistent tap root which enables them to succeed on poor soil. As the tree becomes older it requires less light for its development.

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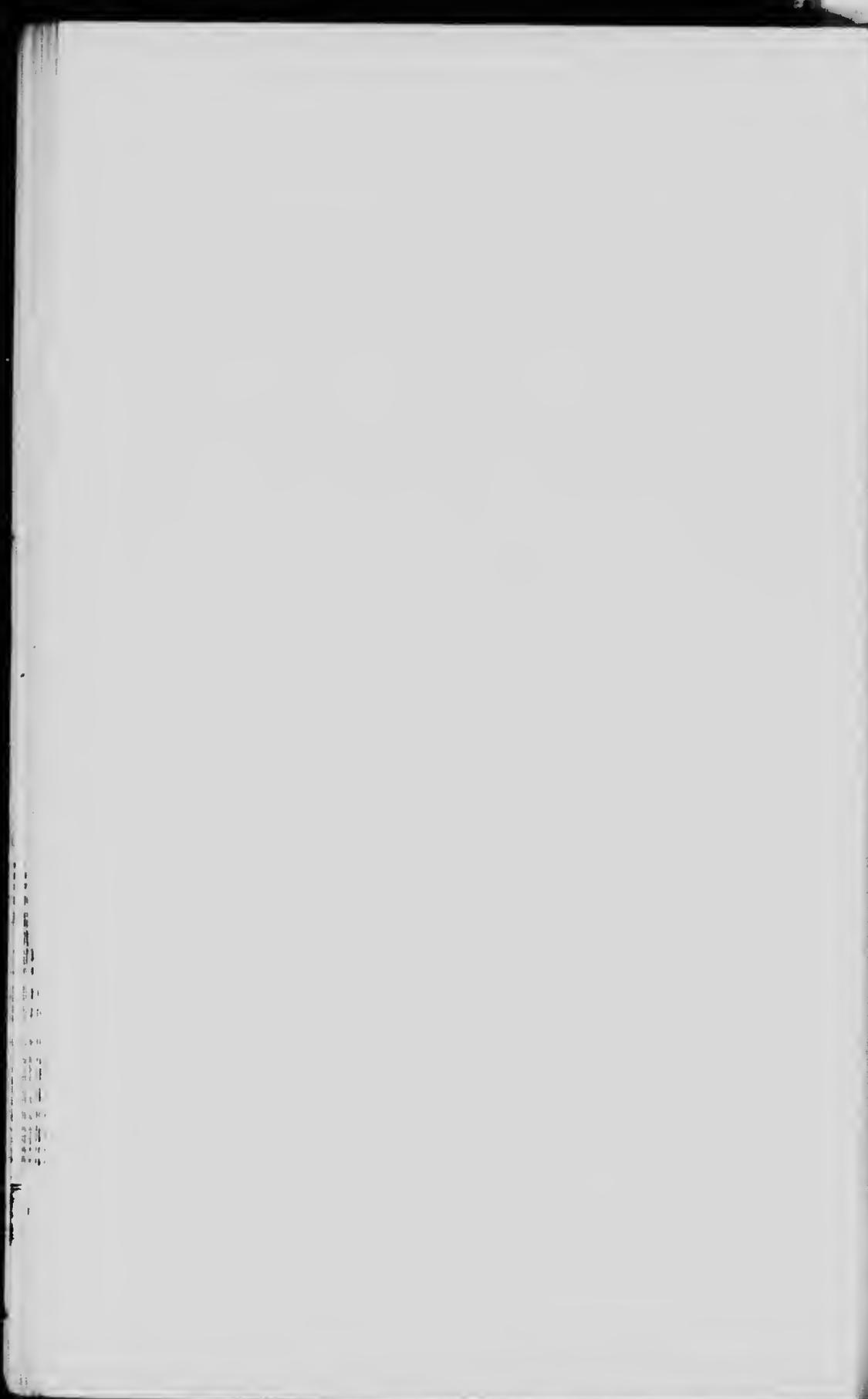
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Pine reproduction on land burned over fourteen years ago.



Douglas Fir, which has defied fire, growing on the lower terraces.

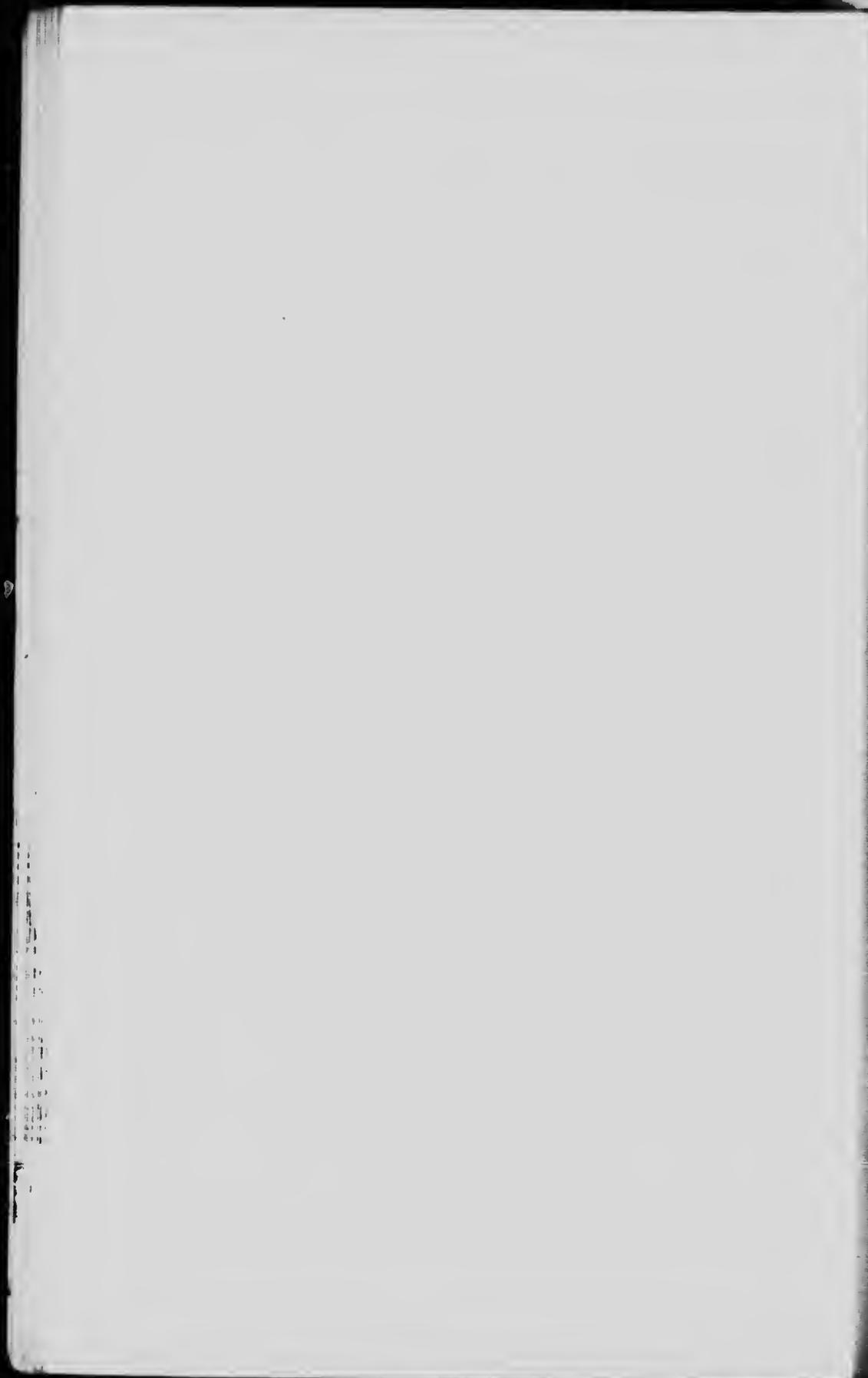




Crow's Nest Valley from Coleman to McLaren's Mill. The meadow land is fit for agriculture, if drained; the terraces on the left are fit only for growing timber.



Burned valley of Old Man River, showing forest replaced by an unproductive sod.



Growth Rate of Lodgepole Pine—Crow's Nest Valley, Alberta.

Measurements taken of the growth rate of the pine in the Crow's Nest valley form a basis for the following table:—

Age. — Years	Diameter. Breast High. — Inches.	Height. — Feet.
10..	3.2	23
20..	5.2	37
30..	6.8	48
40..	8.	58
50.	9.	64
60.	9.7	69
70..	10.3	73
80..	10.7	77
90..	11:	80

Lodgepole is a short-lived tree and seldom reaches a diameter of more than fourteen inches. Its growth rate falls off rapidly after sixty years.

Engelmann spruce and lodgepole pine are similar in that they are both very easily killed by a ground fire and both very free from all other forms of damage. Cull due to decay is not over 2 per cent for either of these timbers.

Douglas fir as a species has been unfortunate in that the sites upon which it reaches its optimum development in the Crow's Nest valley, the terraces, southern slopes and flats at the mouths of creeks, have been most severely burned.

In the Crow's Nest valley fir thrives, on the moist, rich river flats and on the gravelly terraces and slopes, especially on those with a southern exposure.

Fir is very intolerant in the seedling stage and the young trees will succeed only in full light. The trees begin to seed when they reach a diameter of four inches and seed abundantly and frequently. The seeds have a high percentage of fertility and germinate especially well on a fresh mineral soil such as is exposed after a fire. This characteristic together with the great fire resistance of the mature fir trees renders it a tree especially adapted for reproduction on burned over areas. Fires have been so frequent on the terrace and lower slopes of the Crow's Nest valley that the mature trees have finally been killed and the reproduction has been unable to make a start. Around the trees which still remain are prairie areas covered with a fairly dense sod. It is noticeable, however, that the fir makes the best progress of any of the eastern slope species in reproducing on a dry sod. This is probably due to the fact that the seedlings immediately produce a strong tap root which enables them to secure moisture from the subsoil.

Diameter Growth of Douglas Fir—Crow's Nest Valley, Alberta.

Douglas fir is very little damaged by ground fires, is wind-firm and, in the Crow's Nest valley, very sound. Opportunity was found to secure a few measurements of the growth of Douglas fir which form a basis for the following table:—

Age, Years.	Diameter inside bark on a 2-ft. stump, Inches.
10	0.2
20	1.2
30	2.5
40	3.8
50	5.0
60	6.4
70	7.6
80	8.8
90	10.0
100	11.0
110	12.0
120	12.9
130	13.8
140	14.6
150	15.4
160	16.0
170	16.5
180	17.0

Bearing in mind the growth habits of the three species mentioned it is easy to understand that after a fire which destroyed the timber and exposed the mineral soil the shade-loving spruce, with its small quantities of seed, was replaced by the light-demanding pine, which had stored up for the emergency the accumulation of years of seed production. Douglas fir owes its presence to its great ability to resist the many fires which swept the territory.

The tables of growth rates are put forward only as tentative bases from which to make an estimate of the length of time that will be required to produce the various important forest products. Spruce and fir are the two species which should be grown for lumber and dimension timber. In such case they will not be cut before they reach a diameter of 12 inches or more, and will be at least 90 years old, for spruce, and 110 years old for fir, unless the necessity of the times requires the use of timber much smaller than 12 inches in diameter. It will, therefore, be 75 years before the present reproduction is producing spruce lumber and 95 years before the Douglas fir now started will be large enough for use.

Yield Table for Lodgepole Pine—Crow's Nest Valley, Alberta.

The pine which constitutes the greater part of the 80 square miles of production, will probably find its main use for mining props, railroad ties, and fuel, poles and posts for the prairie. The number of poles and props that we may reasonably expect to cut per acre from the present stand of 14 to 17 year old reproduction is given in the following table. This table should not be accepted as wholly authoritative but as a tentative estimate based on several acre measurements in stands of

Years.	Trees per acre.	Props per acre. 8 ft. long, 6 in. at top.
40	600	420
50	450	530
60	310	620
70	210	650
80	170	820
90	170	850

The table shows that the average yield per year is highest at the end of 60 years. Accepting 620 8-ft. props as the yield of one acre every 60 years, the following table shows number of acres that must be kept continually producing props to ensure a constant supply for the mining of the Alberta coal-fields:—

	Acres of growing mine props necessary to insure constant supply.
To supply props for—	
International Coal and Coke Company—	
in 1908	9,660
in 1913	11,500
Crow's Nest Mines—	
in 1908	24,210
in 1913	42,120
Lethbridge Mines—	
in 1908	12,120
in 1913	23,880
Southern Alberta Coal Field—	
in 1908	36,360
in 1913	66,000

Denuded Area.

It is estimated that 85 square miles of land that was originally covered with forest is now without a forest cover, or enough reproduction to justify the prediction that it will, before many decades, bear another forest crop.

The denuded area is a strip along the river bottom from the foothills to the summit, a strip which extends higher on the north side of the hills than on the south side and which widens out so as to include the valley mouths and valleys of all the larger tributary streams. East of the Gap between Turtle and Bluff mountains at Frank practically the whole country is denuded.

The valley bottom was, except for meadows immediately along the stream, very heavily timbered. Fires spreading from the trails, railroad construction and operation have burned it so repeatedly that the timber has been consumed; after the timber the reproduction has been destroyed and with the standing timber and future possibilities of timber there has gone up in smoke the vegetation and humus, the fertility of the soil.

The soil in the meadows and small river and creek flats is a fairly rich, fresh clay and gravel loam. Elsewhere on the terraces, on the benches, and particularly on the higher slopes which constitute at least 90 per cent of the area, the soil consists of clay, stones and gravel, deposited in banks, of sterile gravelly slopes or of a thin covering of sand, stones and clay over beds of rock.

Under virgin timber of the Crow's Nest valley the gravelly clay is overlaid with one to four inches of humus, duff and mossy ground cover, constantly increasing sources and reservoirs of plant food and moisture.

The burned-over soil of the denuded area is hard and dry with no such covering. The thin grass which comes up after the constantly recurring fires neither enriches nor protects the soil, serves but poorly to hold it in place and by its transpiration aids the sun in robbing the soil of moisture.

The denuded land bears a few traces of its former forest cover. There are scattered trees and small patches of reproduction throughout the area but there is no evidence that in the face of the repeated fires the forest cover is making any advance. The contrary is taking place. Every year new fires kill more of the old trees and the

reproduction, impoverish still further the fertility of the soil and spread the boundaries of the denuded land yet wider by running over areas previously covered with timber production.

Value of Denuded Land.

A portion of the land described above may be more profitably employed than in growing timber. The presence of over 4,500 people in the mining towns and lumber camps of the Pass creates a good market for farm and ranch produce. It is 20 miles from Coleman to a good ranching, and much further to a good farming country. Consequently it is not to be wondered at that the following prices prevail.

Hay.....	\$16 per ton.
Bunchgrass.....	10 per ton.
Green feed.....	9 per ton.
Oats.....	1 per bushel.
Potatoes.....	90 cents per bushel.
Turnips.....	60 cents per bushel.
Eggs.....	50 cents per dozen.

Prices for meat, fowl, cattle and horses are correspondingly high. Good prices for produce combined with a belief in the possible future rise in the value of the land have encouraged three classes of settlers.

(a) TRUCK GARDENERS.

Several homesteads have been entered by new comers, chiefly Europeans, for the purpose of growing garden produce. These people have taken up 160 acre homesteads nearly, if not quite, all stony mountain slope, and in the pockets of soil have striven to raise cabbage, cauliflowers, carrots, turnips, &c., for the mines. The soil is too poor and the August frosts have been too frequent for success.

(b) RANCHERS.

Several ranchers have secured fair locations and are making a living by ranging horses and cattle, raising oats and barley for green feed and cutting meadow and shortgrass hay for shipment. Where the number of stock is small and the territory large there is profit in grazing in the valley.

(c) MINERS.

There are a few instances where miners have availed themselves of the homestead law to secure cheaper residences than is afforded by renting or building houses in town. They make no use of the land.

Experiments made by the ranchers and truck gardeners mentioned above have shown that there are comparatively few situations and those easily defined, as meadows, valley bottoms and wide terraces, where families can be maintained and homes supported by the proceeds from the land. Wherever it is possible for industry and intelligence to make a living on the land it should be permitted and settlement should be encouraged, but wherever the land is such that it cannot support a ranch or produce a garden crop it should remain in the hands of the government and be devoted to its only profitable use, the growing of timber. More land than can possibly be used by ranching or agriculture has been homesteaded, the remainder is fit only for, and most valuable for, the production of timber.

The West Canadian Colliery owns 2,700 acres of land, the most of which is denuded. The managers, through European associations, have some knowledge of forestry and favour the adoption of some plan of sowing or planting the land to trees for the production of mining timber.

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One of the best homesteads in the Crow's Nest Valley. Little of the land is fit for agriculture, being too rough and stony.



Land originally forested, but burned over and washed until the stony subsoil is exposed. This particular location has been homesteaded.
705—p. 13.

A portion of the denuded land is within burned-over timber limits. The limits though valueless, are still held under license because, should they be released from the licenses, they would immediately be available for homesteading. The owners fear to have homesteaders within their limits because of the great fire danger.

Small areas of denuded land varying from 160 to 1,200 acres are held by other mining companies. Without exception the managers favour the adoption of some practical plan, which will provide an inexpensive supply of mining timbers on their own land. They would consider favourably sowing or planting under government co-operation, if they could feel sure that trees so sown or planted would not be destroyed by fire.

THE EASTERN SLOPE SHOULD BE FORESTED.

To provide for the complete development of the west every square mile of land will need to be put to its best use. The agricultural land will undoubtedly be farmed; the land unfit for agriculture should grow timber. The reasons for this are based altogether on ordinary business foresight and are in no way sentimental. Where agriculture is possible and not detrimental to more important interests on the eastern slope of the Rocky mountains it should be practised. But, as has been shown above, the greater part, at least 95 per cent of the land area below timber line, is not and never can be agricultural. It should be devoted to the growing of timber for the following reasons:—

The West Needs the Timber.

The Canadian West now has the smallest population it will ever have; the virgin timber supply of the west is greater than it will ever again be. Forces which are increasing the one are still more rapidly decreasing the other. There is no substitute for lumber. If common lumber costs each one of the 1,000,000 people in the west \$22 per M. while the American tariff prevents export, and this while the most accessible forests are being logged, what will it cost when there are 18,000,000 people in the west, when the removal of the tariff permits the export of British Columbia timber, and when all the accessible forest land has been burned and logged over?

The mining industry is the most important in several of the western towns. Coal cannot be mined without timber; mines in Pennsylvania after spending large sums of money in logging timber found it more satisfactory to grow it at home. The mining of the 100,000 tons of coal estimated by the Geological Survey to exist in the Alberta coal-field will require 45,190,400,000 lineal feet of mining props, the produce of 9,000,000 acres for sixty years. That timber is not in sight in the whole coal district, nor are there young trees coming on that will produce it, but the land is there, capable of producing nothing else. The lack of mining timbers near at hand will render mining the coal more expensive. The extra expense will be paid by the western settlers in the shape of a higher price for coal.

The Forest is Valuable for Protection.

Next to the wood problem the water problem is the most important in the west. Mr. J. S. Dennis in his report as Commissioner of Irrigation for 1895 states that there are 59,000,000 acres of irrigable land in the semi-arid region of the Canadian west. The accompanying map shows the location of the arid region, and of the only watersheds from which water may be secured for irrigation purposes. Measurements by the Canadian Irrigation Survey in 1895 show that the total water available from different watersheds is distributed as follows:—

Eastern slope of the Rocky mountains	98.4 per cent.
Cypress Hills and Wood mountain	1.6 “

The total water supply if equally distributed over the whole season is inadequate. Stream gaugings show that it is only sufficient to irrigate 16 per cent of the area of the irrigable land.

The total flow from the eastern slope is sufficient to irrigate 15 per cent of the total irrigable area in the west, but the flow at low water, the season when water is needed, is only sufficient to supply water for 2 per cent of the irrigable area. The above figures are from the most reliable government records and serve to show the dependence of irrigation upon forestry. They show that the water for which private individuals have already constructed about 1,000 miles of irrigation canals and ditches is all drawn from a forested watershed. They show that the total water supply available is markedly inadequate and that in its natural distribution it is by uncontrolled extremes of flow rendered of still less service.

To provide storage and an even distribution of the waterflow through the seasons when it is most needed, an expensive system of storage reservoirs may be necessary, but the construction of such reservoirs increases rather than decreases the importance of the preservation of a forest cover.

The function of a reservoir in an irrigation system is to increase the utilization of the water by holding it over from times of flood, when it is useless and harmful, to periods of drought, when it is required in the production of crops. The forest is to this extent a reservoir. Descriptions given above of the burned-over country in the Crow's Nest Pass have emphasized the fact that the soil mulch or humus was destroyed, that hard gravel, clay and rock were exposed, that the spongy vegetation common in the forest was absent, and the moisture of the soil was decreased by transpiration from the grass and evaporation by the sun. The natural result of these conditions is that the moisture from melted snow and rain is not held, but immediately runs from the bare hard slopes to the streams and rushes to the prairie in a flood. In the forest, on the other hand, moisture from precipitation is absorbed by the vegetation, moss and humus, and, finding no smooth hard surfaces from which the run off is immediate, it soaks gradually into the soil from whence it appears later in springs and seepage. Snow is held later in the spring and its rapid melting is prevented. Thus destructive floods are minimized and a large proportion of the water is held to swell the flow of the streams during the dry season.

The destructive floods in the west are the June floods, occasioned by the rapid melting of the snow on the mountains near and above timber line. If nothing intervenes between the snow line and the streams but bare rock and hard sod, the rush of the water from the melting snow to the rivers is precipitate and productive of disastrous floods. This is exemplified in the rivers of northern British Columbia where under such conditions snow melting at noon finds itself in the rivers in the afternoon. The line above which the greater part of the water comes from melting snow, in June, is, on the eastern slope, 6,000 feet. The average elevations of the main tributaries of the rivers leading from the eastern slope is less than 5,000 feet. If between the above elevations, there is a forest cover and its accompanying soft ground mulch, through which the moisture must soak and trickle in little streams before reaching the main tributaries, the run off will be checked and consequently the extremes of high and low water, so inimical to successful irrigation, will be remedied.

The damage by floods is not confined to that inflicted upon the irrigation interests. Every industry in the west suffers directly or indirectly.

Farmers suffer through the flooding of land and destruction of crops; lumbermen suffer through the destruction of stream improvements, the breaking of booms and the loss of logs in the high water; municipalities, provinces and railways suffer through the destruction of bridges and road-beds; every form of business dependent upon traffic or water-power feels the loss imposed by floods.

Reservoirs may restrain floods, but if reservoirs are to be constructed forests will be necessary for the protection of the reservoir basins. The slow run-off through a



A rollway of logs on Hon. P. McLaren's Limit.



West slope of McGillivray ridge. It has been burned over, but the forest will re-establish itself.

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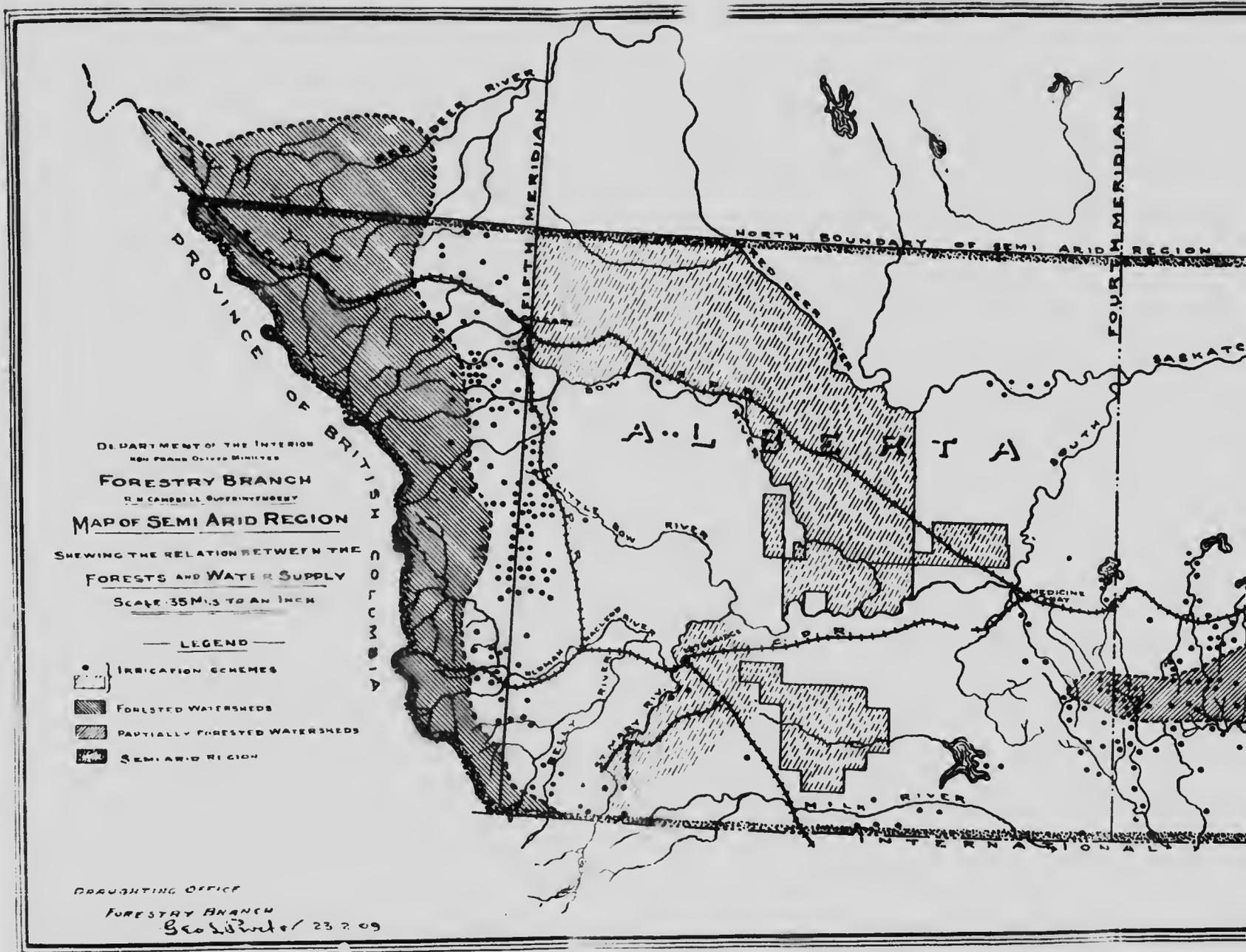
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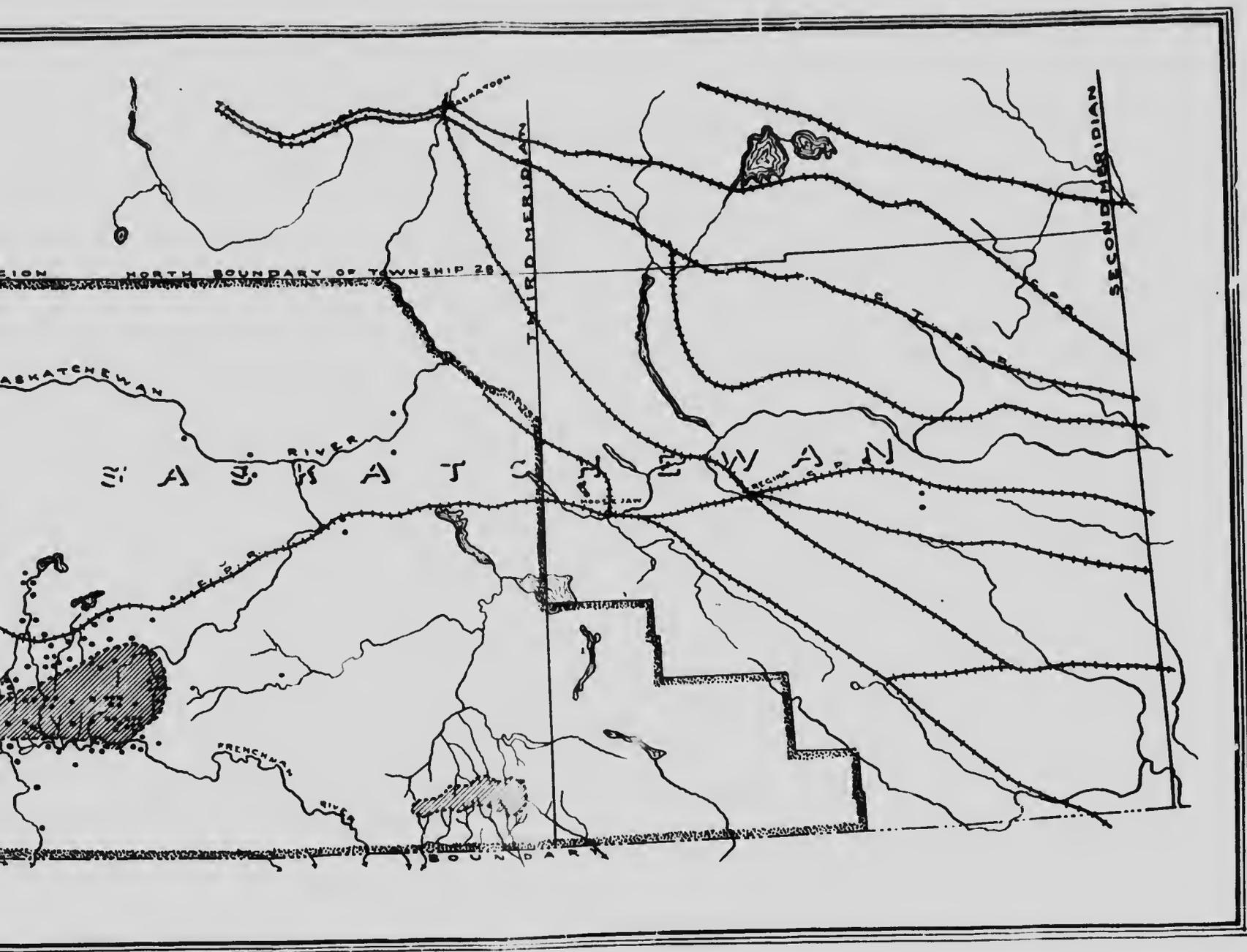
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forest floor does not permit the water to escape in such volume or at such speed as to enable it to wash soil particles into the stream. Water running rapidly from burned exposed soil cover carries large quantities of silt with it to the streams.

The water from denuded areas will come down to the streams at least twice as fast as the water from forest areas. In that case it has 64 times the silt carrying and eroding power. A reservoir on a stream leading from a denuded area would therefore receive annually many times the quantity of silt that would be carried into a reservoir on a stream with a forested catchment basin.

It is quoted in the report of the Commissioner of Irrigation for 1895, that 'should the forests be destroyed, the streams, irrigation systems and crops would meet a similar fate.'

The Forest will Produce a Revenue.

There are approximately 8,244 square miles within the watershed known as the east slope of the Rockies. The maintenance of a forest cover on this area will not entail an expense, but will afford the only revenue which can be secured from land that is unfit for farming or ranching. If no more profitable crop than mining props is produced and these are sold at a stumpage of $\frac{1}{2}$ cent per foot, the prevailing price in the Crow's Nest Pass to-day, the revenue to the government will be for each acre \$24 every 60 years. The east slope will be no exception to the world-wide experience, that forests under business management pay a permanent and substantial profit.

HOW FOREST MANAGEMENT MAY BEGIN.

FIRE PROTECTION.

The greatest menace to the forest on the eastern slope is fire. There is always great danger that succeeding fires will destroy the mature timber and the young forest and convert valuable land into a waste area.

Fires come from the Canadian Pacific Railway, settlers clearing land and carelessness by irresponsible foreign miners.

The fire protective system now in force is as efficient as it can be made under present conditions. The chief fire ranger, whose territory covers all Southern Alberta and whose duty includes forest ranging as well as fire ranging, has established a system of patrol during the dry season and has co-operated with Hon. Peter McLaren to secure efficient protection of the timber. The only point upon which this scheme could be improved would be the appointment of some person to take charge of the fire protection in this district, who could be on the ground all the time and give all his attention to the supervision of the work. The increasing development of mines, prospects and settlement on the eastern slope constantly render this step more necessary; and the increasing value of timber makes the strengthening of the fire protective force advisable.

There is good telephone connection between the danger points; the coal companies and the lumber companies are always ready to call out their men to fight fires all that is needed is organization and sincere effort on the part of some official in authority who can spend most of his time in the district. The Mounted Police have men stationed at Crow's Nest, Coleman, Blairmore, Lille and Frank; if they should receive instructions to co-operate with the official in charge of the territory they would be of great service in general patrol, and in emphasizing observance of the law by initiating a few prosecutions.

The greater number of the fires come from the railroad. The fire rangers on the right of way should be given authority to examine the engines, to see if they are complying with the law, and should be taught how to make such an examination.

Cutting Green Timber.

Under the present system of logging all or nearly all the trees below 10 inches in diameter are left standing, presumably to grow to a large size for future logging, and to seed up the ground for a future crop. In some districts this regulation is no doubt a wise one, but in the timber of the Crow's Nest valley the results are not in the best interests of the lumber trade or the forest.

After a logging operation in a mixed stand of pine and spruce, there is left a scattered stand of pine and spruce poles from four to ten inches in diameter. If it were certain that these poles would remain without wind-throw or destruction by fire until they were twelve or sixteen inches in diameter it might be profitable to leave them, but, as it is, the spruce, being shallow rooted and suddenly exposed to the fierce gales of the Crow's Nest Pass, is blown over within a few years after the logging operations. The pine, a deeper-rooted tree but not as strong, is broken off. Fire protection will probably be better in the future, but up to the present the greater part of the cut-over land has been burned over within five years after logging. The heavy slash remains inflammable for years and carries a fire that destroys all the trees remaining. It has been the general experience that the small trees left after a lumbering operation are not saved for a future crop but are a dead loss.

If the trees remaining seeded up the ground to a valuable species, they might prove a good investment, but natural production is not especially good on a tract logged to the 10-inch diameter limit. Spruce, pine and fir are the important species. Taking out all the trees to 10 inches diameter opens up the forest to such an extent that the soil is dried out too much and too much light is admitted for a successful spruce reproduction. On the other hand, the duff on the surface of the soil prevents a rapid reproduction of fir and pine. The results would be better for spruce reproduction if the forest were not opened so much and would be better for pine and fir reproduction if it were cut clear, or nearly so, and the brush burned broadcast.

Closer utilization of the timber is possible. The lumber companies are taking logs down to 8 inches or less in the top and would take 10 logs more per acre if they were not deterred by the 10-inch limit. They could take the rest of the green spruce and pine down to a diameter of four to six inches for mining props and thus profitably and beneficially clear up the operation. On all the old operations it is noticeable that they cut the stumps six to eighteen inches higher than is necessary. The cutting is nearly all done when there is very little or no snow on the ground, and when there is no necessity for cutting stumps over 12 inches high. They leave on an average in long tops and in old skidways 20 twelve foot logs, 8 inches or more at the top, on every acre. This waste is due to carelessness by lumber-jacks. It is a waste which many governments are checking by charging dues on the timber left in the woods. Lumbering operations in the Crow's Nest valley leave in the woods in skidways, high stumps and long tops, the following amounts per acre:—

30 mining props	8 ft. x 6 in.
15 logs	12 ft. x 8 in.
150 feet beard measure in high stumps.	

Per square mile there is:—
 161,600 lineal feet mining props.
 288,000 feet B. M. lumber.

In addition there are left in trees under ten inches in diameter, trees which are unlikely to stand until another cutting:—

Per acre:—	
40 mining props	8 ft. x 6 in.
15 logs	12 ft. x 8 in.

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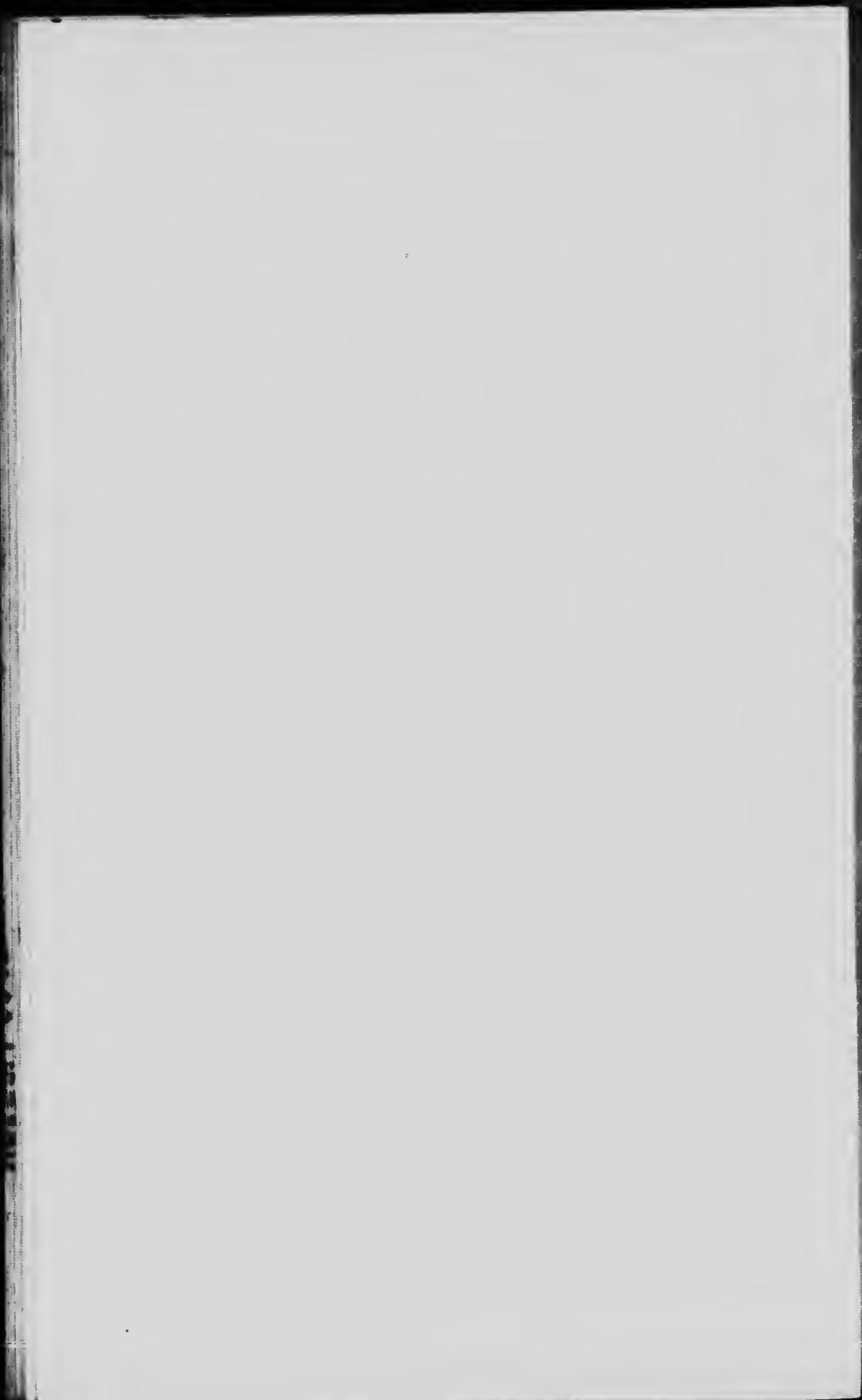
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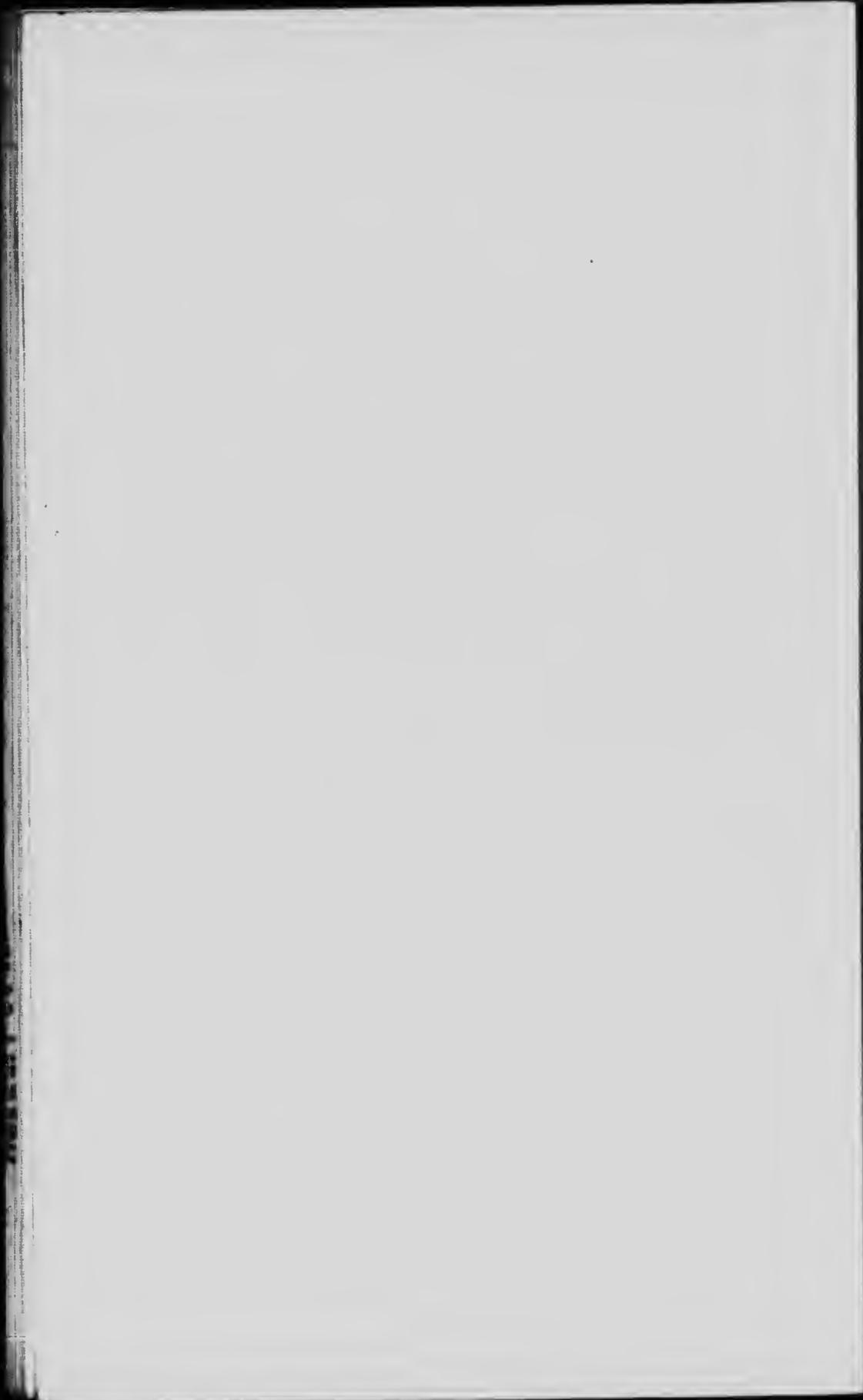


Timber left on a tract logged to the 10 inch diameter limit. Many of the standing spruces have died.
705 p. 20





A skidway left in the woods after logging.



Per mile:—

204,800 lineal feet props.

192,000 feet B. M. lumber.

The total probable waste per square mile is therefore:—

366,400 lineal feet mining props.

480,000 feet B. M. lumber.

The revenue to the government from the above at current stumpage rates would be \$295.75 per square mile. The value of the wasted timber at current market prices is \$9,012 per square mile.

Logging in the east slope should be under the superintendence of some one who would exercise his judgment in following the ideas here outlined. The first care in logging a protective forest such as that on the east slope should be that the forest cover should never be removed on steep slopes where too rapid run-off or erosion would result in damage. In all situations the removal of the timber should be followed by as rapid a reproduction as possible. Fortunately both objects are capable of practical solution. It has been mentioned that it may be found advisable in the Crow's Nest valley to grow spruce for lumber and pine for mining props, ties and polewood. In the valley heads and in the steep and usually moist slopes, where a protective forest is needed and where spruce grows naturally, spruce may be maintained. It will be cut to a diameter limit as it is at present, but not an arbitrary limit. It will not be so heavily cut over as at present, but just sufficient to open up the stand and permit natural reproduction. The amount and manner of cutting should be decided by the forester in charge, and should be such as to impose no hardships on lumbering operators. On the gentler slopes and terraces comprising the greater part of the area, pine and fir may be encouraged. In this case clear cutting would be the rule, the scheme being to leave small blocks of seed trees in the most advantageous positions, properly fire-guarded, to take everything else, down to props, lagging, and cordwood, and to scatter the brush and burn it. The burned-over land would provide the best possible seed-bed for pine and fir, and judging from observations and experience elsewhere a dense reproduction, such as to insure a permanent forest cover and timber supply, would follow immediately.

In the interest of closer utilization of the diminishing supply of timber and to reduce as much as possible the slash left on the ground operators should be encouraged to take out everything they can handle without a loss. A good plan would be to scale and levy stumpage dues on:—

- (a) All stumps over 12 inches in height.
- (b) All timber over 6 inches in diameter left in the top.
- (c) All logs over 10 feet long and 6 inches in diameter left in skids and rollways or left lying in the woods.
- (d) All mining props left in the woods where such are marketable.

Dead Timber.

The present supply of dead timber is being sold at a rate which will ensure its removal before decay ruins its value. When it is sold under contract in blocks the mining companies make a clean cutting, remove all the sound wood down to four inches and leave the ground in good shape. Provision should be made whereby the license should be cancelled on all cut-over land, and all title to and interest in the land should be held by the government.

Agricultural Settlement.

In the interests of the development of the country and the utilization of all natural resources agricultural settlement should be permitted wherever there is fertile

soil of sufficient area to raise under existing climatic and market conditions enough produce to support a family in decency. Homesteads in broken country along creek bottoms, valleys and on meadows in the mountains would be rendered more valuable if they were not laid out in quarter sections but in legal subdivisions. As it is there may be a meadow large enough for only one homestead but divided among four quarter sections. No one family can by any means homestead the whole meadow and no four families can make a living from it. If homesteads could be entered by legal subdivisions of forty acres each, they could be more fittingly adjusted to the irregular areas of arable land existing in the mountains.

Grazing should be permitted as at present on the unoccupied public land of the east slope, but should be under the supervision of the forester in general charge of the country so that steps may be taken to prevent damage to the range or to the forest by over-grazing.

The welfare of unsuspecting immigrants and the best utilization of the lands demand that no homestead entry should be granted until the area involved has been examined by the forester and pronounced fit for agriculture.

Reforestation.

There are large areas, chiefly the land described under the heading 'Denuded,' belonging both to the government and to mining companies, upon which no crop can be raised and upon which in the absence of natural reproduction it may be found advisable to institute some methods of artificial reforestation.

Unless it should develop that some mining company is willing to undertake tree-planting on a small scale this method of reforestation may be dismissed as too expensive for the area under consideration.

Lodgepole pine seed can be secured cheaply in large quantities during the logging operations in the valley. The burned slopes and gravelly benches of the denuded areas, especially the areas with the lightest ground cover, would appear to afford a seed-bed upon which broadcast sowing on the snow in the winter would be productive of good results. A portion of this land suited for reforestation belongs to the West Canada Colliery Company, the managers of which are interested in forest preservation, and it is possible that the company would be willing to co-operate with the government in the reforestation scheme.

Further Surveys.

It is widely believed that the timber on the east slope of the Rocky mountains is very important to the great plains to the east, both for its own sake and because of its influence on climatic conditions and waterflow. Yet it is not known how much timber there is, to what extent it has been destroyed by fire nor how much it affects the waterflow.

Timber and irrigation administration would be assisted by a knowledge of the quantity and location of the timber and the most feasible methods of fire protection, by a study of the interdependence of forests, precipitation and stream flow and by a study of the natural laws governing the advance, reproduction and development of the forest. Such a study could be made and all practical results secured by a small forest survey party working for a few months along the east slope northward from the international boundary.

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Dense cluster of cones on upper branches of lodgepole pine.

