DEPARTMENT OF THE INTERIOR, CANADA
HON. THOMAS G. MURPHY, Minister H. H. ROWATT, Deputy Minister
E. H. FINLAYSON, Director of Forestry

REPORT

OF THE

DIRECTOR OF FORESTRY

1929-30

(FISCAL YEAR ENDED MARCH 31, 1930)

OTTAWA
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1931

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FORESTRY

REPORT OF THE DIRECTOR OF FORESTRY, E. H. FINLAYSON

In the year under review agreements were signed with the western provinces for the return of the natural resources, including the forests. This action will relieve the Forest Service of its former administrative functions with regard to the protection and management of forest lands. The change will enable it to concentrate on investigation, research, and experiment, and to give leadership to the provinces and the forest industries. In particular this Service will be in a position to avail itself of the additional opportunities which are presented for investigation into basic forest-protection problems, for silvicultural researches into the rates and conditions of growth of Canadian tree species, for forest-products research looking to the closer utilization of Canadian raw materials, and for the more intensive prosecution of the national inventory of forest resources now actively under way.

The forest fire situation in Canada during the year 1929 was one of the most severe ever experienced and might easily have been the most disastrous in our history but for the development in protection facilities which has taken place in recent years. The area most affected extended from western Ontario to the Pacific coast. Throughout that region snowfall during the two preceding winters had been very deficient. In addition the spring and summer of 1929 were characterized by almost complete lack of rain. This condition, combined with extended periods of high winds, created an unparalleled drought situation throughout Western Canada. The expenditure on fire fighting alone was almost $1,250,000, the highest on record in the history of fire protection in Canada.

The following table, compiled by the Forest Service from returns made by the different forest authorities, gives in detail the figures of forest fires in Canada for the year 1929 as compared with the average for the five-year period 1925-29 inclusive.

Item	Year 1929	Average per year 1925-1929 inclusive
Total number of fires	6,685	5,146
Total area burned over (acres)	6,030,749	2,319,074
Merchantable timber—		
Area burned (acres)	674,226	376,223
Timber burned (M ft. B.M.	508,715	455,125
Timber burned (cords	2,005,386	1,634,821
Estimated stumpage value	$2,379,582	$ 2,532,868
Young growth—		
Area burned (acres)	1,023,111	531,836
Estimated value	$2,004,759	$ 1,013,925
Cut-over—		
Area burned (acres)	340,225	172,161
Estimated value	285,569	$ 130,002
Non-forested—		
Area burned (acres)	4,128,901	1,275,283
Other property burned—		
Value	$ 301,499	$ 441,883
Actual cost of fire-fighting	$1,239,345	$ 630,624
Total gross damage and loss	$6,210,754	$ 4,749,302

In accordance with an undertaking made to the provinces at the national forest inventory conference in June, 1929, the Research Division of the Forest Service concentrated its work largely on the inauguration of rate-of-growth studies in the main forest regions of Eastern Canada. The usual research activities were, however, continued at the forest experiment stations at Petawawa, Lake Edward, and elsewhere. In addition, a new experiment station was instituted at the forest nursery at Indian Head, Saskatchewan, dealing largely with pathological problems of Western Canadian species. The Forest Products Laboratories, having become settled in their new sites, turned their activities to carrying out research programs the scope of which it has been possible to enlarge considerably by reason of increased staff and equipment.

National Inventory of Forest Resources

At the conference of the federal and provincial forest authorities held in Ottawa, June 25 to 27, 1929, it was decided to conduct a national inventory of forest resources. The provincial authorities administering forests undertook to carry on the work in their respective provinces, and the Dominion Forest Service to conduct the inventory in the Prairie Provinces and to co-operate with and assist the other provinces as far as means were available. It was also agreed that the Forest Service should act as a clearing-house for information regarding the existing forest resources and their depletion and increment, the provinces furnishing reports of surveys and investigations as completed. The completion of the inventory (of the accessible area, at least) in five years was set as an objective.

Pursuant to the scheme adopted by this conference the Forest Service immediately commenced the inventory in the three Prairie Provinces by detailing a forest officer in each to collect and compile all existing data, examine areas concerning which reliable information was lacking, and keep records of depletion due to cutting, fire, etc. In 1929 three stock-taking survey parties were placed in the field in Manitoba and one in Saskatchewan, and in 1930 there will also be one in each of these two provinces.

Each province has been divided into a number of districts based primarily on drainage areas, and for each of these districts separate reports are being compiled showing the classification of the area as to tenure (privately owned, leased, or unalienated), farm land, waste land, and non-productive or productive forest. The latter is subdivided into softwood, hardwood, and mixed types of merchantable timber and young growth. The areas of virgin forest and cut-over and burned-over land are also recorded. An estimate of the amount of timber of merchantable size suitable for lumber, pulpwood, ties, poles, posts, etc., of each species is being compiled. The annual cut for all purposes and the losses from fire, insects, and disease are being estimated as closely as possible.

As a result of the extensive forest surveys conducted in Manitoba during the last four years, the inventory in that province is well advanced and there is every prospect of completing it within the five years set, but in Saskatchewan and Alberta there are such large areas for which the information is very meagre or altogether lacking that this may not be the case.

Aerial photography has been of the greatest assistance in these inventories, especially when used in conjunction with ground surveys. Maps are prepared from the photographs which not only give accurate topographical details, but show the waste land, merchantable timber, and young growth of the various types. With experience, the interpretation of aerial photographs is becoming much more efficient and it is confidently expected that with additional research along the lines started it will be possible by this means, supplemented by a

minimum of ground cruising, to determine, within a reasonable degree of accuracy, the extent of the forest resources over areas in which intensive ground surveys would entail large expenditures of time and money.

As part of its co-operation with the provincial services the Dominion Forest Service is conducting a series of surveys in each province to determine the kind and amount of natural reproduction which is taking place after cutting and fire, and the rate at which this young timber is growing.

Information being obtained through this inventory will make it possible to devise forest policies adapted to the varying forest conditions throughout Canada which will ensure to the forest industries continuous and economical production.

Silvicultural Research

The first field-work in connection with the Canada-wide study of the rate of growth of forests in their various conditions was commenced this year. It is proposed to determine the average current rate of growth of each tree species in each age-class and in each timber type. Particular attention will be given to young timber, the potential forests. Four field parties of eight men each commenced work on this problem in May and continued until October. These parties were located in Nova Scotia, New Brunswick, Quebec, and Ontario. By the end of the fiscal year the data were compiled and summarized in preparation for the interim report.

An additional research party in Quebec was engaged in remeasuring the numerous permanent sample plots that have been established at the several stations—Lac Tremblant, Lake Edward, and Lake Kenogami—from time to time during the past ten years. The results of the first remeasurement, and, in some instances, of the second remeasurement are now available.

Dual activities, research and administration, were conducted at the Petawawa experiment station. Research was concentrated on remeasurement of sample plots in connection with several experimental cutting areas, and with surveying an area for a demonstration woodlot to be managed on a working-plan basis. Considerable advancement has been made in the development of a fire-weather station at Petawawa. The season being exceptionally dry, the collection of most interesting and valuable data was made possible. It was a busy season for the administrative staff. Over a dozen fires started, but prompt action and continuous fighting kept them under control so that loss of timber was very slight. The organization, from detection to suppression, was strong; otherwise much valuable timber and many investigative projects would have been destroyed.

Further progress has been made with the study of type classification based on the distribution and association of floristic species of ground cover. The information collected by a field party in Alberta during the summer of 1929 indicates that some four or five definite types or sites can be recognized by the grouping of certain characteristic floral species.

The bulletin, *Form-class Volume Tables*, now issued, presents in concise form information invaluable to those, from coast to coast, concerned with forest products.

PLATE NO. 1.—A STAND OF RED PINE, UNTHINNED.

PLATE NO. 2.—A STAND OF RED PINE AFTER AN "EXPERIENCE" THINNING

These illustrations furnish an example of the practical application of scientific forestry principles. The scene of the operation is a 31-year-old woodlot near Kingston, Nova Scotia, composed chiefly of red pine trees, with a few white pines, occurring on land formerly under cultivation. The upper picture shows a view of part of the woodlot before any thinning was done. The lower picture shows a portion of the woodlot after thinning. A total of 676 trees per acre was left standing, the thinned material amounting to six cords. In

Fires and Fire Protection

All inspectorates report a very hazardous fire season.

In Manitoba the 1929 season, which lasted until the second week of October, was the longest ever experienced, and the worst since the inauguration of organized fire-fighting. The snowfall during the winter of 1928-9 was light; there was practically no spring rainfall, and the prolonged warm weather of the summer was accompanied by high winds. The loss was comparatively light, except on the east side of lake Winnipeg. Aerial co-operation was hindered somewhat by weather conditions and shortage of equipment, and static interfered to some extent with the use of the radio. Aircraft equipped with skis were used during the late winter and early spring. The total time of flying during April and May, 1929 (under winter conditions) was 176 hours; between May and November, inclusive, a total of 2,607 hours flying was done.

In Saskatchewan the hazard was intense from early spring until late autumn, being even worse than it was during the preceding season. The causes were practically the same as those operating in Manitoba, namely, the dry season of 1928 followed by a winter in which there was little or no precipitation, and a very warm, dry summer with unusually high winds. The fire loss within the national forests was greater than it had been during the two preceding seasons. In the fire-ranging districts, many fires were difficult of access, and could only with difficulty be prevented from spreading. Co-operation with the Civil Government Air Operations staff continued good; a total of 930 hours flying was done. Thirty-seven ground fires were extinguished during the late winter.

In Alberta the fire risk reached its climax in the summer, from the latter part of July on, when the situation in the southern forests of the east slope of the Rockies was fully as bad as those of 1910 and 1919; the first week of September, however, brought relief. In the Cooking Lake national forest and the southern part of the Edmonton fire-ranging district the hazard continued excessive from May till December. In the earlier part of the season, practically no risk was experienced during April. In the latter half of May rains in that part of the province south of the North Saskatchewan river relieved the hazard in southern Alberta, though in the northern part of the province a very acute risk developed. Rains in the middle of June alleviated the hazard except in the Cooking Lake forest and the southern part of the Edmonton fire-ranging district. With the exception of the region just named, the fire risk during the autumn was below the average. Intensive air patrol was necessary on account of the long period of high fire-hazard and the unfinished condition of the lookout units on the Crowsnest and Bow River forests. A total of 1,078 hours of flying was required—644 from the High River base and 434 from the Grande Prairie sub-base.

In British Columbia the fire-hazard was abnormally high. The absence of snowfall and the early spring contributed to this result, though the risk was not out of the ordinary until the last part of July. During the two months succeeding, the conditions were very bad, but after September returned to normal. The very great majority of the fires were of comparatively small extent but three which could not be controlled, in spite of the most strenuous work, were the cause of a large proportion of the season's fire loss. The railways caused most fires, but these were all small in area and were soon extinguished. Lightning was the second greatest cause of fires, and incendiarism, which came third, is still the cause of a serious number of fires (almost ten per cent).

addition to the immediate profit to the owner, his woodlot will be left in much better condition. These plots belong to an experimental series established on a co-operative basis by the owner of the land, the provincial forest service of Nova Scotia, and the Forest Service, Department of the Interior. (F.S. Photos. 19894 and 19891)

In the tables that follow are given the fire-statistics for the 1929 season:—

Table No. 1

FIRES WITHIN AND OUTSIDE NATIONAL FORESTS: AREA BURNED OVER AND FIRE LOSS BY CAUSES

Causes	Manitoba			Saskatchewan			Alberta			British Columbia			Totals		
	No.	Area	Damage	No.	Area	Damage	No.	Area	Damage	No.	Area	Damage	No.	Area	Damage
		acres	$		acres	$		acres	$		acres	$		acres	$
Camp-fires	223	601,305	260,238	125	122,322	78,427	113	61,883	71,544	28	3,086	6,111	489	788,596	416,320
Smokers	55	11,130	6,615	33	9,774	848	34	4,001	2,330	60	3,227	24,327	182	28,132	34,120
Settlers	75	69,342	10,287	179	326,727	381,307	64	89,333	69,448	29	2,511	4,464	347	487,913	465,506
Railways	89	227,043	153,233	44	21,112	12,419	129	5,308	13,465	132	625	61	394	254,088	179,178
Lightning	79	2,164,624	245,275	18	72,090	110,688	8	589	4,028	127	26,546	215,862	232	2,263,849	575,853
Industrial operations	3	36	4	28	90,018	96,686	5	7	.....	16	4,342	21,300	52	94,403	117,990
Incendiary	64	38,690	17,054	61	50,773	41,084	14	20,943	4,912	45	3,511	19,299	184	113,917	82,349
Public works	8	64,625	23,177	1	1,800	1,440	7	5,233	2,270	5	804	1,875	21	72,577	28,762
Unclassified	3	6,341	9,191	8	13,772	14,240	1	1	500	4	161	60	16	20,200	23,991
Unknown	61	221,688	105,412	20	33,879	48,852	21	87,512	211,638	14	2,277	11,558	116	345,356	377,460
Total	660	3,404,824	830,486	517	742,307	785,991	396	274,810	380,135	460	47,090	304,917	2,033	4,469,031	2,301,529
Total cost of suppression	....	.....	150,989	....	.....	112,570	....	.....	60,591	....	.....	69,642	....	.....	393,792
Total fire loss	....	.....	981,475	....	.....	898,561	....	.....	440,726	....	.....	374,559	....	.....	2,695,321

Table No. 1a

FIRES WITHIN AND OUTSIDE NATIONAL FORESTS: FOREST CONDITION OF BURNED-OVER AREAS, EXPENDITURE FOR FIRE-FIGHTING, ETC.

Province	Non-forested	Young growth	Cut-over land	Merchantable timber		Expenditure for fire fighting			Fires under jurisdiction Railway Board		
				Area	Value	Ranger Service	Other expenditure	Total	Number	Area burned	Loss
	acres	acres	acres	acres	$	$	$	$		acres	$
Manitoba	2,898,696	219,257	21,366	265,505	406,480	6,937	144,052	150,989	43	1,242	200
Saskatchewan	334,466	261,730	24,100	122,011	276,849	9,092	103,479	112,570	23	15,305	10,536
Alberta	114,958	110,931	1,562	47,359	163,408	5,095	55,496	60,591	123	508	1,022
British Columbia (Railway Belt)	5,474	11,804	7,630	22,182	234,496	5,303	64,338	69,641	96	503	163
Total	3,353,594	603,722	54,658	457,057	1,081,233	26,427	367,365	393,791	285	17,558	11,921

Table No. 2

FIRES WITHIN NATIONAL FORESTS: NUMBER AND AREA BURNED, BY CAUSES

Causes	Manitoba		Saskatchewan		Alberta		British Columbia		Totals	
	Number	Area	Number	Area	Number	Area	Number	Area	Number	Area
		acres		acres		acres		acres		acres
Camp-fires	19	4,226	38	62,190	11	1,548	10	2,972	78	70,936
Smokers	10	2,843	6	1,446	12	72	13	995	41	5,356
Settlers	5	712	123	99,415	.....	.....	1	3	129	100,130
Railways	.....	.....	25	5,138	5	3	2	55	32	5,196
Lightning	2	803	2	1,065	5	4	15	2,584	24	4,456
Industrial operations	2	36	1	.....	3	1	.....	.....	6	37
Incendiary	48	28,132	22	16,525	3	17,267	31	3,177	104	65,101
Public works	1	640	1	1,840	1	21	.....	.....	3	2,501
Unclassified	.....	.....	1	.....	1	1	2	81	4	82
Unknown	9	4,029	8	3,680	4	61,341	1	2	22	69,052
Total	96	41,421	227	191,299	45	80,258	75	9,869	443	322,847

Table No. 3

FIRES OUTSIDE NATIONAL FORESTS: NUMBER AND AREA BURNED BY CAUSES

Causes	Manitoba		Saskatchewan		Alberta		British Columbia		Totals	
	Number	Area	Number	Area	Number	Area	Number	Area	Number	Area
		acres		acres		acres		acres		acres
Camp-fires	204	597,079	87	60,132	102	60,335	18	114	411	717,660
Smokers	45	8,287	27	8,328	22	3,930	47	2,232	141	22,777
Settlers	70	68,630	56	227,312	64	89,333	28	2,508	218	387,783
Railways	89	227,043	19	15,974	124	5,305	130	570	362	248,892
Lightning	77	2,163,822	16	71,025	3	585	112	23,962	208	2,259,394
Industrial operations	1	.....	27	90,018	2	5	16	4,342	46	94,365
Incendiary	16	10,557	39	34,248	11	3,676	14	334	80	48,815
Public works	7	63,985	.....	.....	6	5,212	5	804	18	70,076
Unclassified	3	6,341	7	13,772	0	.....	2	80	12	20,118
Unknown	52	217,659	12	30,199	17	26,171	13	2,275	94	276,304
Total	564	3,363,403	290	551,008	351	194,552	385	37,221	1,590	4,146,184

Table No. 4

CLASSIFICATION BY SIZE OF FIRE

Province	Class A (under ¼ acre)		Class B (¼ acre and over, but under 10 acres)		Class C (10 acres to 500 acres)		Class D (over 500 acres)		Totals, 1929-1930		Totals, 1928-1929	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent by provinces	Total number of fires	Per cent Class A
Manitoba	35	5·3	150	22·7	257	38·9	218	33·0	660	32·6	380	17
Saskatchewan	101	19·5	98	18·9	174	33·8	144	27·8	517	25·4	320	16
Alberta	137	34·6	94	23·7	105	26·5	60	15·2	396	19·4	396	14
British Columbia (Railway Belt)	147	32·0	213	46·0	85	19·0	15	3·0	460	22·6	475	65
Totals	420	20·0	555	26·0	621	32·0	437	22·0	2,033	100·0	1,571	30

Table No. 5

DISTRIBUTION BY MONTHS

Month	Manitoba		Saskatchewan		Alberta		British Columbia		Totals	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
April, 1929	15	2·3	15	2·8	49	12·4	15	3	94	4·6
May	140	21·2	227	44·0	102	25·7	39	8	508	25·0
June	101	15·3	59	11·4	60	15·1	22	5	242	11·9
July	103	15·6	14	2·7	60	15·1	187	41	364	17·9
August	181	27·4	79	15·3	19	4·8	151	33	430	21·1
September	50	7·6	22	4·2	31	7·9	43	9	146	7·1
October	65	9·8	60	11·6	40	10·1	3	1	168	8·3
November	5	0·8	4	1·0	34	8·6	.....	.....	43	2·1
December	.....	.....	.....	.....	1	0·3	.....	.....	1	.....
January, 1930	.....	.....	6	1·0	.....	.....	.....	.....	6	0·3
February	.....	.....	16	3·1	.....	.....	.....	.....	16	0·8
March	.....	.....	15	2·9	.....	.....	.....	.....	15	0·7
Totals	660	100·0	517	100·0	396	100·0	460	100·0	2,033	100·0

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Table No. 6

STATEMENT OF THE AMOUNT OF TIMBER AND OTHER PROPERTY DESTROYED

Province	Salvable timber			Unsalvable timber			Damage to timber		Damage to young growth		Damage to other property		Total damage
	Sawtimber	Other	Depreciation	Sawtimber	Other	Damage							
	Ft. b.m.	cords	$	Ft. b.m.	cords	$	$	%	$	%	$	%	$
Manitoba	493	53,940	14,422	44,318	855,867	384,998	399,420	48·1	409,073	49·3	21,993	2·6	830,486
Saskatchewan	20,755	355,073	80,365	10,426	511,594	196,482	276,847	35·2	490,998	62·5	18,146	2·3	785,991
Alberta	16,453	1,302	15.862	64,786	96,570	147,546	163,408	42·9	212,959	56·1	3,768	1·0	380,135
Br. Columbia (Dominion Lands)	3,384	37,442	10,555	112,484	49,500	242,941	253,496	83·2	21,248	6·9	30,173	9·9	304,917
Totals	41,085	447,757	121,204	232,014	1,513,531	971,967	1,093,171	47·4	1,134,278	49·4	74,080	3·2	2,301,529

Table No. 7

STATEMENT OF DOMINION LANDS BURNED OVER, SHOWING OWNERSHIP AND FOREST CONDITIONS

Province	Total area burned over	Ownership				Forest conditions							
		Public		Private		Merchantable timber		Partially cut-over		Young growth		Not forested	
	acres	acres	%	acres	%	acres	%	acres	%	acres	%	acres	%
Manitoba	3,404,824	3,387,513	99·5	17,311	0·5	265,505	7·7	21,366	0·6	219,257	6·4	2,898,696	85·3
Saskatchewan	742,307	600,757	80·8	141,550	19·2	122,011	16·4	24,100	3·2	261,730	35·2	334,466	45·2
Alberta	274,810	262,155	95·4	12,655	4·6	47,359	17·2	1,562	0·5	110,931	40·4	114,958	41·9
British Columbia (Railway Belt)	47,090	41,884	88·9	5,206	11·1	22,182	47·1	7,630	16·2	11,804	25·1	5,474	11·6
Totals	4,469,031	4,292,309	96·1	176,722	3·9	457,057	10·2	54,658	1·2	603,722	13·5	3,353,594	75·1

Fire-Hazard Studies

As in previous years, weather records were taken throughout the fire season at a number of selected stations in forest areas in the Prairie Provinces and the Railway Belt of British Columbia. The data obtained at these stations proved of material value to fire-protective organizations in the direction of fire patrols and suppression work.

In addition to the foregoing, fire-hazard research studies were continued at the Petawawa forest experiment station at Chalk River, Ontario, with the object of studying the degree of inflammability of forest-fire fuels (the materials on the forest floor in which fires start or spread) under varying conditions of moisture content. As a result of this work, it is now definitely known precisely what effect a given set of weather conditions has upon the inflammability of the forest fuels in the white pine and red pine type. The information thus obtained proved of great value in accurately determining the condition of inflammability of the forest each day and was useful in detailing the work of the men so that they would be immediately available in the event of a fire being reported. It was also used in determining the necessity of keeping men on duty on Sundays, the number of men necessary to send to a fire, and in posting warnings at the entrance to the forest reserve for the guidance of visitors in the use of fire.

The procedure consisted in establishing five zones of inflammability for mixed red and white pine forest ranging from nil to extreme, depending upon the moisture content of the fuels. The behaviour of fires in each zone was identified. The rates of change of moisture content and consequently the inflammability, under varying conditions of rainfall, wind velocity, relative humidity of the air, temperature, and evaporation, were determined for the mixed red and white pine forest in the climatic area of the Petawawa forest experiment station.

Improvements

Hereunder is a list of the principal improvements made during the year:—

	Number		Miles
Ranger house	1	Telephone lines	154
Ranger cabins	21	Roads	49
Stables	5	Trails	200
Warehouses	2	Fireguards (ploughed)	339
Garages	2	Fireguards (cleared)	107
Barns	5		
Machine sheds	2		
Lookout cabins	2		
Lookout towers	4		
Bridges	6		
Summer-resort pier	1		
Golf course	1		
Fences	5		
Cableway	1		
Nursery water systems	4		
Other buildings	13		

Hay and Grazing

In Manitoba the grazing situation improved somewhat, and the demand for hay was keen owing to the poor hay crop brought about by the dry weather. Practically all the hay meadows in the national forests were cut over.

In Saskatchewan there was a decided increase in the number of hay permits issued, the dry weather permitting the cutting of hay meadows usually flooded. Grazing, however, is decreasing owing to the fact that the farmers are more and more inclined to engage in mixed farming and raise their own forage crops. In Alberta more sheep but fewer cattle and horses were grazed.

In British Columbia weather conditions (in particular the small snowfall of the preceding winter, 1928-9) were unfavourable for grazing. With the idea of encouraging stockmen to use the higher ranges, several trails were constructed and other improvements made.

Timber Sales and Permits

In Manitoba five timber sales were carried on. The number of timber permits was slightly smaller and practically all of them were in the Riding Mountain, Duck Mountain, and Porcupine forests.

In Saskatchewan there was a slight increase in timber sales and permits. Thirty-two new sales (twenty-six "Supervisor's," five "Inspector's," and one "Director's") were awarded. There was a brisk demand for timber permits, especially on the prairie reserves. Very little pulpwood was cut. Owing to the dry season, great care was required in supervising brush-burning operations but practically all the brush was burned.

In Alberta ten new sales were awarded during the year and thirteen sales were closed out. The total cut was slightly less than last year's total, but is above the five-year average. The number of permits issued was **673**. There was an increase in the quantities of fence-posts, fence-rails, poles, and fuelwood. The cut of sawlogs was stationary and there was a decrease in the cut of mining timber and thinnings.

In British Columbia the season was very active in regard to timber sales, nineteen new sales being awarded. The greatest demand was for poles and piling; the demand for sawlogs was small and only a few ties were cut. Sale conditions were well complied with.

Reforestation

In Manitoba 47,500 trees were set out on the Riding Mountain forest, but no seeding was done. Sprinkling systems worked satisfactorily at all the nurseries and a total of 2,429,400 young trees is on hand.

In Saskatchewan 46,000 trees (14,000 white spruce and 32,000 jack pine) were set out on the Dundurn, Nisbet-Pines, and Big River forests. The excessive mortality of jack pine planted in the autumn of 1928 showed that fall planting of jack pine was not a success. In the nurseries growth was hindered by dry weather. The number of seedlings on hand is 5,435,397, and the number of transplants 749,672. A detailed nursery cost system was introduced in 1928, and it is found that the cost of seedlings is on a par with similar nursery stock in the United States, but the cost of transplants is excessive.

In Alberta 50 acres of spruce and 25 acres of lodgepole pine were planted in the Cooking Lake forest. There has been much damage from rabbits and a rabbit-proof fence has been erected around the area planted to pine. Older plantations are doing well. For planting in 1930 there are on hand 180,000 spruce and pine seedlings and 10,000 transplants.

Recreation

In Manitoba the number of visitors at the summer resorts in the national forests showed a marked increase; the estimated daily total number of visitors at all these resorts amounted to 1,400. Improvements made include the clearing of four acres of land at Benito Beach and two acres at Kamsack Beach, the construction of a promenade along the lake at the latter resort, the laying out of two additional tennis courts, and the erection of a pier and a bath-house. At the Clark Beach (Riding Mountain) resort a nine-hole golf course was constructed and throughout all the summer resorts much road-improvement work was done.

In Saskatchewan the resorts continue to be popular, especially at Fish lake (Moose Mountain), where fifty additional lots were laid out in the Sandy Bay subdivision. Fishing permits issued in this forest showed a substantial increase in number.

In Alberta the Elkwater Lake resort, the only one in this inspectorate, has a steadily increasing number of visitors, and the camping grounds in the mountains continue popular in summer and autumn.

In British Columbia both the Paul Lake and the Fish Lake resorts continue popular, though no great demand has been experienced for camp or cottage lots. Attention is being given to camping sites along the automobile highways in the national forests. The ditch connecting Walloper lake and Fish lake has been found useful in providing spawning grounds for the trout and raising the level of Fish lake.

Surveys

In Manitoba the surveys of pulpwood resources were continued by three parties, two in the Nelson River drainage area and one in the Saskatchewan River drainage area. A total of about 4,262,000 acres was covered, of which 1,562,000 acres were in the Nelson area and 2,700,000 acres in the Saskatchewan area.

In Saskatchewan three 4-man crews were engaged in an inventory survey in the Pasquia forest. Though their work was interrupted by fire, they succeeded in covering 128,000 acres. During the winter a 2-man party cruised 9,406 acres in the Fort à la Corne forest.

In Saskatchewan, on account of heavy demands from prospective settlers for the opening of lands in national forests and proposed additions thereto, examinations were made of these lands and 66½ sections were withdrawn from the forests; five townships were also withdrawn as the result of examination by officers of the Department.

Seed Collection and Extraction

In Manitoba there was a heavy crop of Manitoba maple seed, and 3,058 pounds were collected at Dauphin and sent to Indian Head, Saskatchewan, for extraction.

In Saskatchewan 128 bushels of jack pine cones and 125 bushels of white spruce cones were collected, yielding, respectively, 58 and 86 pounds of seed. The cost of the jack pine seed was higher than usual, but the white spruce seed cost little more than half that extracted in 1927. Ten pounds of balsam fir seed were also procured.

In Alberta the crop of spruce and balsam fir cones was very poor and collection was not feasible; 200 pounds of lodgepole pine seed were extracted from cones collected in previous years.

The demand for British Columbia seed continued, and two and one-quarter tons of seed were sent to the British Forestry Commission. Large orders from the Irish Free State, New Zealand, and Australia were also filled, and Norway, Sweden, Finland, Denmark, Spain, and Russia were sent small lots. Although the crop of coast Douglas fir seed was a failure and that of lowland fir was not satisfactory, the crops of other varieties of seed were some of the best on record, especially Sitka spruce, the season's yield of this seed being the best since this Service started the work of seed collecting. All picking was done by contract. The total quantity of seed extracted amounted to five and a quarter tons—the yield of about thirteen carloads of cones. The quality of seed was unusually good, as high as 96 per cent germination being obtained in one shipment of yellow pine seed.

Tree Planting on Prairie Farms

A detailed account of the work in connection with the distribution of trees to settlers on the prairies is given hereunder in the report of the Chief of the Tree-planting Division.

Forest Products Laboratories of Canada

Since the reorganization of the laboratories at Ottawa and Montreal has been completed and these laboratories have become well established in their new quarters, all three laboratories have made satisfactory progress. The past year was one of exceptional activity. Increasing interest in the work of the laboratories has been manifested by the wood-using industries, a fact which provides an important incentive to the staffs of the laboratories. A detailed report of this work is given hereunder in the report of the Superintendent of the Laboratories.

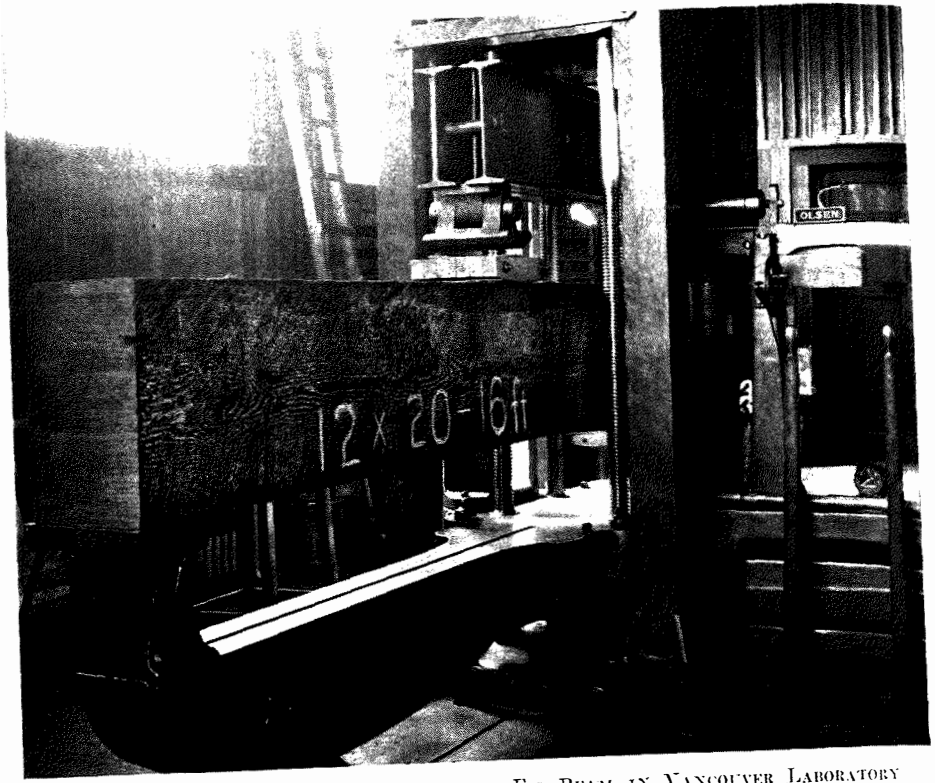


PLATE No. 3.—TEST OF A LARGE DOUGLAS FIR BEAM IN VANCOUVER LABORATORY

This timber (12 inches by 20 inches by 16 feet in dimensions) was obtained during the demolition of a large sawmill at Vancouver, B.C., and had been approximately 35 years in service. The timber, loaded at the trisectional points of the span, failed in horizontal shear at a load of 145,970 pounds. The maximum horizontal shear developed was 472 pounds per square inch, whereas the modulus of rupture was 6,115 pounds per square inch. These stresses in both instances are greater than four times the allowable working stress for the species and grade. As the span was comparatively short for the heavy load, the full strength in bending was not developed, but the probability is that the beam had lost little, if any, of its original strength.

PUBLICITY

As it was felt that the annual forest-week campaign which had been staged each spring for several years had outlived its usefulness, this method of fire prevention was discontinued in 1929. The newspaper-advertising campaign, previously an integral part of the forest-week campaign, was, however, maintained as a separate venture and showed uniform success. Advertisements appeared under this plan in all dailies, weeklies, farm periodicals, and foreign-language and financial papers over the period from May to September.

In June, July, and August, four different lecturers were in the field, visiting boys' and girls' vacation camps. In all, 32 camps and 3,013 campers were visited.

A representative of the Service again supervised the forestry exhibits at the Class A fairs in Western Canada. Following the success of the log cabins erected by this Service on the fair grounds at Calgary and Edmonton, similar structures were erected on the fair grounds at Saskatoon and Brandon; the latter is a particularly fine example of log building, and has come in for considerable commendation and admiration. In addition to these exhibits at Class A fairs, booths were established by local officers at twelve of the smaller fairs and exhibitions in the Prairie Provinces and British Columbia.

The course of forestry lectures at Dauphin normal school was carried on as usual. Routine publicity materials—calendars, posters, pamphlets, novelties for distribution at fairs, and similar items—were designed and distributed throughout the year. The district inspectors report a steadily increasing interest in forestry problems, stimulated by the publicity work of the Service.

PUBLICATIONS

The most important publication issued during the year was the book of *Form-class Volume Tables* for red, white, and black spruce; red, white, jack, and lodgepole pine; and balsam fir. This embodies the results of several years' work by the Research division of the Service. These tables will prove of great service to foresters and executives of large lumbering and pulp companies in computing the quantities of wood to be obtained from different stands of timber, and a large demand has already been experienced for them. The format is designed to make the book of service in the field as well as in the office. The book includes 170 volume tables showing the volume of wood to be obtained from trees of specified diameters and heights, and a number of other tables of value to foresters and timber estimators. Two new circulars were issued, namely, No. 27, *Creosote Treatment of Douglas Fir,* and No. 28, *Stain and Decay in Lumber-seasoning Yards.* Forestry Topic No. 6, *The Christmas Tree Trade in Canada,* was also issued during the year.

REVENUE

The revenue from all sources during the fiscal year showed a net decrease of $33,591.28. With the exception of the fiscal year 1926-7, the revenue was less than that of any year in the five-year period 1924-5 to 1928-9 and about $18,000 below the average. The decrease was due mainly to lessened receipts of $24,170.44 in timber sales and $10,298.51 in miscellaneous receipts.

The decrease in timber-sale revenue is due mainly to the drop in receipts from the Pasquia forest, Saskatchewan, which amounts to $36,596.80. Although the number of active sales was greater than the previous year, "Supervisor's" sales predominated, and, while this class of sale evidently fills a long-felt want, the volume of timber thus sold was below that included in "District Office" or "Head Office" sales of previous years, as partly indicated by the decrease in revenue. A substantial increase in the revenue from timber sales in the Big River forest, Saskatchewan, somewhat offsets the net decrease in Saskatchewan. Active timber sales show an increase of 16, with "Supervisor's" sales predominating.

The revenues from fishing and nursery stock show slight increases and that from tree seed is increased by $4,936.16. Grazing fell off somewhat in Alberta, but shows increases in the other provinces; the net decrease is $689.01. Owing to the continued dry weather the demand for hay was unusually heavy, resulting in an increase of $1,009.17. The increased demand for summer-resort privileges is also indicated in the increase of $1,005.95 in surface rentals.

The kinds and total quantities of timber authorized to be cut from all reserves, the revenue of which is shown under the heading of "Timber Permits" in the statement of revenue, were as follows:—

Fuel-wood (cords)	25,161
Fence-posts, rails, and piling (number)	338,070
Fence-posts, rails, and piling (linear feet)	15,060
Telephone poles (linear feet)	1,670
Railway ties (number)	770,201
Saw-timber (feet board measure)	7,568,961
Mining timber (linear feet)	498,760
Mining ties (number)	500
Building logs (number)	21,287
Building logs (linear feet)	131,723
Miscellaneous (cords)	1,666
Miscellaneous (number)	215

Sixty-two new timber sales were awarded during the fiscal year. The dues payable amounted to **$99,050.26**, and **$110,519.19** including arrears was collected.

The kinds and amounts of material cut and scaled on national forests in connection with timber sales are shown in the following statement:—

Number of active sales	166
Sawlogs (feet board measure)	21,804,842
Mine timber—	
Lagging (linear feet)	115,627
Other kinds (linear feet)	718,016
Railway ties hewn (number)	29,014
Telephone poles (linear feet)	887,487
Fence-posts, rails, and droppers (number)	18,683
Fuel-wood (cords)	1,364½
Pulpwood (cords)	1,105
Boxwood (cords)	3,905
Piling (linear feet)	24,767
Mine props (feet board measure)	477,216
Mine ties (number)	8,395

STATEMENT OF REVENUE, FOREST SERVICE, FISCAL YEAR 1929-1930

National Forest	Number of timber sales operating	Revenue from timber sales	Number of timber permits	Revenue from permits, etc.	Number of grazing permits	Revenue from grazing permits	Other Sources of Revenue							Total revenue all sources
							Hay permits and seizures	Surface rentals	Special uses	Tree seed	Miscellaneous including fishing	Casual revenue	House rent	
		$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.
Duck Mountain	3	1,209 81	299	2,463 23	17	183 60	388 25	566 35	62 00	.....	36 00	0 70	.....	4,909 94
Porcupine No. 1	4	441 18	89	1,453 37	1	2 00	29 00	.....	27 00	.....	164 00	.....	.....	2,116 55
Riding Mountain	1	3,553 25	1,187	10,417 08	17	160 40	754 84	1,744 57	145 00	.....	239 70	.....	.....	17,014 84
Sandilands	3	1,901 19	13	203 20	.....	.....	.....	.....	4 00	.....	.....	.....	.....	2,108 39
Spruce Woods	.....	.....	10	22 50	.....	.....	40 25	.....	.....	.....	.....	.....	.....	62 75
Turtle Mountain	.....	.....	16	55 25	34	331 00	178 75	72 60	16 00	.....	50 00	.....	144 00	847 60
Manitoba Total	**11**	**7,105 43**	**1,614**	**14,614 63**	**69**	**677 00**	**1,391 09**	**2,383 52**	**254 00**	.....	**489 70**	**0 70**	**144 00**	**27,060 07**
Beaver Hills	.....	.....	28	109 50	18	79 79	314 25	.....	2 00	.....	.....	.....	.....	505 54
Big River	2	12,269 99	76	388 32	2	31 52	163 75	.....	28 50	.....	.....	.....	288 00	13,170 08
Dundurn	.....	.....	22	84 00	5	155 68	26 00	.....	7 00	.....	.....	.....	.....	272 68
Elbow	.....	.....	269	615 25	156	917 50	80 00	1 00	227 20	.....	.....	.....	.....	1,840 95
Fortà la Corne	7	936 82	259	2,372 59	1	2 76	34 75	27 00	21 00	.....	.....	.....	210 00	3,604 92
Keppel	.....	.....	6	41 50	51	362 28	.....	.....	6 00	.....	.....	.....	.....	409 78
Manito	.....	.....	79	252 50	94	1,549 48	41 50	115 30	47 00	.....	.....	18 53	.....	2,024 31
Moose Mountain	1	19 43	169	710 35	22	189 97	223 33	275 48	31 00	.....	881 00	15 00	144 00	2,489 56
Nisbet-Pines	8	981 66	242	1,347 05	20	284 47	212 25	5 00	869 88	.....	.....	.....	.....	3,700 31
Pasquia	36	25,818 72	88	2,617 52	2	23 42	220 25	8 00	59 00	.....	.....	.....	288 00	29,034 91
Porcupine No. 2	13	2,778 61	293	1,979 61	6	70 78	433 25	140 00	206 00	.....	.....	.....	.....	5,608 25
Seward	.....	.....	.....	.....	29	713 44	52 50	.....	26 00	.....	.....	.....	.....	791 94
Saskatchewan Total	**67**	**42,805 23**	**1,531**	**10,518 19**	**406**	**4,381 09**	**1,801 83**	**571 78**	**1,530 58**	.....	**881 00**	**33 53**	**930 00**	**63,453 23**
Athabaska	.....	.....	3	43 40	7	82 28	7 25	.....	35 00	.....	94 00	.....	84 00	345 93
Bow River	2	4,925 96	43	539 28	67	4,264 02	17 00	1 25	51 25	.....	22 00	32 81	.....	9,853 57
Brazeau	12	6,765 55	32	1,555 66	84	306 50	.....	1,536 56	26 00	.....	634 25	.....	144 00	10,968 52
Clearwater	4	9,140 28	12	290 88	39	303 56	4 75	573 78	14 19	.....	298 62	30 80	.....	10,656 86
Cooking Lake	.....	.....	6	17 00	63	469 28	153 75	.....	3 00	.....	.....	.....	144 00	787 03
Crowsnest	7	2,216 15	131	5,042 41	140	5,995 26	.....	339 06	306 25	.....	137 00	.....	.....	14,036 13
Cypress Hills	1	.....	454	2,363 76	92	1,952 19	.....	65 15	127 83	.....	9 00	.....	144 00	4,661 93
Lesser Slave	6	9,419 50	.....	.....	.....	.....	6 50	.....	10 00	.....	39 75	.....	144 00	9,619 75
Alberta Total	**32**	**32,467 44**	**681**	**9,852 39**	**492**	**13,373 09**	**189 25**	**2,515 80**	**573 52**	.....	**1,234 62**	**63 61**	**660 00**	**60,929 72**
British Columbia Reserves	**54**	**22,684 71**	**23**	**230 28**	**91**	**1,606 10**	**41 25**	**297 80**	**201 67**	**13,310 60**	**199 61**	**95 23**	.....	**38,658 25**
Indian Head Nursery	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	**5,014 95**	**34 00**	**1,200 00**	**6,248 95**
Forest Products Laboratories	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	**67 80**	.....	.....	**67 80**
Sundries	.....	.....	.....	.....	.....	.....	.....	.....	.....	**12 00**	**574 05**	**1,420 00**	.....	**2,006 05**
Head Office (Petawawa)	**2**	**5,456 38**	**4**	**265 00**	.....	.....	.....	.....	.....	.....	.....	.....	.....	**5,721 38**
Grand Total	**166**	**110,519 19**	**3,853**	**35,480 49**	**1,058**	**20,037 28**	**3,423 42**	**5,768 93**	**2,559 77**	**13,322 60**	**8,452 73**	**1,647 07**	**2,934 00**	**204,145 45**
Refunds	.....	**7,816 73**	.....	**1,227 17**	.....	.....	**115 50**	.....	.....	.....	**18 00**	.....	.....	**9,177 40**
Net revenue	.....	**192,702 46**	**3,853**	**34,253 32**	**1,058**	**20,037 28**	**3,307 92**	**5,768 90**	**2,559 77**	**13,322 60**	**8,434 73**	**1,647 07**	**2,934 00**	**194,968 05**

Tree-Planting Division

Norman M. Ross, Chief

Tree Distribution

Everything considered, the season of 1929-30 proved to be the most unfavourable that has been experienced since 1901, with respect to both nursery work and general tree culture over practically the whole of the Prairie Provinces. This condition was brought about by drought, heat, and excessive windstorms throughout the season, following a winter of comparatively light snowfalls and two or three periods of abnormal temperatures.

Conditions for spring planting were fairly favourable, as the soil, being free from excessive moisture, could be easily worked. From June onward, however —except in the extreme north and northwestern areas—conditions became worse.

On the whole, plantations suffered more than usual from winter-killing, which was more particularly in evidence in south-central Saskatchewan and central Alberta, and much less noticeable in the northern districts. The winter-killing, it is thought, was due chiefly to the abnormal temperature changes in January and February. Such species as Manitoba maple, willow, and poplar were the ones that suffered; the ash, on the other hand, showed up splendidly, and each season it becomes apparent that this is one of the most dependable trees for planting in the Prairie Provinces. Plantations on the heavier clay soils suffered much more than those on lighter soils. Established evergreens came through everywhere in good condition. As might be expected, the newly set out plantings were the ones to suffer most, owing to lack of precipitation. Broad-leaved rooted stock did wonderfully well under the conditions, reports indicating a survival of maple 90 per cent, ash 92 per cent, and caragana 95 per cent. The cuttings showed a very high loss, the survival of poplar being 60 per cent and willow 67 per cent. Cutworms in some districts contributed very materially to failures among cutting stock.

Newly planted evergreens were very hard hit. The spruce stood up fairly well with a survival of 70 per cent. The pines, however, showed a loss of from 50 per cent to 70 per cent. Such results are naturally discouraging, but planters generally seemed to realize that the loss was due entirely to abnormal conditions.

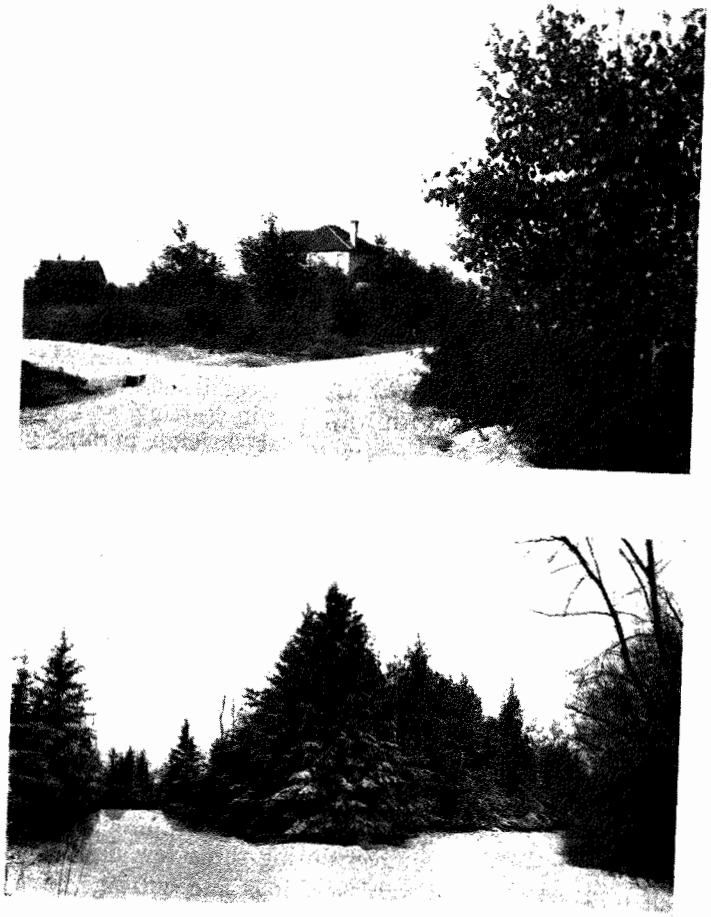
Precipitation at Indian Head during the growing season was approximately only 4½ inches, less than 50 per cent of the normal. At Sutherland conditions were somewhat more favourable.

Field Inspections

Nine inspectors started out to cover their respective districts about June 1. The inspection lists included 13,011 names, of which number 2,672 were new applications. Notwithstanding the very discouraging weather conditions, reports indicate a continued keen interest in tree planting and rather an improvement in the care of the plantations. Of 6,280 plantings of two years and over reported on, 81½ per cent were good, 15½ per cent fair, and only 3 per cent poor. The dry season, of course, accounted for a much smaller growth than usual and also induced early shedding of leaves in the fall, indicating a satisfactory maturing of the new growth. Reports are rather free from mention of damage from rabbits, hail, and insects. Red-spider injury on spruce appears to be rather prevalent, in some cases being the cause of considerable damage.

A good deal of interest has been shown during the past few years in the establishment of shelter-belts for the protection of field-crops. The number of belts set out for this purpose is gradually increasing, and a number of the planters have reported that already a benefit to their crops is quite apparent. Though of late years there does not appear to have been any serious soil-drifting over large areas, as sometimes has occurred, the belts have evidently had an influence in checking the evaporation of soil moisture, and in at least one case that was reported a comparatively young belt not more than four feet high saved the crop on the sheltered side when on the exposed side there was a complete failure.

For some years now our inspectors have been observing very closely the effect of mulching on the development of prairie plantations. The use of a straw mulch has been strongly advocated in some quarters as a means of lessening labour in keeping down weeds and of conserving moisture. Observations covering a large number of plantings, however, do not indicate that this is a sound practice; on the contrary, many instances are reported where plantations treated in this manner have suffered very considerable injury. The fire-hazard during the past season in the case of mulched plantations was extreme.



Plates 4 and 5.—Conifer Growth in Twenty-two Years

The two pictures show views taken in the grounds of the Indian Head Forest Nursery Station. They are made from almost the same point—the upper in 1908, the lower in 1930. The difference is the result of the growth of the coniferous trees. The house, partially concealed by broad-leaved trees in the upper view, is entirely hidden by coniferous growth in the lower.

(F.S Photographs 878 and 20774)

The past season has emphasized the great importance of surface cultivation, especially the value of keeping a good wide strip well worked along the edges of the already well established plantings, so that the trees have as large an area as possible from which they can draw moisture during periods of drought.

All inspectors report on the increasing number of farmers who are improving the attractiveness of their homes by setting out ornamental trees, shrubs, and flowering plants and by the establishment of lawns. The increased interest in the cultivation of the more hardy tree fruits is also noteworthy, as is the success attained by many in these experiments.

Distribution

A total of 8,537,375 seedlings and cuttings of maple, ash, caragana, poplar, and willow were sent out to 6,486 applicants in the spring of 1929. Of these, 4,223,900 went out from Indian Head and 4,313,475 from Sutherland. Nine hundred and sixty-six applicants were supplied with 138,700 transplants of spruce and pine from Indian Head, and, in addition, 118,000 seedlings were shipped for planting on the Spruce Woods National Forest.

The broad-leaved shipments were packed in 12,702 bales. Weather conditions during shipping were ideal for that class of work. Shipping started on April 20, and was completed in 14½ days.

General Nursery Operations

Spring opened up rather late, and weather conditions were cold and backward up to the end of May. Growth was slow in starting, and owing to subsequent drought the broad-leaved stock did not develop normal growth. The stock, however, is well rooted, and, although somewhat small, will make quite satisfactory planting material Poplar and willow cutting-stock plots made but little growth and furnished very little material for cuttings in the fall. Evergreen seed-beds came along very satisfactorily owing to artificial watering. For the first time there was some winter-killing in both spruce and pine beds, as there was practically no snow covering during the winter. The loss, however, on this account was fortunately not serious.

Six thousand square feet of new seed-beds were sown to spruce and Scotch pine, also some small lots of red pine and Western larch for experimental purposes.

Seedlings of spruce and Scotch pine to the number of 397,656 were set out in transplant rows, and showed an excellent stand during the early part of the season. In late August and early September several days of intense heat occurred and the young transplants were severely injured. Probably 50 per cent of the new transplants succumbed during these few days.

A total of 6,721,600 broad-leaved seedlings and cuttings have been heeled in at the two nurseries—at Indian Head, 2,502,400, and at Sutherland, 4,219,200. Evergreen transplants to the number of 177,150 are available also for spring shipping.

Seed Collection

This was a fairly good seed-year for maple, and 2,219 pounds were collected in the Qu'Appelle valley, 3,522 pounds in the Dauphin district, and 300 pounds on the Indian Head nursery. Owing to the very hot dry season it was very difficult to make collections of caragana, as the pods split open so readily under such conditions. Two hundred and sixty-three pounds of clean seed were collected at Indian Head. Small quantities of balsam fir and Scotch pine seed of a special strain were also collected at Indian Head. A considerable quantity of *Abies balsamea* cones were collected from squirrel caches in the variety plots and a fair amount of good seed threshed out.

RESEARCH

A start was made this year to secure complete plotting and measurement records in all the permanent plantations on the Indian Head nursery. Altogether, eighteen plantations, of a total area of 31·72 acres, were carefully surveyed, every tree being measured and plotted. Some of the plantations were marked for thinning and in addition trees to be left for the permanent stand were banded with white paint.

Height Measurements in Variety Plots

Some indication of height-growth of the various species is given in the table below:—

Plantation No.	Age	Species	Height of Dominants
			Feet
18	21	Tamarack	31·0
18		Ash	25·0
38	19	Tamarack	28·0
23	21	Tamarack	32·5
11	23	European Larch	36·0
1	25	Tamarack	35·5
3A	23	Tamarack	35·0
3B	23	Tamarack	32·0
3A	23	Scotch Pine	32·0
3B	23	Scotch Pine	31·0
3A	23	White Spruce	31·0
3B	23	White Spruce	26·0
46A	17	White Spruce	16·0 (with caragana)
46B	17	White Spruce	18·0 (with maple)
37A	19	Scotch Pine	22·5 (with caragana)
37B	19	Scotch Pine	26·0 (with maple)
22	21	Scotch Pine	30·0 (with ash)
21	21	Lodgepole Pine	24·5
21	21	Jack Pine	24·5
41	18	Jack Pine	26·0
40A	18	Colorado Spruce	13·86 (with caragana)
40	18	Colorado Spruce	14·40 (with maple)

(NOTE.—Difference in height of Colorado spruce, 0·54 ft., average of over three hundred measurements of each.)

Species	Age	Height of Dominants
Siberian Larch	21	39·0
European Larch	21	38·5
Tamarack	21	34·0
Japanese Larch	21	27·0
Norway Spruce	19	27·0
White Spruce (var. Black Hills)	21	26·0
Balsam Fir	21	27·0

Exotics

In the spring a large number of exotics were lined out from the seed-beds both in trial-ground nursery rows and also in transplant beds, where they could be watered. Altogether, 1,772 were planted in the nursery rows and 941 in the transplant beds. In addition, 80 seedlings—five of spruce and the rest of six species of balsam fir—were left for another year in the seed-beds.

Field-shelter Studies

These were carried out at a farm, ten miles north of Indian Head, where there are two mile-long caragana field-shelter hedges running east and west. A

field of wheat lay between the two hedges, with barley and oats on the north side of the north hedge. Seven strips were laid out with twelve square-foot sample plots in each at intervals of 15 feet, 25 feet, and so on up to 105 feet, out from the centre of the hedge, and also at 250 and 500 feet out in the field. Five were on the south side of the field and two on the north side. The study could not be properly balanced because harvesting started before the three other lines projected on the north side of the field were completed. Three lines were done in the oats and two in the barley.

In the oats and barley the results are very striking out to about 64 or 75 feet from the hedge. Beyond that there is no influence that could be detected.

In the wheat there was a significant difference up to 65 or 70 feet from the hedge, and about a five-to-one probability in favour of the influence of the hedge extending out to 105 feet or so. As far as could be estimated, the hedges had in all probability increased the total yield by two or three bushels per acre over the field as a whole.

Pathological Research

The problem of most concern at the present time is a disease affecting principally the Russian poplars and commonly known as Poplar Canker. There seem to be two types of disease—one injuring the young cutting stock in the nursery and the other appearing on the trees in older plantations. It has not yet been determined whether there is any direct relation between these two forms.

Poplar Canker: (A) Nursery Disease

1. Investigations.—Study of this serious infection was first commenced in the summer of 1928, a very large proportion of the poplar cutting stock in the forest nursery station showing damage from this cause. Affected shoots showed from one to five "bla kened" areas, these injured spots being oval in shape, depressed, up to 1 inch in length and with the tissues dead over one-half the circumference of the stem.

The attempt was at once made to isolate the causal organism from diseased spots on agar slants, a number of bacteria and fungi being secured. The next step was to find cuttings as nearly free from this disease as possible, to which end some thousands of cuttings were selected by careful inspection in October, 1928. Part of these were planted in early 1929 in the Dominion experimental farm's greenhouse, and all grew well without a trace of the nursery disease. This discovery and its confirmation in the field led to the control procedure discussed below, by which clean cuttings in clean ground are found to give disease-free poplars.

The inoculation of these clean plants in the green-house proved all the fungi and bacteria isolated to be harmless with one exception. This organism (apparently a form of *Septoria*) produced the typical nursery disease in all cases and is in all probability the cause of the disease. Further greenhouse tests are now being conducted.

A further series of tests in the field in 1929 has yielded some interesting figures relating to the nursery disease under discussion. The disease was proved to live over winter in the cuttings and to continue growth the next spring after planting, eventually killing the new shoot by girdling at the collar. This condition is often seen in the nursery, many such shoots appearing during the summer with yellowed leaves which later dry out, remaining attached to the dead stem. The former practice of removing these dead shoots is, of course, valueless. The entire plant must be uprooted when one such yellow shoot first signals the presence of this fungus in the roots and base.

In order to test the part played by this blackening disease in killing off young poplars from cuttings, a number of varieties were planted, clean, normal

run and diseased stock, respectively, being used. Clean cuttings were selected carefully for absence of surface blackening or of stain in the pith, as described above, and known to grow free from disease. Normal-run cuttings were taken from the regular spring shipment; the diseased specimens each carried a "blackened" area, proving the presence of the disease. After planting it was expected that the fungus in the diseased cuttings would resume growth and eventually succeed in killing the new shoot above ground, usually by girdling at the surface of the ground.

Results from the test plantation with regard to the losses during the summer of 1929 show the average survival from *clean* cuttings to be 82 per cent, from the *normal-run* cuttings 59 per cent, and from the *diseased* cuttings 33 per cent.

The indicated loss of almost 50 per cent of the normal-run cuttings from this disease shows its serious nature in the field and emphasizes the value also of the selection method of control. These figures show only the loss in one season, but diseased cuttings will often fail after a season of apparent health, and the final loss is greater than the above figures indicate.

2. Control Measures.—The field tests and greenhouse plantings of poplar cuttings indicate that for the selection of clean cuttings ocular inspection is sufficient, followed by planting in clean ground. The latter procedure is not proved to be a necessity; but until the experimental proof that it is *unnecessary* is secured, the selection of clean ground should be urged as a reasonable precaution.

Poplar Canker: (B) Perennial Canker

The disease discussed above is a nursery form and is quite distinct in character from the disease of older trees which produces an ugly and damaging perennial canker of stem or branch. This latter injury, perpetuated by a fungus of the form genus *Cytospora*, is of unknown origin, the fungus involved serving merely to continue the disease. By inoculation the *Cytospora* appears harmless on healthy tissue, but in callus tissue surrounding wounds in the Russian poplar it becomes established and by repeated annual injury with fresh callus formation causes a very common and eventually fatal deformation of other trees.

1. Investigations.—The first step in any research problem is a search of the available literature for possible record of previous study in this connection. In the case of the poplar diseases here, the world literature has been gone over, in so far as it is indexed in the libraries of the Dominion and United States Departments of Agriculture and a number of other institutions of equal standing. Only two references—and these of doubtful value have any bearing on the problems here; this would indicate that the study is practically untouched.

After this discovery had been made, pure-culture isolations from perennial cankers were made, and fresh specimens of the disease sent for check isolations to several prominent investigators. The consensus of opinion pointed to the *Cytospora* form commonly associated with this canker, and this is cited as the organism responsible for the *continuance* of the disease. A number of inoculations in the greenhouse, with entire absence of infection, lead to a belief in the low-vigour parasitism of this fungus, suggesting the need of some assisting cause (e.g., a wound), producing energy which may be mechanical, fungal, or bacterial in nature. Whether or not the *Cytospora* may establish itself in any wound is not definitely known, but in view of its universal distribution infection is highly probable. The great majority of such wounds may heal over, perennial canker resulting only in those wounds which, for various reasons, fail to do so, where a weakened callus growth is produced which is progressively penetrated by the slow annual advance of this fungus parasite.

This disease is being carefully investigated for explanation of the origin of these perennial cankers, particularly its possible relationship to the nursery disease.

2. CONTROL.—Obviously no control measures can be devised until the causal agency is discovered. Providing this is done, and that it is a form which may be regulated, the Russian poplar may be propagated at some future date free from this serious injury. If, however, the *Cytospora* is proved a sufficiently strong wound parasite to attack any open tissue and survive in a fair proportion of these openings, the Russian poplar will be subject to this disease without a practical remedy other than the doubtful method of breeding for resistance. That the Russian poplar is more susceptible than the cottonwood (*Populus deltoides*) seems evident, although the latter species occasionally shows a similar canker. The present need, however, is for close search of a possible cause, which course is being followed.

(C) Other Studies

No other major pathological problems are available at this station or in the established farm shelter-belts so far as is known. There are minor diseases of elm, ash, and caragana known, as well as several forms of injury—some serious—on balsam poplar and aspen (*Populus balsamifera* and *P. tremuloides*) in natural wooded areas near Indian Head. These latter are worthy of special study in view of the rather general utilization of these species for cordwood, and a beginning has been made in this direction. The diseases of hardwoods mentioned above are all leaf-stopping or defoliating forms, and easily subject to spray control if injurious in the propagation blocks in any unusual season.

Herbarium

A very representative collection of the fungous flora of the region has been assembled in the past two seasons and is being added to by exchange as well as collection whenever possible.

Preservative Treatment of Posts

There are now approximately 600 posts of several different varieties under observation, treated with creosote, creozol, and zinc chloride, with a sufficient number of untreated posts for checks. The first lot of posts (Russian poplar) was treated with creosote in the fall of 1916 and to-day, after thirteen seasons in the ground, the posts appear to be in as good condition as when originally set out. Farmers are now taking a very real interest in this particular question, and inquiries along this line received during the winter were so numerous that it was found necessary to get out a mimeographed circular describing a simple and practical method of treatment which could be employed directly on the farm.

Fruit

Standard apples on the nursery at Indian Head this season have an enormous crop of fruit, but owing to the extreme drought this fruit did not attain a normal size and lacked very much in quality. Plums were badly affected by plum pocket. For some years this Station has been testing a very promising variety of gooseberry, the fruit of which is very similar to the English gooseberry, and much larger and of better quality than the ordinary kinds grown on the prairies. Not only is the fruit much superior, but the bushes seem to show more hardiness, and plants from these bushes are being supplied to the Morden experimental farm and one or two other places for testing over a wider area.

At Sutherland conditions do not appear nearly so favourable for fruit culture as at Indian Head. So far, apples which have been so successful at the latter station have not shown hardiness at Sutherland. Tests in a small way, however, are being continued. Plums, also, have not done so well as at Indian Head, but last summer several seedlings originated at Indian Head came into bearing at the Sutherland station, producing fruit of very fair quality.

Publicity

Exhibits were prepared and set up at the summer fairs in Saskatoon and Regina, and, as in the past, attracted very considerable interest and were favourably commented upon. Addresses on tree planting were given over the radio and at several farmers' meetings.

NATIONAL FORESTS IN MANITOBA

Col. H. I. Stevenson, D.S.O., District Forest Inspector

The work of the Manitoba inspection office comprises the administration of the national forests in Manitoba and that part of the Duck Mountain national forest lying within the province of Saskatchewan, and of the protection from fire of the forests on the public lands within the province of Manitoba. For the latter purpose these lands are divided into three fire-ranging districts, known, respectively, as the Manitoba North, Manitoba South, and The Pas fire-ranging districts.

Fires and Fire Protection

The fire season of 1929 was the longest and, possibly, the worst ever experienced in the history of organized fire protection in the province of Manitoba.

During the winter of 1928-9 the snowfall was light, and had little or no effect on the already parched condition of the forest areas. The break-up came about during the last week in March and almost immediately following this period fires began to break out in different parts of the district. From a fire-protection standpoint, conditions at the commencement of last season were decidedly unfavourable, and this state of affairs existed practically all over the district for the duration of the fire season, which lasted until the second week in October. The absence of the usual spring rainfall, together with prolonged hot weather and high winds, kept the forest in such a state of inflammability that it was practically impossible to keep fires within controllable size. Considering the seriousness of the fire situation in this province last season, the actual loss of timber of the more valuable species was comparatively light.

Aerial Co-operation

As in previous years, the Royal Canadian Air Force assisted this Service in carrying out protection work in the three fire-ranging districts. This organization co-operated with this Service in every way.

Sub-bases for aerial work are located at Lac du Bonnet, Cormorant Lake, and Norway House. Detached operations are carried out from Snake Island in lake Winnipegosis, Berens River, and Thicket Portage; the last two were put into operation for the first time last season. All sub-bases and detachments are equipped with two-way wireless sets. During the height of the fire situation and when rapid communication was of vital importance in the work, static disturbances greatly interfered with the transmitting and reception of messages. However, when conditions were normal, ground communication was satisfactory and messages were handled with all dispatch.

Aircraft fitted with skis were used by this Service during the late winter and early spring months for the purpose of detecting and assisting in the suppression of winter fires. This operation commenced in March and was main-

tained until such time as ice conditions would not permit the operation of aircraft so fitted for winter flying. Planes for winter work were stationed at Cormorant Lake, Norway House, and Lac du Bonnet bases.

The time of flying under winter conditions (March to May) amounted to 252 hours, and that under summer conditions (May to November) to 2,607 hours.

Seed Collection and Extraction

Of late the supply of seed of Manitoba maple (*Acer Negundo*) and red pine (*Pinus resinosa*) required by the Forest Service in the Prairie Provinces has been secured in this province. During the past year the crop of red pine seed was negligible and none was collected. The Manitoba maple seed crop was heavy, and 3,058 pounds were collected at Dauphin. This seed was shipped to the forest nursery at Indian Head, Saskatchewan, where it will be utilized to grow stock for distribution to farmers in the Prairie Provinces.

Surveys

There were three parties in the field last year continuing the cruise of the pulpwood areas. Two of these parties were operating in the Nelson River drainage area, and the third in the Saskatchewan River area. The two parties on the Nelson river examined a total area of approximately 1,562,000 acres, while that on the Saskatchewan river examined 2,700,000 acres. Reports have been prepared by each party showing, among other features, the total quantity of wood merchantable for pulp that is available and a classification of the land under such headings as merchantable timber, young growth, stagnated growth, open swamps, bare rock, water, etc. Maps have been prepared showing for this total area of 4,325,000 acres detailed timber conditions.

Forest Inventory

An inventory of the forest resources of Manitoba has been undertaken. This project, which will take several years to complete, was commenced in August. The work done to date includes a general tour of the settled portions of the province, the preparation of a plan for future work, and a special subdivision of the province into districts. The results of the cruise of the pulpwood-selection area in 1927 have been compiled and adjusted, and a set of maps has been prepared showing areas of all fires of which records exist for 1928 and 1929. A considerable amount of data on conditions of land tenure has been accumulated, and steps have been taken to secure the co-operation of licensees of Crown Timber lands in the preparation of the inventory.

Recreational Uses

A marked increase in the number of visitors at the summer resorts in the national forests of this province was noted last summer, and it is quite apparent that the demands of the citizens of this province for lots and recreational facilities at these resorts are increasing. The following is a brief résumé of the activities carried out by this Service at each of the resorts during the past summer:—

Benito Beach Resort.—Approximately 4 acres of land were cleared to be used for camping and parking purposes. In addition to this, the Alpine road, which is the highway to this resort from the North, was graded, greatly facilitating the accessibility of this beach by automobile.

Kamsack Beach.—Approximately two acres of land were cleared at this resort to meet the increased demand for picnicking and parking space. A path 4 feet wide and 28 chains long was cleared along the boulevard fronting the lake and gravelled throughout. This path affords a wonderful promenade along the whole of the water front.

Two additional tennis courts were built, making a total of three at this resort. That portion of the road passing through the forest reserve from Kamsack village to this resort was gravelled, which treatment has made this road by far the best section between these two points. Further improvements at this resort consisted of the construction of a pier for docking boats and the erection of a 16-compartment bath-house.

Clear Lake Resort.—The most important improvement at this resort was the construction of a 9-hole golf course. This project was completed excepting the seeding of the fairways and the sanding of the greens. A graded road was built from the east end of the Clark Beach subdivision eastward to the end of Clear lake and then extended around on the north side to join up with the road running from lake Audy to Clear lake.

The total daily average number of visitors to the summer resorts of the district during July and August is estimated at 1,400.

Grazing and Hay

The use of the national forests by settlers for grazing stock showed a slight increase over the preceding year. On the Turtle Mountain forest 35 permits were issued for 514 cattle and 97 horses; on the Riding Mountain forest 14 permits were issued for 275 cattle and 38 horses; on the Duck-Porcupine forest 17 permits were issued for 370 cattle, 18 horses, and 10 sheep; the total thus was 66 permits for 1,159 cattle, 153 horses, and 10 sheep.

Owing to the dryness of the past summer the hay crop was not nearly as good as usual, and as a result the demand for hay was very keen. Practically all known hay meadows in the national forests were cut over. The total amount of hay cut shows an increase of more than fifty per cent over that of the previous season.

Timber Sales and Permits

Owing to the depression, the returns for this year showed a considerable falling off from those of previous years.

The Riding Mountain national forest still continues to lead in the number of permits issued and the quantity authorized thereby. The Riding Mountain and Duck-Porcupine forests supplied practically all the material authorized by permits, the cutting on the Sandilands, Turtle Mountain, and Spruce Woods forests being almost negligible.

Nurseries

Satisfactory progress was made during the summer of 1929 at each of the six tree nurseries. The sprinkling systems were improved on some of these and there is now an entirely satisfactory gravity water-supply at each nursery. Additional areas were added to some, and the necessary improvements were made to keep pace with the growing demands for planting stock on the National Forests. Abnormal losses in one-year-old pine seedlings occurred at two of the nurseries in the early spring; precautions are being taken to safeguard against a repetition in the future.

The following list shows by species the quantity of stock on hand: White spruce, 902,000; Colorado blue spruce, 12,000; Siberian larch, 8,000; red pine, 490,000; white pine, 400; jack pine, 744,000; Scotch pine, 45,000; lodgepole pine, 228,000; total, 2,429,400.

Planting and Seeding

No reforestation by direct seeding was attempted during the past year. The only planting done was on the Riding Mountain forest where 47,500 plants (chiefly white spruce) were set out in permanent plantations. These were spaced approximately 6 by 6 feet, and covered an area of 40 acres.

Publicity

It is encouraging to note that during the year there has been a marked increase in unsolicited requests for lectures, literature, and information regarding forests and forest products. The weekly lectures at the Dauphin Normal School have been continued, and many of these lectures have been modified to meet the requirements of collegiate classes and various grades in the public school. Considerable information has been disseminated through the active co-operation with Service clubs, Women's clubs, Western Retail Lumbermen's Association, Farm Boys extension service, United Farmers of Manitoba, and church and teachers' organizations.

National Forests in Saskatchewan

James Smart, District Forest Inspector

The Saskatchewan inspection district includes all permanent forest-reserve lands within the province of Saskatchewan, with the exception of areas known as the Cypress Hills forest in the southwestern part of the province and the Duck Mountain forest on the central eastern boundary, which are, for administration purposes, under the jurisdiction of the Alberta and Manitoba inspection districts, respectively. The reserve areas under the Saskatchewan inspection district comprise approximately 5,212,523 acres. The greater portion of this reserve area lies within the northern timbered section of the province, from approximately Township 36 on the eastern boundary and Township 52 on the western boundary. The remaining reserves—nine separate blocks of reserve land—are located south of the above, in the prairie section of the province, and are widely separated; with the exception of the heavily wooded Moose mountains they are essentially afforestation areas, at the present time used extensively as grazing lands.

Complete jurisdiction, including timber administration and fire protection, is exercised by the Forest Service over these forest reserves, and the Service is also responsible for fire protection on the timber-lands outside permanent forest reserves.

There are three organized fire-ranging districts to cover fire protection on the areas outside forest reserves.

Fire Protection

The Saskatchewan district was subjected to an extremely hazardous fire situation from early spring until late autumn. The previous fire season had been considered the most protracted and severe on record up to that time, but conditions were much worse during the season just past. This, of course, was due to dry conditions of the 1928 season followed by a winter with little or no precipitation and the continued lack of rainfall and abnormally high and persistent winds during the season. In comparison with the two previous seasons forest reserves suffered from increased fire damage.

The fire-ranging organizations carrying on the fire protection in all the timbered areas outside national forests had a busy time throughout the entire season. Many of the fires occurred on areas difficult of access; this accounts for the great number of fires being in the larger classes. Of the land burned over, a great portion was non-forested land, comprising grassland and muskeg.

The Prince Albert and Battleford fire-ranging districts, mainly confined to the southern fringe of the timbered portion of the province and settlement districts, are patrolled by means of canoes and saddle-horses, and the detection of fires is further effected by a system of lookout towers. The fire protection in the northern portion of the province as far as the Churchill river is accomplished by the use of aircraft operated by the Royal Canadian Air Force in co-operation with the Saskatchewan Air Patrol staff of fire rangers. Not only is detection of fire carried out by means of aircraft, but practically all fire suppression is also effected by the same means. In 242 flights 930 hours of flying were done, covering a distance of 61,055 miles.

Hay and Grazing

Hay permits showed a decided increase over previous years, owing principally to the fact that the past year was the driest experienced for some time. There were 301 permits covering a total of 5,374 tons.

Grazing continues to decrease; this is due primarily to the fact that the method of farming is changing. Mixed farming is now in vogue, and the farmers are cultivating pastures and raising forage crops. The number of permits issued was 406, covering 6,019 cattle, 2,216 horses, and 420 sheep.

Miscellaneous Uses

Miscellaneous permits to the number of 883 were issued during the year; the uses covered consisted of lot rentals, fences, cabins, fishing, gathering seneca root, gravel, and logging roads. Fishing permits showed a very substantial increase, 413 permits being issued; all these permits were confined to the Moose Mountain forest.

Recreation

An additional fifty lots for summer-resort purposes were surveyed in the Sandy Bay subdivision of the Moose Mountain forest. This resort is situated on the Fish lakes, and is gaining an ever increasing popularity, particularly with tourists from the United States.

Land Classification

During the season a heavy demand was encountered from prospective settlers for the withdrawal of various lands from established forest reserves and proposed additions. All lands so petitioned for were carefully examined by forest officers; of 169 sections examined, 66½ were classified as suitable for settlement. In addition to the above, five townships were examined by officers of the department and were subsequently withdrawn from the Three Rivers proposed forest reserve and opened for settlement.

Publicity

During the summer of 1929 this Service put on displays at the "Class A" Exhibitions at Saskatoon and Regina, as well as at some nine other points in the "Class B" circuit. These exhibits were greatly appreciated by the various fair boards, and a great interest was taken in the various articles manufactured from wood, particularly in the rayon and cellulose products. Framed exhibits of native wood specimens were made up by the staff on the Pasquia forest reserve and placed in the waiting rooms of the Canadian National Railway stations in the vicinity of the reserve. These exhibits contained photographs of lumbering activities in the province and carrie da fire warning in addition to the wood specimens.

Ten moving picture shows combined with lectures on the activities of the Saskatchewan Air Patrol district were given by the district office staff to Rotary and Kiwanis clubs and other organizations in Prince Albert and Saskatoon.

Timber Sales and Permits

During the past year the demand for timber on national forests in this district shows a slight increase for timber sales and permits over previous years in so far as actual applications were concerned. Thirty-eight new sales were

applied for, of which thirty-two were awarded, involving 9,631,000 feet board measure of spruce, 500,000 feet board measure of poplar, 10,000 feet board measure of jack pine, 10,371 jack pine ties, 590 cords green jack pine cordwood, and 1,535 cords fire-damaged spruce pulpwood. During the year 63 sales were active and 17 were closed out.

The activity in timber permits was very brisk during the year; the number of permits issued shows a substantial increase over previous years. The greatest activity took place on the prairie reserves; the material removed consisted mainly of green poplar fuel-wood and willow fence-posts.

The pulpwood situation was very quiet; sales were confined to material that was fire-killed or fire-damaged during the past fire season.

All logging operations under sales and permits were given careful supervision and, with the exception of fire-killed material and inferior species, all timber was marked for removal.

The past year being very dry, with an exceptionally dry fall, fire conditions were very hazardous at the start of the logging season. All operators were therefore informed that no brush-burning was to take place until written permission had been secured from the supervisors. At the beginning of the season, therefore, brush was piled, and when conditions were favourable the operators received instructions to burn. Careful supervision was exercised by the rangers, with the result that, with one or two exceptions where conditions did not become favourable, all brush was burned, and a final check-up in the early spring showed that conditions were safe.

Reforestation

Nurseries.—The estimated amount of seedling stock of all species on hand in all nurseries in the fall of 1929 was as follows: 3-0 stock (3-year seedlings), 372,115; 2-0 stock (2-year seedlings), 2,412,635; 1-0 stock (1-year seedlings), 2,650,647; total, 5,435,397.

This total seedling stock represents an increase of only a little more than half a million plants over the total of this class of stock reported in the nurseries in the autumn of 1928. This condition was partly attributable to the drought conditions of 1929. There was an estimated 33 per cent mortality in the transition from the 1-0 to 2-0 class of stock. A total of 167 pounds of seed of all species was sown in these nurseries in the autumn of 1928 and spring of 1929 as compared with 218½ pounds sown in the autumn of 1927 and spring of 1928. It was estimated that the seed allotment of 167 pounds would produce approximately 2,500,000 seedlings surviving in the fall of 1929, so that the actual survival of 2,650,647 seedlings, as shown above, is quite satisfactory.

Of the 5,435,397 seedlings of all age-classes reported to be in the nurseries in the fall of 1929, there are approximately 32·9 per cent of white spruce, 35·3 per cent of jack pine, 16·9 per cent of lodgepole pine, 12·3 per cent of Scotch pine, 1·7 per cent of Manitoba red pine, and 0·8 per cent of Siberian larch. The rather unfavourable relation of white spruce to the sum of the several species of pine is the result of so many of these small nurseries being located in proximity to areas unsuited to the establishment of white spruce forests.

The transplant lines contained a total of 749,672 plants in the fall of 1929. This total represents an increase of 297,815 over the 451,857 plants of all classes reported to be in transplant lines in the previous autumn. There were almost 600,000 seedlings set out in transplant lines in the spring of 1929. With 435,828 of these surviving in the fall of 1929, the mortality was 27 per cent.

Planting.—Small planting operations were carried out on the Dundurn, Nisbet-Pines, and Big River forests during the spring of 1929. Approximately 14,000 of 2-2 white spruce and 32,000 of 2-2 jack pine were used for this work; one-third of the stock was set with a 4 by 4 foot spacing and the remainder with a 6 by 6 foot spacing. The planting operations in the spring of 1929 would have been more extensive if it were not for the fact that 47,800 of 2-2 jack pine in the Pines nursery were used to plant a sixteen-acre block in September of 1928.

There was an excessive mortality in the jack pine planting of the autumn of 1928, indicating that planting at this season of the year is not practical unless it has been preceded by an unusual amount of autumn precipitation. The jack pine planting in the spring of 1929 in the Dundurn forest also suffered heavy mortality owing to dry soil at the time of setting out the stock and an almost entire absence of rain throughout the ensuing season.

Seed Collection and Extraction.—A total of 128 bushels of jack pine and 125 bushels of white spruce cones were collected in the fall of 1929. This amount yielded 58 pounds of clean jack pine seed and 86 pounds of clean white spruce seed at costs of $3.74 and $3.71 per pound of clean seed respectively. In the spring of 1930, there were supplied to the Tree Planting Division at Indian Head and the Forest Service offices at Winnipeg and Calgary a total of 60 pounds of white spruce seed, 10 pounds of jack pine seed, and 4½ pounds of balsam fir seed.

Silvicultural Research

Experimental Cutting Areas.—The sample plots established in connection with the Carrot River experimental area for the study of conditions in different types of white spruce cut-overs were re-examined. Plans for a similar experiment were drawn up for the southern portion of the Pasquia forest. This area, known as the Prairie River experimental area, is located on Timber Sale No. 164 in the vicinity of Prairie River. Considerable preliminary work in connection with the location of the plots was done, and three plots of one acre each were finally selected.

Thinnings.—The four-plot series of thinnings in the 40-year-old jack pine stands of the Prince Albert Block of the Nisbet-Pines forest was re-examined. The work included diameter and height measurements.

Rate-of-growth Studies.—The 191 permanent sample plots established within the Prince Albert Block of the Nisbet-Pines forest in connection with the working-plan survey of this block were remeasured.

Inventory

An inventory survey party of three 4-man crews was organized on the Pasquia forest and took to the field on May 15. During the field season a total of 200 square miles (128,000 acres) was covered. Throughout the winter months a two-man party cruised some 9,406 acres on the Fort à la Corne forest, making a total of 137,400 acres cruised during the past field season.

National Forests in Alberta

C. H. Morse, District Forest Inspector

The Alberta inspection staff is responsible for the administration and protection of the national forests in the province, for the protection from fire of all Crown timber outside the reserved areas, and for the supervision, under the Board of Railway Commissioners, of railway fire patrols and the inspection of fire-protective appliances on locomotives.

Forest Fires

In spite of the light fall of snow during the winter of 1928-9, no great hazard developed anywhere in the district during April, as the spring was backward and there were numerous snow flurries during the month. During the first half of May, drying winds occurred which brought on a danger of

moderate intensity; this hazard was, however, relieved south of the upper North Saskatchewan river by heavy rains during the latter part of the month. Elsewhere in the province a very acute danger developed, particularly on the Brazeau, Athabaska, Cooking Lake, and Lesser Slave forests and on the district north of the Peace and the regions about Wabiskaw and McMurray. Relief from this prolonged dry spell occurred at the middle of June with a heavy rain of twenty-four hours' duration over most of the northern part of the province. Unfortunately, the Cooking Lake forest and the southern part of the Edmonton fire-ranging district got only very light showers. The summer weather was very bad on the southern forests of the East Slope, the Cooking Lake forest, and the south part of the Edmonton district. Temperatures were high, humidity was low, and winds were strong and dry. This danger continued to mount until the latter part of July, when the fire-hazard could be compared only to that of 1910 or 1919. Fortunately, the danger did not exist to the same extent on the northern forest or the Edmonton fire-ranging district. Relief was not obtained until the first week in September. The fire-risk during the autumn period was below the average, with the exception of the southern part of the Edmonton district and the Cooking Lake forest, where the drought continued well into December. The other forest regions did not get much moisture during this period, but received enough to keep down the hazard.

PLATE NO. 6.—A WELL-SHELTERED ALBERTA FARMSTEAD

The first planting was made nineteen years before the picture was taken. Trees furnished by the Forest Service, Department of the Interior. Farm of F. Dawe, Gleichen, Alberta. (F.S. Photograph 20525)

Aerial Fire Patrol

Owing to the long period of great fire-hazard and the incomplete state of the lookout units on the Crowsnest and Bow River forests, it was necessary to requisition a great deal of air patrol. A total of 644 hours of flying on fire patrol was provided by the Royal Canadian Air Force over the Crowsnest, the Bow River, and the Clearwater forests during the past season. The sub-base at Grande Prairie was increased by the addition of one plane and pilot; a total of 434 flying hours was rendered from this base. The total number of flying hours on fire patrol was thus 1,078 for the inspectorate.

Grazing

The grazing of live stock on the national forests is a most important use. Not only does it yield a certain amount of revenue, but it also gets rid of the grass crop which, if allowed to dry out, would constitute a very decided fire menace. If properly regulated, grazing does not adversely affect the forests. Permits are issued at eight cents per head per month for cattle, ten cents for horses, and two cents for sheep. During the summer season there were 460 permits issued, covering 20,394 head of cattle, 3,720 horses, and 2,600 sheep. This is a decrease from last year in the number of cattle and horses grazed but an increase in sheep.

Timber Sales and Permits

There are twenty-eight active sales in this district, involving an area of approximately 30,710 acres, of which ten, with an area of 3,820 acres, are new sales awarded during the year. The new sales involve approximately 4,273,000 feet board measure or its equivalent. Thirteen sales satisfactorily completed operations and were formally closed out. The cut for the year on all sales totalled 10,491,848 feet board measure and 975,934 lineal feet of mining timber, a slight reduction from the previous year but still well above the average for the past five years; the greatest reduction was in mining timber. There were 673 permits issued during the year, most of which were for dry or fire-killed timber. The amount authorized to be cut under these permits indicates an increase in fuel-wood, fence-posts, fence-rails, and poles, a stationary condition in saw-logs, and a decrease in mining timber and thinnings as compared with last year. There is a remarkable increase in permits for fencing material.

Seed Collection and Extraction

No cones were collected during the past year, but approximately two hundred pounds of lodgepole pine seed were extracted from five hundred bushels of cones collected during the previous year. The crop of spruce and fir cones was very poor in 1929, so that collection was not feasible.

Recreation

There is only one summer resort in this district, located at Elkwater lake in the Cypress Hills national forest. This place offers a fine opportunity for citizens from the prairies to have cottages or to camp amid green timber, or to boat and fish on a woodland lake. People are using this resort in increasing numbers. In the mountain forests, although there are no organized summer resorts, there are, nevertheless, favourite camping spots where visitors from the prairies flock to enjoy good trout fishing. Later in the season, those who are fond of hunting can readily secure their quota of big game, including moose, deer, sheep, and goats from these same mountain forests.

Planting and Seeding

Approximately seventy-five acres were planted on the Cooking Lake forest with local nursery stock—fifty acres to spruce and twenty-five to lodgepole pine. The pine was planted on an area which is now enclosed by a rabbit-proof fence; this area had previously been planted but had been destroyed by rabbits. There is now on this forest a total of 275 acres of plantations varying in age from one to ten years, in addition to 340 acres which have been reforested by the seed-spot method, the young growth now being five years of age. Although the plantations have been subjected to periodical depredations by rabbits, the seedlings are doing very well and rapid growth is being attained by the older plots, on which the young trees are now too large to be subject to rabbit damage. Twelve beds were seeded to white spruce, lodgepole pine, and

Siberian larch on this forest; there are seven beds of spruce, three of pine, and two of larch. These are to serve as planting stock in 1931. For 1930 planting there are 180,000 spruce and pine seedlings in addition to approximately 10,000 transplants.

Thinnings

Thinnings in the dense lodgepole pine stands of the Cypress Hills were carried on during the past year under the careful supervision of a technical staff, and a considerable area has been improved silviculturally. The material removed is very much in demand locally and, although there is a natural preference for the better class of material, such as large poles and logs, practically all the material removed is being disposed of at a price sufficiently in advance of the usual permit rates to repay the additional supervision which it is necessary to give to the cutting operations.

Investigative Work

A party was in the field during the past season classifying forest land according to what is known by foresters as the Cajander method. Briefly, this system of classification uses the type and character of the vegetation on the ground as an index of the quality of the situation for purposes of wood-growing or for farming. Considerable progress was made in delimiting the various types and correlating them with the soil, moisture, and other factors influencing growth.

National Forests in British Columbia

C. MacFayden, District Forest Inspector

The Forest Service, Department of the Interior, is responsible for the administration of all the national forests within the Railway Belt of British Columbia and for the protection from forest fires of all Dominion lands within the Railway Belt.

Fires and Fire Protection

It was quite generally predicted, even amongst meteorologists, that the summer of 1929 would be one attended by high fire-hazards. This prediction proved true for the British Columbia Railway Belt, during the latter part of the season at least. Despite the lack of snowfall during the previous winter and the fact that spring opened early, conditions did not become unusually hazardous until the last part of July. From this time, however, until the last part of September there was no break in an abnormally acute situation. From September onward, conditions were again normal for that season of the year. Altogether the summer must be recorded as one considerably worse than the average in so far as hazard was concerned and one that tested all protective organizations to their limit.

If the season can be considered as a fair test of the efficiency of the protective staff in an abnormally hazardous season, the records are not unfavourable. Of the 354 fires actually fought by the service (106 fires were fought by the railway companies without cost to this service) almost one-third were kept to less than one-quarter of an acre, or, in other words, 110 fires were allowed to burn over a total area of less than twenty-seven acres. Three-quarters of all fires were not allowed to exceed ten acres in size before being extinguished; in other words, 261 fires burned over a total area of not more than six quarter-sections. Twenty-two per cent exceeded ten acres before they were controlled, and four per cent burned over areas exceeding 500 acres. Included in the last were three very large fires that spoiled what otherwise must have been a record. These three fires, starting at a time of peak hazard, got away and, in spite of

the most persistent efforts, gained very large proportions, causing great damage and entailing the expenditure of very considerable sums for their suppression. The worst of these three was responsible for almost one-sixth of the total fire-fighting costs within the district, but, while it was a losing fight, it could not be neglected because of the timber values threatened.

An examination of the causes of the different fires reveals little change from the average. Railway operation still holds first place as a source of fire, but in fairness to the companies it must be pointed out that they handle a very large percentage of such fires without cost to this Service and while still in an incipient stage, and even those fires due to railway causes and fought by this Service are in the majority of cases reported and brought under control at small cost and while the damage is still inconsiderable. Lightning, the next most prolific cause, can be charged with many of the worst fires, in that they are often difficult of access and control measures are consequently delayed. It is regrettable that in this day so many fires must still be reported as maliciously set out; almost one fire in ten is believed due to incendiarism. On the other hand, it is pleasing to note the decreasing number of fires reported as due to unknown causes, less than one per cent being so classed this year.

The season of 1926 excepted, that of the past summer was attended by higher fire-hazards than any within the last decade at least, and it was to be expected that the costs and loss would be comparatively great. Considering the abnormality of the season the showing is not at all discreditable and except for the unfortunate occurrence of a single fire—the Bluewater fire in the Golden district—a remarkably good showing would have been made.

Timber Sales

In point of numbers, at least, the year is unprecedented in timber-sale activities, there being a total of 69 sales active at some time during the year. Of this total 19 were new sales made during the year, and 52 are still unexpired and in good standing on March 31.

The greatest demand continues to be for poles and piling, these products being the principal cut in all but a very few sales. Sawlogs are in little demand except by a few operators supplying box stock to the Okanagan fruit trade, but in these few cases the competition has been keen and good prices were realized for the standing timber. The year has been a poor one for the railway-tie men, the railway companies having large supplies on hand and letting very few contracts.

All conditions of sale, including the special conditions relating to slash disposal and utilization, were in the majority of cases quite satisfactorily complied with, especially by the larger and more permanent operators.

Grazing

The winter of 1928-9 was one of remarkably little snowfall; spring found the lakes at an unprecedented low level and a poor range year threatening. The situation was somewhat relieved by well-distributed rains in May, June, and the first part of July, but on the whole, taking one district with another, forage at the lower levels was not good and the drought of the latter part of the summer and autumn found many of the ranges bare. In all, 90 permits were issued, covering 4,055 cattle, 267 horses and 14,226 sheep.

To encourage sheepmen to utilize the alpine ranges, the Service constructed a trail suitable as a sheep driveway from the neighbourhood of Malakwa to tap the east end of the Hunter's Range area, and completed a second trail that now gives ready access to the Stoyoma grazing division of the Fraser Canyon forest. On other ranges stockmen were assisted in the construction of corrals and one or two short drift-fences.

Miscellaneous Uses

The two summer resorts—that at Paul lake on the Niskonlith forest, and that at Fish lake on the Long Lake forest—continue to be popular fishing and recreational places for residents of Kamloops and district and are also patronized to some extent by residents of Vancouver and other Coast points.

With increasing tourist traffic the national forests traversed by or adjacent to the highways and better roads are more and more used for camping purposes. With the object of concentrating the fire-hazard that attends this new use, the local rangers have selected and prepared camp-sites at the most desirable locations. A number of these were selected and improved during the year with little outlay except that of the rangers' time. Most of these have been well patronized and, it is believed, appreciated.

The ditch first constructed several years ago, diverting the water from Walloper lake into Fish lake in an attempt to improve fishing conditions in the latter, was widened and generally improved during the year. Contrary to some opinions when it was first started, the project has proved, particularly this year, a real success. Great numbers of trout went up the ditch and spawned either in it or farther up in the creek or Walloper lake, and fry or fingerlings were numerous in the ditch until freeze-up. In giving access to proper spawning grounds and raising the level of Fish lake, there seems to be now no ground for fearing any diminution in the fishing resources of the latter.

Seed Collection and Extraction

The demand for tree seed from forest authorities within the Empire continued at about what it has been for several years. The Imperial Forestry Commission, the Irish Free State, and the central and state forest services of Australia and New Zealand were responsible for all the large orders. These services together were supplied with over 4,500 pounds of seed. The almost complete failure in the Coast variety of Douglas fir prevented the filling of an order for 1,000 pounds from the Imperial Forest Commission. This species seeded abundantly in the Interior, but the Commission requires that its supply be collected at a lower elevation and within a more humid range. Small shipments, aggregating not more than a couple of hundred pounds, were made to countries outside the Empire—Norway, Sweden, Finland, Denmark, Spain, and Russia. Most of these were samples or small lots required for experimental or arboretum purposes. Small quantities of the seed of certain less important species—amongst them lowland fir (*Abies grandis*) and Alpine larch (*Larix Lyallii*)—are in regular demand, but a good crop year seems to occur only infrequently or irregularly and a number of orders remain unfilled.

With the exception of the Coast form of Douglas fir and lowland fir (*Abies grandis*), all the more important species seeded heavily, the crop as a whole being one of the best recorded. The crop on the Sitka spruce (*Picea sitchensis*) of the Queen Charlotte islands was reported by pickers to be particularly heavy, the best, in fact, that has occurred in the history of the Service's seed operations.

All cones were collected by contract. Indians collected a great proportion of the whole, but many settlers, loggers, and even women and children participated in this comparatively new business. An innovation was made this season in that the pickers were required to have an order or contract from the local forest officer setting forth the maximum quantity of each species to be accepted, the rate of payment, point of delivery, locality and trees from which the cones were to be collected, and other particulars. These served as a check on the quantities that were likely to be delivered, allowing the Service to anticipate any shortage and, on the other hand, preventing the collection and delivery of more cones than were required. Yet more important, the contracts provided the means of controlling, or at least better determining, the source of the seed.

Altogether 8,796·85 bushels, or approximately thirteen carloads, of cones were collected, somewhat over ninety per cent of the total being Sitka spruce and yellow pine (*Pinus ponderosa*). The yield of seed, on the whole, was good, and, in the case of Sitka spruce and yellow pine, exceptionally so. The total yield in cleaned seed was slightly over five tons—10,449·95 pounds.

The quality of the seed collected this year, as determined by germination tests, was surprisingly good. The Seed Branch of the Department of Agriculture was kind enough to test the germination of each species.

Schools and Conferences

For a number of years it has been the practice in the Tranquille and Shuswap districts to have all the rangers gather at a central point for purposes of instruction. Since there has been no great change in the personnel for several years, it was decided to dispense with any formal or extended meetings in these two districts and the rangers were brought together for one day only, in order to receive their supplies and any very special instructions that had to be given. In the Revelstoke and Coast districts these "schools" have not been held so regularly, and have not been so highly developed; in these two districts all rangers were called in to Cultus Lake and Beavermouth for several days' intensive instruction. The meetings were purposely held in the field where there were no outside attractions, and every opportunity was open for interchange of ideas. Detailed instructions were given in all phases of a ranger's work and so far as possible demonstrated under actual field conditions in which all were required to take part. Both meetings were attended by representatives of the district office and at their close all the rangers were required to write an examination on the work taken.

Following the practice of previous years, the four district supervisors were called in to the district office for a few days in December for the purpose of discussing administrative matters of all kinds. An innovation at this meeting was the attendance, on the invitation of this Service, of two representatives of the provincial forest service. The two organizations have so many problems in common and are so interdependent in several ways, that a contact of this kind cannot help but be mutually beneficial.

Forest Products Laboratories of Canada

T. A. McElhanney, Superintendent

The fiscal year 1929-30 was an exceptionally active one with respect to general advancement of investigational work in the Forest Products Laboratories in Ottawa and in the branch laboratories in Vancouver and in Montreal. Considerable disorganization of work had resulted in the two Eastern laboratories during the two previous years, on account of the transfer of the main laboratories to Ottawa and the establishment of the Pulp and Paper division in its new quarters in the Pulp and Paper Institute in Montreal. During the past year, however, all three laboratories have been well established in buildings suitable for carrying on an active research program, and very satisfactory progress has been made. That there has been a growing interest in the work of the Laboratories has been manifested very definitely by the fact that requests for technical information with respect to the various investigations being carried on by the Laboratories showed an increase of over 27 per cent over those of the previous year. Such increased demands on the services of the Laboratories on the part of the industry is a most encouraging indication of the growing interest of lumber-using industries in the more efficient use of an important natural resource.

During the meetings of the Canadian Lumbermen's Association in Ottawa in January, 1930, an opportunity was given the Ottawa Laboratories to demonstrate their facilities and the nature of the work which is being carried out. Over 100 lumbermen visited the Laboratories, many of them for the first time. This visit assisted in fostering a closer understanding between the industry and the Laboratories of the ways in which they can be of mutual assistance.

With respect to pulp and paper investigations in the Montreal laboratory there has been the closest co-operation between the Laboratory and the industry. The technical section of the Pulp and Paper Association was freely consulted in drawing up the program of work of the Laboratory when it was in a position to resume active operations after the reconstruction period. The activities of the Pulp and Paper division are therefore definitely linked up with problems of a fundamental or practical nature of interest to the pulp and paper industry.

The Vancouver laboratory is located at the centre of the Pacific Coast lumber industry. Many of its problems, such as the study of the utilization of sawmill waste and the curtailment of kiln-drying losses, have required active assistance and co-operation of the lumber industries. This has been most freely given, with results of a very valuable nature to the industry.

MAIN LABORATORIES, OTTAWA

On account of many new problems presented to the Laboratories by the various wood-using industries, it was found necessary during the year to add some special lines of investigation to those already launched, and to make provision for this increased work by the establishment of special new divisions. As now organized, the work of the Ottawa Laboratories is being carried out under the following divisions: Office Administration, Wood Preservation, Timber Mechanics, Timber Physics, Timber Pathology, Wood Utilization, Lumber Seasoning, and Markets and Exhibits.

The following gives a brief review of the main activities under these various divisions:—

Division of Office Administration

This division is charged with the supervision of the clerical staff, the library, the photographic laboratory, the draughting room, the wood-working and mechanics' shop, and the general labour staff. The library of the Forest Products Laboratories is probably the most complete in Canada with reference to information respecting wood uses. This library is available to any person interested in the study of any particular problem relating to wood utilization.

The study of wood structure and the preparation of reports in connection with the various researches call for numerous photographic illustrations. This involved the making of 756 negatives, 3,519 prints, and 221 lantern slides.

Division of Wood Preservation

The work of the Division of Wood Preservation pertains to treatment of wood with chemicals or otherwise in order to increase its resistance to the attack of insects and wood-destroying fungi, and also to render it resistant to fire. A description of a few of the main problems which have engaged the attention of this division follows.

Protection of Timber from Marine Borers

Some time ago, at the request of the federal Department of Public Works, an investigation was started, having in view the determination by service tests of the relative efficiency of the following preservatives in resisting the attack of marine borers on timber in exposed situations in salt water:—

(1) Creosote containing 40 per cent naphthaline,
(2) Creosote conforming to the specifications of the American Railway Association for Grade 1 creosote oil,
(3) A mixture of copper carbonate and Paris green in an ammonia solution.

During the year seventy jack-pine posts were impregnated with the above preservatives and installed at Lunenburg and Grand Narrows in Nova Scotia, and at Charlottetown, Prince Edward Island. These timbers will be observed periodically in order to determine their relative effectiveness for the intended purpose.

Hardwood Ties, Air-Seasoned and Creosoted

The air-seasoning of hardwood ties prior to creosoting causes severe checking in a large percentage of the ties. During the 1929 treating season the Canadian Pacific Railway incised all hardwood ties immediately on arrival at the treating plant, during the months of February, March, and April. They were then stacked for air-seasoning until August, when they were ready for treatment. At the request of the Canadian Pacific Railway, and on account of the economic importance of the problem, the Laboratories undertook a study which would make it possible to determine whether incising prior to air-seasoning does reduce checking, and at the same time, if possible, enable them to form an opinion as to whether the benefits from such a practice would justify adopting it as standard practice. An opportunity was afforded at the same time to find out whether more uniform absorption and penetration can be secured by treating different species of hardwood separately than by putting them in the treating cylinder in the same charge. The results indicated:—

(1) That incising prior to air-seasoning slightly reduces checking in ties seasoned four to five months, but has no appreciable effect on the rate of air-seasoning or on the absorption of preservative as compared with incision after air-seasoning,
(2) That yellow birch ties should be treated separately from maple and beech, though maple and beech ties may be treated together.

In connection with this investigation 1,200 ties were under observation and were treated in the laboratory tie-treating cylinder.

Sodium Chloride as a Wood Preservative

On account of the interest of the Department of Public Works in developing a cheap treatment for timber in the Maritime Provinces, where supplies of salt are easily available, some preliminary work was carried out in order to obtain data on the efficiency of sodium chloride (common salt) as a preservative under certain conditions. The results so far obtained have not been conclusive, but it is planned to continue the work during next year, having in view not only the determination of the toxicity to fungi of sodium chloride, but also methods of treatment that will ensure satisfactory penetration and retard leaching of the salt.

Division of Timber Mechanics

In addition to the work of testing the different Canadian species of wood in small and structural sizes, to determine their mechanical and physical properties, this division also carries out a series of investigations on different kinds of glues and their application to wood. The testing of boxes and other containers by the use of a large drum is also carried out in this division.

Tests on Small Clear Specimens of Canadian Woods

Ever since the Laboratories were established, standard tests have been carried out on the commercial species of Canadian timber. Such tests have taken into account different conditions of growth in different localities. Gradually there has been built up a mass of information regarding physical and mechanical properties of all the important woods. During the past year 1,946 tests were carried out on air-dry material of balsam poplar, aspen poplar, jack pine, balsam fir, white spruce, black spruce, tamarack, Manitoba maple, white elm, green ash, and bur oak. This material had air-seasoned down to a mois-

ture content of approximately 12 per cent. Four shipments of new material were obtained; three of these consisted of ash, beech, and cedar from New Brunswick, and one of white birch from Beauchene, Quebec.

Glues and Glued Joints

Arrangements were made during the year for a series of tests for the purpose of developing glue standards and twenty-five pounds of each of twenty-one grades of glue were obtained for these tests.

Nail-Holding Power of Canadian Woods

The nail-holding properties of the different woods constitute an important factor in connection with the use of wood for a variety of purposes, particularly where it is subjected to heavy stresses, as in the case of boxes and other shipping containers. Further information was assembled during the year in connection with this project, 410 tests being carried out on aspen poplar, jack pine, white spruce, black spruce, hemlock, Manitoba maple, and white elm.

Considerable work was also done to determine the effect on the holding power of the depth to which the nail is driven and of the gauge of the nail. These tests have related particularly to the sizes of nails used for boxes. The work to date has been principally on white pine, black spruce, and red pine, though it is planned to extend this investigation to include white spruce, white elm, birch, and basswood.

Strength of Wooden Containers

During the year a survey of packing methods and materials used by leading manufacturers of western and southwestern Ontario was undertaken. About one hundred and fifty plants were visited. This information is being used in planning a systematic study of the use of lumber for box construction and of the best methods of designing boxes.

Comparative Study of the Effect of Trametes Pini *and a Second Red-Staining Fungus on the Strength of Jack Pine*

Considerable work has been done during the past few years in studying the fungi causing red stain and red heart in jack pine. Two of these fungi have been isolated for study. In collaboration with the timber pathologist, some work was carried out in the Timber Mechanics Division to determine the effect of these two fungi on the strength of jack pine. Small specimens of clear jack pine were cut and tested in compression parallel to the grain. Corresponding blocks were inoculated with the fungi in the division of Timber Pathology. The control pieces have already been tested, and the inoculated pieces will be tested after periods of three, six, nine, and twelve months.

The Determination of the Interrelationship of the Mechanical and Physical Properties of White Spruce

A study was made some time ago of the relationship between the rate of growth and the density of white spruce. It was considered advisable with the material available from this project to make an investigation of the relation between density and crushing strength of white spruce, and between rate of growth and crushing strength. The results obtained agree with the record of previous tests and confirm the opinion that density, rate of growth, and strength are very closely interrelated.

Strength Tests of Telephone Poles

As the result of a questionnaire sent to the more important telephone and telegraph companies, requesting information concerning their present and future pole requirements, it was apparent that a scarcity of cedar poles in Eastern

Canada was impending. In order to avoid the necessity of importing foreign material to replace the naturally decay-resistant cedar, it became immediately necessary to investigate the possibilities of utilizing other common native species. In order that information might be available regarding the relative strength values, of these species, a number of poles of commercial sizes were collected during the fiscal year 1928-9, and were prepared for test, under conditions simulating those in commercial use, by air-seasoning and butt-soaking. The butt-soaking consisted of immersing the butt of the pole up to the ground line in a tank, and permitting this section to become saturated with water, thereby reducing its strength to that of wood in the green condition, as is the case in most poles when placed in the ground.

The following species were collected and held in storage during the fiscal year 1928-9:—

Species	Number of poles	Locality from which obtained	Condition of seasoning at time of collection
Eastern cedar	26	North Bay, Ont.	2 years
Red pine	27	Newcastle, N.B.	6 months
Jack pine	23	"	6 months
Red pine (creosoted)	25	"	6 months
Red pine	25	Fort Coulonge, P.Q.	4 months
Jack pine	25	Timmins, Ont.	Green-cut

The butts of the cedar poles were permitted to soak in the conditioning tank for a period of seven months. The other species—red pine and jack pine—were soaked for a period of four months. Periodic alexaminations of the moisture content of the material were made, to ensure before testing that the moisture content of the pole butts corresponded to the moisture content of poles in the green condition. Tests to the number of 4,326 were carried out, computations completed, and an analysis of the results obtained.

Strength of Treated and Untreated Douglas Fir Beams

Among users of treated Douglas fir structural timbers considerable difference of opinion has existed as to whether creosote treatment seriously impairs the strength of the timber. On account of frequent requests to the Laboratories for information in this connection, it was decided to carry out a series of tests on commercially treated beams and untreated beams of structural size. Some of them were incised before treatment, and some were left unincised. In all, 139 beams were tested. In general, while it was shown that there was some decrease in strength of Douglas fir through treatment, it was not of sufficient extent to limit their usefulness or serviceability from a commercial standpoint.

Mine Timbers

On account of specific requests, some work has been done by the Laboratories in testing the relative strength of different species of wood for use as mine timbers, but as a result of general inquiry among mine owners it was decided not to proceed at the present time with an exten sie investigation of mine timbers, but to confine attention only to special problems as presented.

Miscellaneous Investigations

In addition to the major projects of this division already described, a number of investigations involvin ga lesser amount of work, but of considerable importance were carried out. A few of these are as follows:—

(1) Tests on telephone top-pins,
(2) Investigation of the physical and mechanical properties of mora wood imported from British Guiana,

(3) An investigation of the physical and mechanical properties of Siberian pine,
(4) Various tests on different classes of wood used in the construction of aeroplane parts, such as propellers, spars, longerons, struts, and skis,
(5) A variety of tests on containers submitted by commercial firms, in order to determine relative strength and efficiency of different methods of construction and of different materials,
(6) Comparative tests on plywood containers for domestic and export shipment,
(7) Comparative tests on standard and wire-bound containers for packing liquors, herrings, and maple sugar,
(8) Tests to determine various methods of strapping upon the strength of butter boxes,
(9) Investigations to determine the spike-holding properties of hardwood ties imported from British Guiana.

Under the various projects 15,430 tests were performed during the year. In connection with miscellaneous work resulting from inquiries from the industry, 2,159 tests were conducted.

Division of Lumber Seasoning

Toward the end of the year, an officer was appointed to take charge of research work in lumber seasoning. Prior to that, considerable work had been done in connection with log-sinkage studies, the investigation of electrical apparatus for moisture-content determinations, and other studies of a related nature.

Kiln-drying

A commencement was made with kiln-drying studies of white pine (*Pinus Strobus*). Previous investigations had shown that the occurrence of brown-stain was a controlling factor in the kiln-drying of white pine. Investigations so far, while not conclusive, would seem to indicate that brown-stain may be avoided by the proper control of temperature and humidity during the dry-kiln run.

Changes in Moisture Content during Shipment of Kiln-dried Stock from British Columbia

By co-operative arrangement with the Vancouver branch of the Laboratories a check-up was made of the moisture absorbed in transporting, by rail, kiln-dried stock from British Columbia to Eastern Canada.

Division of Timber Physics

In connection with the various investigations being carried on by the Forest Products Laboratories there is constant need of systematic study of the physical structure of the various woods of Canada, of woods which are imported into Canada, and also of foreign woods with which Canadian exported timbers must compete. Such studies permit accurate identification of the different woods and serve to explain many of the characteristics which make wood so variable as between species. Study of wood structure and related problems are carried out in the Division of Timber Physics.

A few of the most important investigations conducted by this division during the year are as follows:—

Microscopic Preparations of Canadian Woods

As wood structure determines to a considerable extent its utility, the Laboratories receive frequent requests for microscopic preparations of Canadian woods. These have come principally from universities and schools which have not facilities for this class of work.

Wood Identification

In connection with the commercial utilization of wood, as well as in many of the projects being conducted in the various divisions of the Laboratories, it is frequently necessary to make careful identification of wood. Requests for such information were received from engineers and architects and from companies using timber in large quantities.

A Study of the Factors affecting the Sinkage of Wood in Fresh Water

On account of the very serious losses sustained by pulpwood operators in driving logs from the woods to the mill, some work was undertaken at the request of the Pulp and Paper Association, in order to study some of the causes affecting such sinkage. Logs of various species, both hardwoods and softwoods, were obtained and floated in a specially prepared tank in the laboratory. After nearly a year's floatation in the tank the logs were removed and their decreased floatability noted, as well as the regions of penetration of the water in the log.

The Effect of Agitation of Water on the Rate of Absorption by Logs

A considerable difference of opinion has existed among lumbermen as to whether logs floating in smooth water or logs which have been run through frequent rapids would float longer. A tank was prepared capable of floating logs, the water in which could be constantly agitated during the daytime. Companion logs were floated in still water. No important difference in the water absorbed by the two lots of logs was observed.

Investigation of the Effect of Water Temperatures on the Sinkage of Wood in Fresh Water

During the year special attention was given to the design of apparatus which would permit definite control of temperatures in small tanks built for floating logs, and a compressor with refrigerating coil equipment and temperature control apparatus was placed in an insulated tank for the purposes of this study. One tank was held at a temperature of approximately 35° F., whereas the other was maintained at a temperature of about 65° F. The experiment has not yet been completed, but it would appear that there is no difference in floatation due solely to the temperature of water. A comparison of results of this investigation with results of other investigations in log sinkage indicates that sinkage is faster when logs are subjected to varying temperatures of the water. A further study of this point is in progress.

In addition to these more important problems a number of minor investigations were carried out. These included such subjects as

(1) A comparison of the density and fibre-length of Russian spruce and Canadian species of spruce.
(2) The cause of black spots appearing on the surface of Douglas fir after finishing in the British Isles.
(3) Determination of fibre dimensions of spruce.

An Investigation of Electrical Resistance in Wood

Two members of the staff of the University of Toronto, by the aid of a grant from the National Research Council, developed an apparatus for the determination of moisture content of wheat by electrical methods. At their request permission was granted to them to install their instrument for a short period in the Forest Products Laboratories in order to get some indication of its usefulness in the determination of moisture content in wood. The investigation yielded some rather interesting results but showed that the apparatus in its present form was impracticable for the determination of moisture content in wood.

Division of Timber Pathology

Under conditions favourable to the action of wood-destroying fungi, wood will decay, whereas, under conditions unfavourable to their development, it will last practically indefinitely. The study of the durability of wood and the various decays which affect that durability is therefore one of the most important technical features of wood utilization. Problems of this nature are investigated by the division of Timber Pathology. Among the more important matters which have engaged the attention of this division during the year are the following:—

Reference Collection of Pathological Material

In order to facilitate the identification of decays in wood, it is necessary to have a large stock of reference decays; to this additions are continually being made. During the year, 60 specimens of rotted wood or sporophores were added to the collection. This gives a total of 750 specimens now in the herbarium of the Timber Pathology laboratory. In addition to these, over 200 cultures form part of the collection.

Red-stain in Jack Pine: its Development in Treated and Untreated Railway Ties under service conditions

Jack pine ties affected by red-stain or red-heart, which had been examined from a pathological standpoint, (some of them being afterwards treated), were placed during the year in the tracks at Ellwood station, on the Canadian Pacific Railway south of Ottawa. Of these, 197 creosoted ties and 195 untreated ties were placed in the main-line track. Twenty-three creosoted and 23 untreated ties showing white pocket rot were laid in siding tracks. These ties will be observed over a period of years in order to complete this study.

Comparative Study of the Effect of Trametes Pini *and a Second red-staining fungus on the strength of jack pine*

This project is being carried on co-operatively between two divisions, namely, Timber Pathology and Timber Mechanics.

Trametes Pini stains jack pine red and eventually produces white pocket rot. A second fungus still unidentified, designated as Fungus No. 2, has been frequently isolated from red-stained jack pine, and when inoculated into culture blocks of jack pine has stained them red.

Plans have been made to stain fresh jack pine with each of these two fungi. The action of each will be followed during the course of a year, and strength tests will then be made on the culture blocks, to determine the reduction in strength due to penetration by each of the fungi. The work of setting up cultures for this experiment was begun.

Blue-stain in White Pine with Special Reference to Methods of Prevention and Control

In the early part of July, 1929, the Timber Pathologist visited a number of white-pine mills in the Ottawa Valley and Northern Ontario, in order to examine conditions in white-pine yards, such as the lay-out of mill-yard, general sanitary conditions, methods of transportation and piling of lumber in yards, segregation of stock as to species, grades, widths, and lengths, position of lumber, crossers, chimneys, roofs, and any methods of treatment of lumber to prevent stain. A report on observations made in connection with this survey was prepared and published.

Tests were made of the effect of twelve selected toxic chemicals in the control of blue stain. Solutions of the chemicals were made up, and white pine sapwood, after being dipped in the solution, was piled in contact with stained wood or sprayed with spores of blue-staining fungi. The exposed blocks were kept for four weeks under conditions favourable to infection of blue-staining fungi. They were then examined. Five of the twelve chemicals gave promise of commercial usefulness. These five are being submitted to further tests in order to determine (1) their stability when brought into contact with white pine lumber, (2) their effect on tool steel, (3) the time necessary for immersion in the chemical in order for them to be effective, and (4) concentrations required in each case. The results of these experiments will constitute a basis for practical mill-yard tests during the coming year.

Systematic Study of Fungi Causing Blue-stain in Softwoods

Fungi were isolated from stained pine, spruce, and Douglas fir from different sources. The cultures were purified and grouped according to cultural characteristics. Twelve of these fungi will be inoculated into blocks of red pine, white pine, black spruce, white spruce, and balsam fir. Variations were noted in the type and amount of stain produced by the several fungi in the different species of wood. Eleven of the twelve fungi caused more or less staining in pine blocks. Several types of *Ceratostomella* and of *Graphium*, one *Cadophora*, and several unidentified fungi were associated with the blue stains in softwoods which are being studied, and the study of the several forms is being continued.

Trial of New Medium for the Development of Sporophores of Wood-rotting Fungi

In the July-August number of "Mycologia" there appeared an article by Mr. B. E. Etter, entitled "New Medium for the Development of Wood-rot Fungi." Seven common wood-destroyers were grown on this medium in the hope of obtaining fruiting bodies. The cultures set up in July were examined in November. *Pleurotus ulmarius* had produced a small, fairly typical sporophore. Distorted fruits also appeared in a second *Pleurotus ulmarius*, in *Polyporus Schweinitzii*, and *Lentinus lepideus*. The medium cannot, however, be considered a success.

Brown-heart in Birch

The increasing use of yellow birch has drawn attention to some of the decays found in this wood. The question of brown- or red-heart in birch was brought to the attention of the Laboratories several times during the year, particularly by the Pulp and Paper Association. Some preliminary work was done in connection with this problem.

Torula ligniperda was isolated from brown streaks in birch heartwood, and when this fungus was reinoculated into birch culture-blocks it produced noticeable discoloration in the wood. This heartwood discoloration has been found to be a troublesome defect from the commercial standpoint. A more extensive study based on the findings already made will be conducted during the coming year.

Surface Sterilization of Culture Blocks with Acetic Acid

A satisfactory method of surface sterilization of wood blocks for culture purposes was worked out and is being applied in the setting up of cultures in connection with the determination of the effect of red rot on the strength of jack pine. *Trametes Pini* was inoculated into culture-blocks of jack pine which had previously been surface sterilized with acetic acid, and after a period of eight months the wood was found to have been reduced to an advanced stage of white pocket rot. The fungus produced fruit bodies with well-formed hymenium on the surface of the culture blocks.

Susceptibility of Mora Wood to Attack by Fungi

Certain of the very heavy and strong hardwoods of South America are being suggested for Canadian use for railway ties. Among these is mora wood. A request was received for certain tests on the mechanical and physical properties of this imported wood and on its durability, and these are under way.

Division of Wood Utilization

During the year, the nucleus of a new division of the Laboratory was established to concentrate on special problems arising in actual operations in logging, sawmilling and manufacturing. The following projects received particular attention:—

Effects of Seasoning on the Floatability of Logs

Considerable work has been done in Canada on problems relating to the floatability of water-driven logs by the Woodlands section of the Pulp and Paper Association and co-operating pulp and paper companies. The Laboratories have assisted these organizations in some of the more technical phases of the general problem. From work already done it appeared that one of the most promising solutions of the problem related closely to the question of seasoning the logs before putting them in the lakes or rivers for driving to the mills. Particular attention was therefore devoted to this phase of the problem by the Laboratories, and in order to forward this work two shipments of logs were obtained, one from Chicoutimi, Quebec, and the other from Sand Lake, Ontario. The material consisted of green logs, as well as logs which had sunk and afterwards been recovered. The species represented were white birch, white spruce, and balsam fir.

Test logs were assigned to seven different seasoning classes, ranging from green butt logs to logs which had been severely cracked in seasoning. After seasoning so as to place these in the various classes, prior to placing them in a large tank where they could be observed for floatability, data were taken regarding (1) diameter, both at large and small end, (2) moisture content, (3) specific gravity, (4) number and character of annual rings, (5) number and character of knots, (6) defects, (7) shape of log, (8) length of log, (9) volume (by displacement in water). After being placed in the water, logs were measured periodically, in order to determine the variation in "margin of floatation" in each class of logs. In addition to these tests on green logs, 'sinker' logs were also seasoned in four different ways and placed in a tank for similar observation and measurement. After the logs had been a few months in the water, a progress report was prepared.

Investigation of Sawmill Waste in the Hardwood and Softwood Mills in Eastern Canada

Each year the Laboratories receive numerous requests from the lumber industries regarding methods of disposal of by-products of the sawmill industry, such as sawdust, slabs, and edgings. On account of keen competition from substitute building materials, it has become necessary for the lumber industries to pay closer attention to all possible sources of revenue from their operation and to the curtailment of waste as far as possible. In order to assist industries in this connection it was decided to make a special survey of sawmills in order to obtain data on the amounts and physical condition of so-called waste. Considerable attention was therefore devoted to preparation of plans in connection with this study.

Determination of Factors affecting Inflammability of Forest Fuels

The Forest Service of the Department of the Interior has been devoting considerable attention to the study of weather conditions with relation to

forest fires. Assistance was requested from the Laboratories in dealing with certain phases of this problem, particularly those relating to temperatures at which forest fuels of different kinds readily ignite and to weather conditions with respect to temperature and relative humidity which produce in forest fuels conditions at which they readily ignite.

Some experiments were also carried on to determine whether forest fuels such as pine needles and small pine twigs gave off in oven-drying to 105° C. any volatile oils in addition to water vapour. While considerable progress was made in connection with these studies, it will be necessary to carry the work on for another year in order to complete the investigation.

Division of Markets and Exhibits

A constantly increasing demand on the services of the Laboratories, particularly from foreign sources, for specimens of the principal commercial woods of Canada occurred during the year. The large number of requests from manual-training departments, technical schools, and colleges for specimens of Canadian woods indicates increasing interest in the woods of Canada and in their various properties and uses. Ninety-six sets of hand specimens of Canadian woods were sent out on request.

Exhibit in National Museum, Ottawa

A permanent forest-products exhibit was installed in the Canadian National Museum, Ottawa. This consisted of a large panel 6½ feet by 12 feet on which was mounted a flow sheet with materials attached, illustrative of the four processes of manufacturing wood-pulp in Canada. A similar-sized panel shows samples of various products of wood-pulp. In addition, five logs 6 feet in length of Sitka spruce, Douglas fir, white pine, maple, and birch, suitably cut to illustrate the timber in different sections, were installed in cases in the Museum.

The Laboratories also participated in the following exhibits: —

Toronto Builders' Exhibition, Toronto, April 15-20, 1929; Exhibits in offices of the Department of Immigration and Colonization at Buffalo and Detroit; Exhibits in the Royal York Hotel, Toronto; Provincial exhibition of natural resources at Quebec.

Exhibits sent to Canadian Trade Commissioners

At the request of the Commercial Intelligence Service, panels 8 feet by 15 feet of twelve of the principal Canadian woods, from an export standpoint, with large labels giving principal uses and characteristics of the woods, were sent to Trade Commissioners at the following points: Paris, Brussels, Milan, Rotterdam, Rio de Janeiro, Melbourne, Hamburg, Liverpool, Glasgow, Kingston (Jamaica), Dublin, Tokio, Wellington (New Zealand), Cape Town, Buenos Aires, Shanghai, Bristol, London, and Trinidad.

Imperial Institute, London, England

A request was received for a comprehensive exhibit of Canadian forest products at the Imperial Institute, London, England. This exhibit is being prepared by the Canadian Exhibition Commissioner, who requested the co-operation of the Laboratories in designing, and selecting the contents of, three large cases to illustrate pulp and paper products, lumber, and lumber products of Canada. These exhibits will be accompanied by a considerable quantity of statistical matter.

International Exhibition, Antwerp, Belgium

At the request of the Canadian Exhibition Commissioner a large forest-products exhibit was designed and material selected for the Antwerp Exhibition.

This will occupy space in the centre of the Canadian Building 10 feet square and 20 feet high.

The Laboratories maintain at Ottawa an exhibit room in which forest products are displayed for the benefit of visitors to the Laboratories as well as for the use of Laboratory officers. During the year a large amount of material was added to the collection, including pressed-wood products, building boards, paper products, mouldings, pulp samples, insulating boards, samples of foreign woods, rayon products, and a variety of small articles manufactured from wood.

Publications

During the past year a number of government publications, papers on technical subjects, articles for trade periodicals, and addresses have been prepared by members of the staff of the Ottawa laboratories. The following is a list of some of the more important articles contributed during the year by members of the staff of the Laboratories to technical periodicals and other publications:—

"The Preservative Treatment of Mine Timbers." Paper read at the annual meeting of the Institute of Mining and Metallurgy, Toronto, March 30, 1930, by J. F. Harkom.

"Wood Preservation". Paper presented by Dr. C. Greaves, before the Queen's University Branch of the Society of Chemistry and Industry.

"The Effects of Seasoning on the Floatability of Logs." A paper by K. G. Fensom read before the annual meeting of the Woodlands section of the Canadian Pulp and Paper Association in January, 1930, and published in their transactions.

"A Study of Log Sinkage by the Forest Products Laboratories of Canada". A paper by K. G. Fensom, published in the *Canada Lumberman,* April 15, 1930.

"Factors affecting the Sinkage of Logs in fresh Water". A paper prepared by J. D. Hale for the annual meeting of the Pulp and Paper Association in Montreal in January, 1930.

"Slime in Pulp and Paper Mills with special Reference to Methods of Prevention", by Dr. Clara W. Fritz. Research Notes, Forests Products Laboratories of Canada, Montreal Laboratory, Vol. 2, 1929.

"Forest Products Research in Canada". A paper by T. A. McElhanney, published in the April, 1929, issue of the bulletin of the Professional Institute of Canada.

"Timber Decay". An address over radio station CNRO, by Dr. Clara W. Fritz.

"Forest Products Research in Canada". By T. A. McElhanney. Vol. VI, No. 1, *The Forestry Chronicle,* February, 1930.

"Research in Relation to Wood Uses". By T. A. McElhanney. Address before Canadian Lumbermen's Association at the time of their visit to the Laboratories in January, 1930. Published in *Canada Lumberman,* February 1, 1930.

"Growth of Forest Products Research in Canada", by T. A. McElhanney. Published in *Industrial Canada,* January, 1930.

PULP AND PAPER DIVISION (MONTREAL)

E. P. Cameron, Superintendent

The Pulp and Paper Division of the Laboratories is accommodated in the new Pulp and Paper Research Institute in Montreal, which was erected by the Canadian Pulp and Paper Association. In addition to providing accommodation for the pulp and paper laboratories, the association contributes an annual grant to assist in financing the work of the Laboratories.

The program of work and activities of the division are under the general administration of a committee composed of representatives of the Department of the Interior and of the pulp and paper industry. In order to link up the activities of McGill University with those of the Pulp and Paper Division, an invitation was extended to the university during the year to appoint two representatives who might meet with the above-mentioned committee to discuss problems of mutual interest in connection with pulp and paper research.

Very satisfactory progress has been made by the Laboratories during the year in formulating a program of work, in obtaining competent personnel to launch such a program and in getting various projects well organized.

Program of Work

During the year the program of researches for the Pulp and Paper division was completely reconstructed. The new program was developed in close co-operation with the pulp and paper industry through several committees of the Technical Section of the Pulp and Paper Association. Practically all projects which had previously been actively undertaken were included in the new program, but in several instances it was deemed advisable to embody in the form of progress reports the status of these projects at the time of launching the new program. These progress reports were published in January, 1930, as a series of articles appearing as Research Notes, Volume 2. The program of work as finally developed was published in January, 1930, as a booklet of seventy-eight pages entitled "Research Program: General Discussion and Problems".

Publications and Papers

The following papers were published in Research Notes, Volume 2:—

(1) The estimation of cellulose in wood. J. H. Ross, A. L. Davidson, and E. O. Houghton.
(2) The determination of lignin by means of formaldehyde and sulphuric acid. J. H. Ross and A. C. Hill.
(3) The fractional precipitation of alkali lignin. F. H. Yorston.
(4) Slime in pulp and paper mills. C. W. Fritz.
(5) The estimation of reducing sugar. J. H. Ross.
(6) The estimation of lignin in pulp. J. H. Ross and G. J. C. Potter.
(7) Hydration of cellulose by beating. W. Boyd Campbell.
(8) Equilibria in sulphur dioxide solution. W. Boyd Campbell and O. Maass.
(9) Chestnut ligno-cellulose. J. H. Ross and A. C. Hill.
(10) Soda process studies: I. Effect of high concentration in cooking. Part I. J. H. Ross.
(11) Soda process studies: I. Effect of high concentration in cooking. Part II. J. H. Ross and W. E. Adlington.
(12) Soda process studies: II. Effect of concentration on quality. J. H. Ross and C. R. Mitchell.
(13) Pitch troubles. G. J. C. Potter.
(14) Determination of lignin by means of formaldehyde and sulphuric acid. Part II. J. H. Ross and G. J. C. Potter.
(15) Penetration studies: I. Path of liquid penetration in jack pine. H. Wyatt Johnston and O. Maass.

In addition to these papers the following articles were published:—

Equilibria and sulphur dioxide solutions. W. B. Campbell and O. Maass. *Canadian Journal of Research,* January, 1930.

Pulp and Paper Research in Canada. E. P. Cameron. *Industrial Canada,* January, 1930.

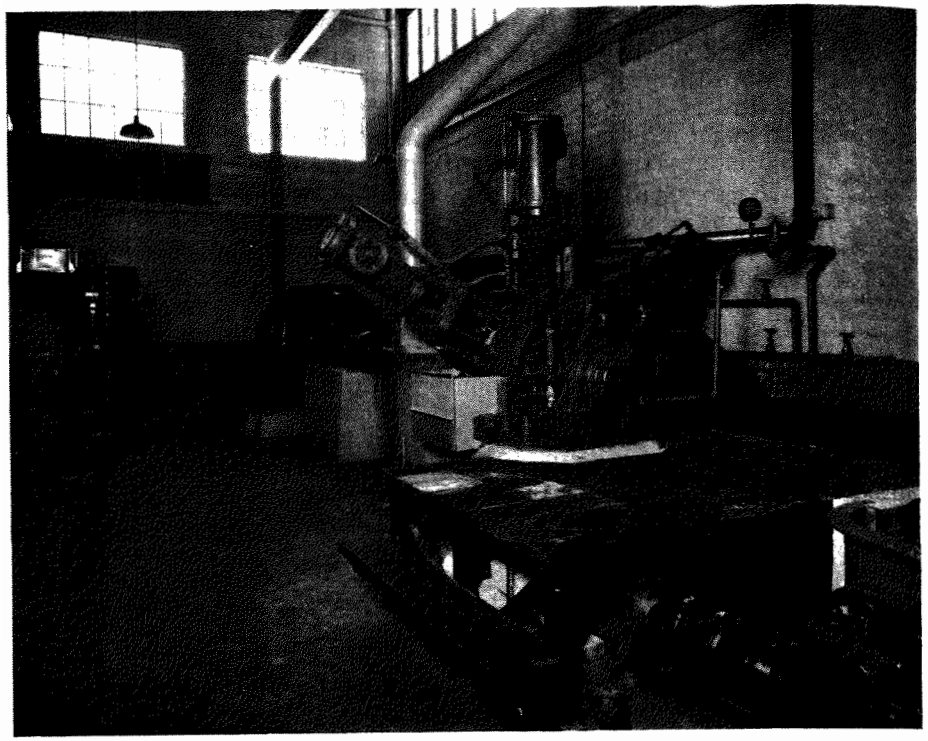


PLATE 7.—The wood grinder.

EXPERIMENTAL PAPER MILL AT PULP

The equipment of the laboratory includes a full complement of machinery

The following projects engaged the attention of the Laboratory during the year:—

Pulp Testing

This project has for its object the compilation of a manual which will contain complete methods of testing, both physical and chemical, for use in this Laboratory. The methods developed under previous projects are being incorporated. Exploratory work for improvement of methods or the development of new methods will be undertaken only as the general work of the Laboratory demands. Suggestions developed in the study of alkaline cooking have been further developed under the new project, "Kraft and soda pulps for artificial silk".

Sulphite Studies

The project on sulphite studies has for its object the definition of

(1) The relation of pulp quality to wood species as revealed by a standard pulping technique,
(2) The effect of process variables on the yield and quality of pulp,
(3) The effect of changes in operating procedure on over-all process efficiency.

The first has for its object the direct comparison of the pulping qualities of Canadian woods on the basis of a predetermined and standard method of cooking.

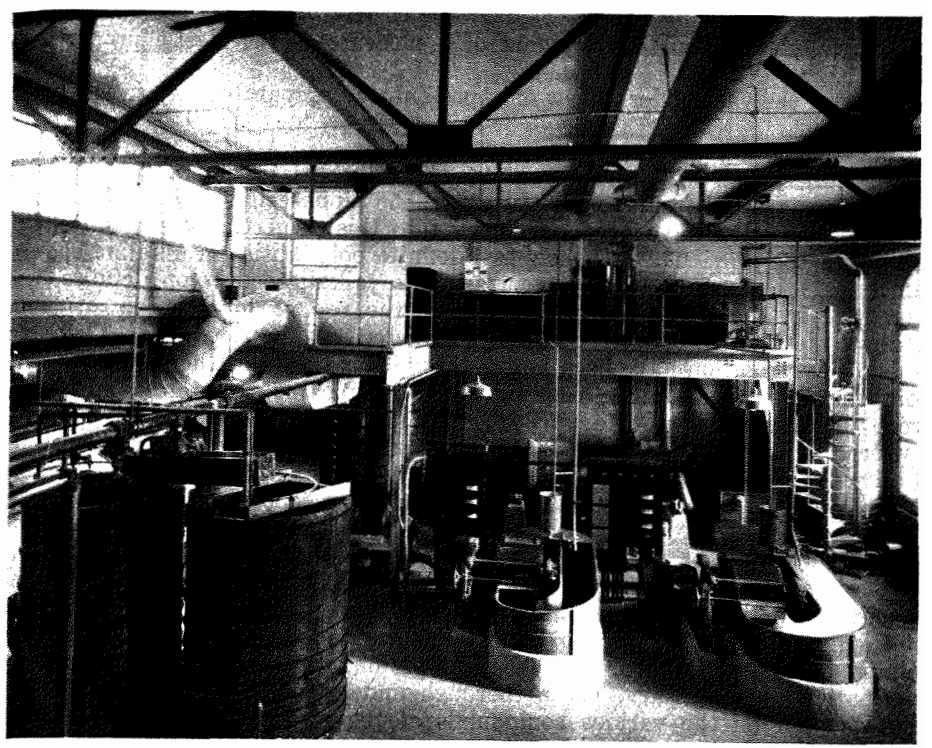


PLATE 8.—The beater.

AND PAPER LABORATORY, MONTREAL

for the making of paper, part of which is shown in the illustrations.

The second is concerned only with those variables which are definitely related to process, i.e., temperature, pressure, acid strength, base, cooking, curve, etc.

The third comprises changes in the technique of operation rather than in the variation of the process variables.

These three phases of the investigation cover quite completely the whole problem of sulphite cooking, and the selection of the actual work to be undertaken has been carried out with a full appreciation of the importance of the various factors concerned. The field defined for study falls under (1) and (2) above. Stated briefly, it has for its object a grading of wood and pulps for quality in relation to the paper- and cellulose-using industries by pulping under a considerable number of correlated conditions, and fully testing the product for all of its physical and chemical characteristics.

Definition of Pulp Quality

The object of this investigation is to define the quality of a pulp which affects the properties of paper made from it, and eventually to find practical means of measuring these qualities.

The main problem divides itself into a number of minor ones, such as (A) the relation of the ultimate strength of the pulp fibre to the strength of the paper made from it, (B) definition of the adhesive bond between adjoining fibres in paper, (C) definition of "Hydration" as developed by beating (i.e., whether the chemical constitution of the fibre affects the hydration and the

development of the adhesive bond), (D) the correlation between fibre dimension and paper quality, (E) development of a measure of the elastic properties of the fibre.

During the year under review only preliminary preparatory work was undertaken.

Kraft and Soda Pulp for Artificial Silk

Ideas suggested from previous work on the alpha-cellulose test, the estimation of lignin, etc., have been developed into this project. Briefly stated, the findings of the previous work show two definite possibilities in alkaline cooking, namely, (1) the use of high concentrations of alkali to develop definite characteristics in the resulting pulp, and (2) the use of low concentrations of alkali to develop altogether different characteristics in the pulp. These two fields of investigation have been active throughout the year, the results accruing from the low-concentration cooking being of particular interest and value. From the hypothesis put forward and the substantial evidence developed, it now seems that it will be possible to produce alkaline pulps which are suitable in all ways for artificial-silk production. This work is still in its initial stage of development, but the results so far obtained are encouraging.

Penetration

As is generally known, chemical pulp is produced by the action of certain reagents upon the cementing or non-cellulose materials of the wood, their dissolution making it possible to break the original wood down into free and isolated fibres. To control this chemical pulping action, two general types of information are necessary, (1) a thorough understanding of the action of the reagents used on the various compounds of the wood structure, and (2) the predominating factors controlling the penetration of the liquor into the wood itself. A thorough understanding of these two general fields of information would do much to elucidate the main problems concerned in chemical cooking. As an advance in this field, this laboratory has undertaken a thorough study of the factors and conditions governing the penetration of cooking liquors into wood.

Three broad types of problems are presented, namely:—

(1) What is the mechanism by which liquid enters the fibre cavities of wood, and how may this entry be facilitated?
(2) What governs the diffusion of liquid through the wall of the fibre cavity, and what are the optimum conditions of this diffusion?
(3) What are the rates of reaction between the solvent and the cementing matrix, and what are the optimum conditions for this reaction?

The mechanism by which liquids enter the fibre cavities and the factors which govern their diffusion through the walls of the fibre cavity are primarily concerned with the fundamentals upon which the mechanism of the flow of liquid through the chip is based. It is known, from common practice, that the reactivity of cooking liquor is largely depleted by the end of the cook. This points to a flow of reagent to the zone and some similar flow of reaction products away from the zone. The mechanism of this flow is obscure at present, and the thorough study of it will not only elucidate the problem of penetration, but will yield a far clearer conception of the reaction conditions within the digester itself.

When once the mechanism of this flow is understood, the conditions under which it can be obtained will be studied. Independent variables of the chip itself, the reactive liquor used, and the conditions of reaction will all have an effect upon the flow. Naturally these variables will also affect the type and the rate of the reaction itself, but it is axiomatic that to accomplish the reaction

the reagents must be supplied to the zone of activity and the reaction products removed therefrom. This can be done only by a flow of some kind within the substance of the chip itself. The balance of conditions which will yield the type and rate of reaction required, together with sufficient flow to supply the reagents necessary at all times, is most desirable. The variables which will affect the rate of flow and the type and rate of reaction may be summarized under the following general headings: (1) Species, (2) Condition of sample, (3) Form of sample, (4) Solvent, (5) Temperature, (6) Pressure, (7) Time, (8) Catalysts.

These variables and their interrelation and interdependence are being studied under a definite plan from which it is anticipated that data will be developed which will aid materially in the solution of the problem and its technical application.

Bleaching

This work has for its object the investigation of the processes of whitening chemical pulps with special reference to the reactions involved.

The type and extent of this investigation requires that it be undertaken in two phases, namely,

(1) Preliminary investigation.
(2) Main investigation.

The so-called preliminary investigations deal with those problems and studies, accurate data from which are essential for conducting the main investigation. They cover the development of apparatus and technique, substantiation of methods, and all related subjects which have a direct bearing on or utility to the main investigation. The main investigation constitutes a thorough study of the physical chemistry of the hypochlorite process. Such a study will include the interrelation of the variables—bleach concentration, catalysts, and time—on the course of the reaction with respect to utilization of oxidant, first, effectively, in the destruction (and perhaps dissolution) of those bodies lending colour to the fibre, and second, ineffectively, in the oxidation of the general fibre substance. This also includes the lowering of the oxidation potential of the system due to inorganic change of state without the liberation of useful oxygen.

This will be followed by the application of the results obtained to bleaching procedure, which will include ratio of bleach liquor to pulp, multiple-stage bleaching, etc.

To date, suitable apparatus has been designed and constructed for the correct estimation of hydrogen-ion concentration in oxidizing solutions and for the circulation of bleach liquor through pulp.

Groundwood Studies

This investigation constitutes a systematic study of the groundwood process, its factors of operation, quality of product, machine design, and related appliances and processes.

The general course of the investigation covers the following salient points in the order named: (1) Definition of groundwood quality, (2) Definition of stone quality and stone surface, (3) Study of the factors of operation, (4) Study of machine design, auxiliary appliances, and related methods of procedure.

(1) *Definition of Groundwood Quality.*—While the definition of groundwood quality is covered elsewhere in this "Research Program", yet the importance of the question to this investigation is sufficient to explore at least certain lines of thought in the effort to supplement the existing methods of testing. The main body of the work is the substantiation of the existing methods and their application to pulps of known running qualities in order to determine, as far as possible, their definite utility.

(2) *Definition of Stone Quality and Stone Surface.*—Stone composition in relation to the impressed surface pattern is a large field of study, and necessitates the development of some accurate means of defining composition in terms of grit character and matrix and also a more definite understanding of the function of surface pattern and how best obtained.

(3) *Study of the Factors of Operation.*—The data already available give a very definite indication of the trend of the various factors of operation on production efficiency and to a lesser degree on pulp quality. The present need is, first, the substantiation of the data available and their correlation to some definite basis of testing quality, and, second, the exploration of speeds, pressures, conditions of stone surface, and temperatures, little known at the present time.

(4) *Study of Machine Design, Auxiliary Appliances, and Related Methods of Procedure.*—The work so far on this project has related to the study of the problems involved and the consideration of the method of attack. This has largely been accomplished so that the active work of investigation may be proceeded with immediately.

VANCOUVER LABORATORY

R. M. Brown, Superintendent

Located at the centre of the Pacific Coast lumber industry of Canada, the Vancouver laboratory is becoming more closely associated each year with the technical problems of the lumber industry of the region. The steadily increasing demand for authoritative information and the necessity of fundamental data relating to the properties of British Columbia species has, during the year, necessitated increased facilities in both staff and equipment.

During the year over 400 requests for technical information were received, an increase of approximately 10 per cent over the previous year. A number of such requests were of considerable importance from an industrial standpoint and led in several cases to special laboratory investigations.

The Vancouver laboratory is organized at present under two major divisions, (1) the division of Timber Mechanics, and (2) the division of Timber Products; included under the latter division is the work on Timber Pathology.

Division of Timber Mechanics

An important function of this division is the testing of British Columbia woods to determine their physical and mechanical properties, such as compression, bending, hardness, and shock-resisting properties, in order to provide a definite standard of comparison with the analogous characteristics of wood from other regions. Physical and mechanical tests to the number of 13,677 were carried out during the year.

Standard Tests on Mechanical and Physical Properties

Considerable advance was made in the testing of British Columbia species by standard methods. The following woods were tested either in the green condition or after seasoning down to an air-dry condition of approximately 12 per cent: Western white pine, Western larch, Western red cedar, Douglas fir. The analysis of results of tests made previously was forwarded, the following woods receiving attention: lodgepole pine, Douglas fir, Western red cedar, Sitka spruce, Western hemlock, Western yellow pine, Western larch, Western white pine. A total of 4,326 tests was made in connection with this project.

The Effect of Variable Moisture Content on the Strength of Wood

Tests to determine the effect of the moisture content on the strength of wood were carried out on Western white pine, Western larch, and Douglas fir. Curves showing moisture-strength relations were drawn. In all, 1,688 tests were conducted under this project.

The Deterioration of Black Cottonwood Logs in Fresh-water Storage

As the previous work on this project produced inconclusive results, a further shipment of four logs was secured, the working plan revised, and all material tested. A report on the project is in course of preparation. A total of 1,292 tests was made and the results computed and listed.

The Retention of Nails and Screws by Wood

Tests to determine the relative power of different British Columbia woods to hold nails and screws were carried out as opportunity offered. The total number of such tests was 977.

Tests to Determine the Effect of Incising and Creosoting upon the Strength of Douglas Fir Ties

Work under this project was commenced during the last fiscal year and completed during the current year. All computations from tests were made and tabulated, and a preliminary report presented. In all, 5,394 tests were made under this project.

Miscellaneous Tests

The opportunity offered to manufacturers and consumers of wood and of wood products to secure authoritative test results on materials in which they are interested is being more widely recognized and utilized, not only by local firms but also by firms outside the province. Tests under this heading covered such items as fire-resistant paint, moisture content of various softwoods and hardwoods, strength of Sitka spruce for use in aeroplane construction, built-up structural joints, bending tests on structural Douglas fir in long use, and impact tests on plywood trunks. A series of shear tests for the Fisheries Experiment Station on glue made from fish waste has been of such marked value as to result in a request for co-operation with this station in a further and much more comprehensive series of tests on improved glues, developed as a result of the original tests. Miscellaneous tests of such nature totalled 469.

Division of Timber Products

The principal work engaging the attention of this division at present comprises lumber seasoning, utilization of sawmill and logging waste, and special pathological investigations.

Lumber Seasoning

Many problems of a widely varied nature, touching the general subject of lumber seasoning, are presented to the Laboratories for solution. For convenience, seasoning studies have been grouped under the three project divisions "Absorption of Moisture," "Air Seasoning," and "Kiln-drying of Lumber and Shingles." All problems are allotted to one of these projects and dealt with as part of the project work.

Absorption of Moisture.—The study of the absorption of moisture in air-dried stock, open-piled in an open shed, which was begun in November, 1926, was completed during the year. Much valuable information was obtained from this study on the variation of the moisture content of Douglas fir, Western hemlock, Western red cedar, and Sitka spruce with changing seasonal weather conditions.

The most important study under this project was on the absorption of moisture by shipments made both by boat and by rail. This study was begun during the previous year and is being continued. During the year, four rail shipments to Montreal and two to Ottawa were studied with the assistance of the staffs of the Ottawa and Montreal laboratories. Two shipments were made

by boat to England, and co-operation was extended by the Forest Products Research Laboratory staff at Princes Risborough, who made the necessary moisture-content determinations at destination. Active co-operation was furnished by local shipping firms in facilitating examination and preparation of the shipments. Water shipments indicate that kiln-dried material shipped with green lumber will have an average moisture content of 15 per cent and higher upon arrival in England, and such material will therefore, for some purposes, require reconditioning before use. The final report on the rail shipments, which is now in course of preparation, indicates that kiln-dried lumber shipped by rail, if properly seasoned and loaded, will reach its destination in a satisfactory condition.

The moisture condition of a shipment of red oak on arrival at Vancouver from Alabama was checked up.

Air Seasoning.—Degrade studies were carried out on six items of air-seasoned Engelmann spruce at two mills in the interior forest region. The results of these studies will be compared with similar studies on kiln-dried Engelmann spruce made at another mill.

Kiln-drying of Lumber and Shingles.—The investigation of the effect of temperature, humidity, and circulation on the rate and quality of the kiln-drying of the commercial woods of British Columbia was continued. Several charges of Western red cedar, yellow cypress, and Western alder were dried in the experimental kilns during the year. The drying of charges of alder and cottonwood at a local mill was supervised. As a result, efficient drying schedules were evolved for the seasoning of 1-inch cedar, yellow cypress, and alder.

The shrinkage of the commercial sizes of cedar, when kiln-dried to various moisture contents, was investigated.

The drying of six experimental charges of Engelmann spruce was supervised at a co-operating mill in the interior forest region with a view to eliminating the cupping of the 2-inch spruce, and to determine the feasibility of drying 1-inch stock. The effect of various combinations of temperature and humidity on the degrade from cupping and loosened knots was studied, and definite recommendations made to the co-operating mill for improving the seasoning practice.

A project was initiated having for its object the determination of the effect on durability and serviceability of shingles of the various temperatures used in kiln-drying them. This investigation was originally requested by the Ontario Retail Lumber Dealers' Association and was sponsored by the Consolidated Shingle Manufacturers Association of British Columbia. Nineteen test panels of shingles of various sizes dried at temperatures varying from 160° to 200° Fahrenheit were erected during the year. Shingles for an additional six panels are now being pressure-treated by the Ottawa laboratories with creosote.

A moisture-content survey was undertaken to determine the variation in the moisture content of kiln-dried lumber at the time of shipment and the effect of moisture content on machining. Eighty-nine per cent of the Coast sawmills operating dry-kilns were covered by the survey, 10,333 boards being tested. The results of this survey have aroused considerable interest, and will probably cause increased attention to the seasoning and storage conditions at certain mills.

By request, special degrade studies were made at four Coast mills to determine whether improvement in kiln-drying practice had occurred since 1925, when such studies were first made. Marked improvement was noted at the four mills studied.

The third annual six-day kiln-drying course was held, with an attendance of twenty-one. The course, which has now a favourable reputation with the lumber industry, proved very successful.

Special visits were paid to 45 Coast sawmills to co-operate in solving various seasoning problems. These visits, together with lectures on kiln-drying, delivered before various lumbermen's organizations, and information available for distribution form a valuable means of keeping the industry informed of the seasoning investigations of the Laboratory. A marked improvement in seasoning practice in Coast mills was reported by the British Columbia Lumber and Shingle Manufacturers' Association.

The investigation of the causes of " loosened grain "—a defect in kiln-dried Douglas fir—and " collapse " in kiln-dried shingles, and an investigation of the effect of different methods of lumber piling on the rate and uniformity of drying were continued. During the year, 1,041 standard and 11,110 electric-meter moisture-content determinations were made in connection with the seasoning investigations.

The effect of various combinations of temperature and humidity on the yield of seed during the process of extraction from lodgepole pine cones was investigated by means of four test runs in the experimental kiln. This investigation was initiated at the request of the Forest Superintendent, New Westminster.

Utilization

The problem of the economic utilization of timber and of waste incident to present manufacturing methods has long been recognized as of major importance. The mill-waste studies initiated last year were designed with the idea of determining the amount of this waste in British Columbia lumber mills, and, if possible, finding uses for it. Fifteen studies were made during the year of the quantity, quality, and disposal of so-called " mill-waste " under present manufacturing methods. The survey shows that, on the average, 67 per cent of the volume of the log is recovered as lumber. This is somewhat greater than was commonly supposed. This study has created considerable interest among lumbermen and has resulted in a number of special studies in connection with individual problems. Studies on logging waste were commenced on two plots in the Coast Douglas fir and cedar type.

Pathology

Two new projects in timber pathology were initiated during the year, namely, " The effect of kiln-drying on the sterilization of lumber," and " The effect of purple stains on the properties of Douglas fir and Western red cedar." The study on " The development of stain in overseas shipments " was continued. This latter project was carried on in conjunction with studies of moisture absorption in overseas shipments. Material was taken from three shipments and 930 cultures prepared. Over 1,700 special cultures were made in connection with other projects, and with special decay and staining problems presented to the laboratory for solution. Eight hundred cultures were prepared in connection with the study on " The effect of water storage on the strength of black cottonwood." This study was completed, and a report prepared for incorporation with the report on the strength tests.

Publications and Papers

A chart " Dimensions and Constants for Structural Timbers " was printed and is in considerable demand. A mimeographed " Summary of Kiln-drying Information," prepared for the 1928 Kiln-drying Class, was enlarged to thirty-one pages and 300 copies distributed. Two progress reports on the " Sawmill Waste Studies in British Columbia " were mimeographed and distributed to the sawmill managers of the province.

A number of articles by laboratory officers were published in lumber and engineering journals, including the following: " Structural Timbers," " Utilization of Mill Burner Heat for the Kiln-drying of Cedar Shingles," and " Lumber Yard Sanitation."

There is an increasing demand by lumbermen's organizations and educational institutions for technical papers and lectures on various phases of the work of the laboratory. During the year laboratory officers delivered twenty-five such lectures, most of which were illustrated by lantern slides.

Exhibits

The exhibition service was continued during the year, providing valuable publicity for the laboratory and assisting in the advertising of British Columbia forest products.

The most important work in this connection was the preparation and assembly—in co-operation with the British Columbia Lumber and Shingle Manufacturers, Limited, and in accordance with plans prepared by the Markets and Exhibits Division of the Ottawa laboratory—of an exhibit of British Columbia forest products for inclusion in the forest-products exhibit of the Canadian Pavilion at the International Exhibition in Antwerp, Belgium. The exhibits were assembled in units, finished in Vancouver, and forwarded to Antwerp to the Canadian Exhibition Commission.

Assistance was extended to the British Columbia Forest Service in selecting and preparing certain material for use in setting up an exhibit of British Columbia products in the Crystal Palace, London, England.

In the preparation of the annual forestry exhibit at the Vancouver Exhibition, a panel exhibit was prepared in co-operation with the Canadian Forestry Association, showing photographs, pulp and paper products, rayon manufacture, miscellaneous forest products, and the finishing of lumber products. Co-operating with the British Columbia Lumber and Shingle Manufacturers, Limited, a model sawmill operation showing all phases of a modern plant was also set up.

A set of moulding patterns in Douglas fir, Western hemlock, and Western red cedar was prepared for the British Columbia Lumber and Shingle Manufacturers, Limited. Considerable assistance was also extended in selecting and preparing an exhibit of Western hemlock lumber, manufactured products, and furniture; this was used for display at the annual meeting of the West Coast Lumbermen's Association in Tacoma. The exhibit received a great deal of very favourable comment and has given wide publicity to the use of Western hemlock.

A special set of samples of Canadian wood species was prepared as an exhibit for use by the Canadian Forestry Association, resulting in a number of inquiries being directed to the Laboratory for specific information regarding uses of various woods.

In response to requests for samples the Laboratory has prepared several special exhibits, including log sections of Douglas fir and Sitka spruce for the National Museum, Ottawa; selected material for Poland; photographs for the Rosenwald Industrial Museum, Chicago; samples of eighty-year-old hewn fir and hemlock timbers for the British Columbia Lumber and Shingle Manufacturers, Limited, and associated bodies; and eight sets of hand samples. A special collection of photographs of timber and logging methods was assembled and has been used as the nucleus of a laboratory collection. Sets of Australian, Manchurian, and Japanese wood samples were received by the Laboratory during the year.

General

Some rather important changes were made in accommodation at the Laboratory. The Provincial Government, through the University of British Columbia, constructed a roof over the loading platform of the experimental kiln building. Officials of forest products laboratories and forest services in Australia, England, and the United States paid visits to the Vancouver laboratory at various times, thus providing contact between institutions carrying on work of a similar nature.

LIST OF FOREST SERVICE PUBLICATIONS

(Correspondence in regard to bulletins listed below should be addressed to the Director of Forestry, Department of the Interior, Ottawa, *except where the price is noted,* in which case requests for the publication should be addressed to the *King's Printer, Ottawa.* Where name and number are omitted, the publication is not available for distribution.)

Mimeographed lists of accessions to the library of the Forest Service are issued monthly and may be obtained on application to the Director of Forestry.

A list of mimeographed articles dealing particularly with the technical work of the Service is also obtainable on request.

A number of translations of articles from European technical publications have been made for the Service. A list of these may also be obtained on application, and arrangements may be made for a loan of these translations for a limited time.

Where the title is followed by an asterisk (*), the publication may be obtained in French.

ANNUAL REPORTS of the Director of Forestry, 1914-15-17-18-19-21-22-24-25-26-27-28-29-30.

BULLETIN	1	Tree-Planting on the Prairies.
"	59	Canadian Woods for Structural Timbers.
"	61	Native Trees of Canada. (Price, 50 cents, post-free. Apply King's Printer.)
"	66	Utilization of Waste Sulphite Liquor. (Price, 50 cents, post-free. Apply King's Printer.)
"	69	The Care of the Woodlot.*
"	71	Canadian Sitka Spruce: Its Mechanical and Physical Properties. (Price, 15 cents, post-free. Apply King's Printer.)
"	72	Success in Prairie Tree Planting.
"	74	Distillation of Hardwoods in Canada. (Price, 25 cents, post-free. Apply King's Printer.)
"	75	Wood-using Industries of Ontario—II.
"	78	Some Commercial Softwoods of British Columbia. (Price, 25 cents, post-free. Apply King's Printer.)
"	83	Sawmill Waste and its Utilization in British Columbia.
CIRCULAR	13	The Cascara Tree in British Columbia.
"	16	Preservative Treatment of Fence-posts.
"	22	Report of Tests of the Relative Strength of Green-cut and Fire-killed Western Cedar Pole Timber.
"	23	Absorption of Moisture by Kiln-dried Lumber.
"	24	Strength of Reinforced and Unreinforced Butter and Cheese Boxes.
"	25	List of Forest Service Publications.
"	26	Creosote Treatment of Douglas Fir.
"	27	Stain and Decay in Lumber-seasoning Yards.
"	28	Strength Tests of Creosoted Douglas Fir Beams.
"	29	Strength Tests of Creosoted Douglas Fir Railway Ties.
"	30	Rate of Growth and Density of the Wood of White Spruce.
"	31	Strength of Telephone Poles: Eastern Cedar, Red Pine, and Jack Pine.
"	32	Change in Moisture Content of Kiln-dried Lumber when shipped by Rail.

TREE PAMPHLET	1	White Pine.*
"	2	White Spruce.*
"	3	Douglas Fir.*
"	4	Hemlock (Eastern).*
"	5	Western Hemlock.*
"	6	Red Pine.*
"	7	Jack Pine.*
"	8	Lodgepole Pine.*
"	9	Balsam Fir.*
"	10	Cedar (Eastern).*
"	11	Western Cedar.*
"	12	Sitka Spruce.*
"	13	Western Yellow Pine.*
"	14	Sugar Maple.

Stories and Plays for Children—

Talking Trees.
Betty in Dreamland.
The Woodland Fairy.*

Bow River National Forest. Descriptive pamphlet with map.

Forestry Lessons.

FORESTRY TOPIC 2 Forest Fire Protection in Canada.
" 3 Silviculture in Canada.
" 4 The Need of a Definite Forestry Policy.
" 5 Tree Planting for Ornamental Purposes.
" 6 The Christmas Tree Trade in Canada.*

Manual of Methods of Communication Adapted to Forest Protection. (Price, $1, post-free. Apply King's Printer.)

Dominion Forest Service Message Code. (Price, 10 cents, post-free. Apply King's Printer.)

Forest Research Manual. (Price, $1, post-free. Apply King's Printer.)

The Tree-planting Division: Its History and Work.

The Forests of Canada.

Form-class Volume Tables.

Papers presented before the Third British Empire Forestry Conference, held in Australia and New Zealand, 1928:—

Tree Planting in the Prairie Provinces of Canada.
Timber Testing in Canada.
Timber Pathology in Relation to Wood Utilization in Canada.
Wood Preservation in Canada.
Forest Fire Protection in Canada: Progress since 1923.
Pulp and Paper Research in Canada.
Timber Physics Research in Canada.
Silvicultural Research in Canada.
State Forests in Canada.
Softwood Resources of Canada.

Blue Stain: a Cause of Serious Loss to Manufacturers of White Pine Lumber in Canada.

LISTE DES PUBLICATIONS QUI PEUVENT ETRE OBTENUES EN FRANÇAIS

BULLETIN 69—Entretien d'un Lot Boisé.

CIRCULAIRE 18.—Le séchage au Four des Bois Tendres de la Colombie-Britannique.

Informations relatives à quelques essences canadiennes importantes: Fasicules: 1, Le Pin Blanc; 2, L'Epinette Blanche; 3, Le Sapin de Douglas; 4, La Pruche; 5, Le Tsuga de l'Ouest; 6, Le Pin Rouge; 7, Le Pin Gris; 8, Le Pin de Murray; 9, Le Sapin Baumier; 10, Le Thuya (Cèdre de l'Est); 11, Le Thuya Géant; 12, L'Epinette de Sitka; 13, Le Pin à Bois Lourd.

La Fée des Bois (The Woodland Fairy).

Questions forestières N° 6. Le Commerce des Arbres de Noël au Canada.

L'Arbre et la Forêt (Forestry Lessons):