Photo E. H. Finlayson, 1911.

Brazeau Forest : Cut-Banks and Spruce Flats on Hay River.
Tp. 55, Range 25, west of 5th Meridian.

DEPARTMENT OF THE INTERIOR

DOMINION OF CANADA.

REPORT

OF THE

DIRECTOR OF FORESTRY

FOR THE YEAR 1912

(PART VI., ANNUAL REPORT, DEPARTMENT OF THE INTERIOR, 1912.)

OTTAWA
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No. 1.

REPORT OF THE DIRECTOR OF FORESTRY.

DEPARTMENT OF THE INTERIOR,
FORESTRY BRANCH,
OTTAWA, April 1, 1912.

W. W. CORY, Esq., C.M.G.,
Deputy Minister of the Interior,
Ottawa, Ont.

SIR,—I have the honour to submit the report of the work of the Forestry and Irrigation Branch for the year 1911-12, and also the reports of the officials in charge of the different divisions. During the year the administration of the Dominion Parks was withdrawn from this branch and a separate branch established for that purpose, and, therefore, the parks will be separately reported upon.

STAFF.

Messrs. T. W. Dwight, D. R. Cameron, S. S. Sadler and E. G. McDougall, graduates of the School of Forestry of the University of Toronto; H. C. Kinghorn, a graduate of the School of Forestry of the University of New Brunswick; F. W. Beard, a graduate in forestry of the University of Minnesota, were appointed to the permanent staff for forestry work at the beginning of the year.

Mr. W. N. Millar, a graduate in forestry of Yale University, who has had a very successful administrative career in the Forest Service of the United States, has been appointed to organize the administration of the Rocky Mountains Forest Reserve.

Mr. J. T. G. Whyte, who was fire guardian at Split Lake on the proposed route of the Hudson Bay Railway, was unfortunately drowned in July by the swamping of his canoe while in the discharge of his duties as fire-ranger. Mr. Whyte was a forest ranger of large experience, and was faithful and conscientious in the discharge of his duties according to the evidence of those who lived in that vicinity, including the missionary, Rev. Mr. Fox.

The staff of the Commissioner of Irrigation has been considerably enlarged. The staff at Calgary now consists of twenty-two engineers and seven clerks and draughtsmen.

Mr. W. G. Bligh, Member of the Institute of Civil Engineers of Great Britain, has been placed in charge of the inspection of the irrigation works of the Canadian Pacific Railway Company, under the supervision of the Commissioner of Irrigation, and is already at work examining the plans and arranging for the actual field work which will be taken up as soon as the weather permits.

Unfortunately the staff at the head office at Ottawa has not been sufficiently enlarged to handle the increasing volume of business that is necessitated by the expansion of the work in the field, and this has made it necessary to use members of the outside staff for work at Ottawa for such time as it was possible to do so. For

efficient administration the force at the head office will need to be considerably strengthened. The proper direction of the work of the field force and the recording of the information obtained and of the business transacted are in the best public interest and should not be considered of minor importance.

FOREST ADMINISTRATION.

The Forestry Division of this branch covers a variety of work, all of which requires development as rapidly as it can be overtaken.

Up to the present time one difficulty in the way of rapid development has been the lack in Canada of men who have had technical training in forestry. Little progress can be made without a fair proportion of men in the service who have had the advantage of the study of forestry methods from the scientific standpoint, and who, therefore, understand the lines upon which advancement must be made and the ultimate purposes which the administration must have in view. The difficulty is now being overcome by the forest schools established in the Dominion, which are graduating each year a number of men who should fill this gap in the administration. The Forestry Branch of this department has so far furnished the chief opening for employment of these graduates, and there are now on the staff five graduates from the Forest School of the University of Toronto, three graduates of the Forest School of the University of New Brunswick, and seven graduates of Foreign Schools, most of them, however, Canadians who were employed before the Forest Schools of Canada were established.

The exploration of the public domain in order to ascertain the extent and present condition of the forests and to hold permanently in national forests the non-agricultural lands is an important side of the work, and a first necessary step for the establishment of a permanent forest policy. Consequently six parties were detailed for this work during the past year in Keewatin, Northern Manitoba and Saskatchewan, and in Alberta and the Railway Belt in British Columbia, and these have added much to our knowledge of the forests, and defined extensive additional areas that should be held for forest purposes.

The protection of the vast extent of northern forest is a task of great magnitude. The belt of land, more or less forested, stretching from Hudson Bay to the Rocky Mountains covers a distance of 1,500 miles from east to west, and from 300 to 700 miles from north to south, and, with travel, railway construction and settlement steadily working into it from all directions, the danger of fire is great and constant. On the whole, the staff of rangers patrolling in these districts is of a good class, but the number so far employed, 129, is utterly inadequate to the task when the season is at all dangerous.

One of the weaknesses of the fire-ranging work outside of the reserves has been the lack of proper inspection to determine what districts should be patrolled, and how the patrols of the rangers should be arranged, and to ensure that the patrol is being carried out faithfully. I have previously made representations in regard to this phase of the administration, and further experience has only confirmed my conclusions in regard to the necessity for inspection. I am satisfied that a competent system of inspection would result in a much more effective fire-ranging organization and in a more economical handling of the work. There is yet too much of haphazard in the manner in which the fire patrol is administered.

The lumbermen in the West have not heretofore taken as live an interest in the protection of the timber from fire as the investments that they have in timber limits would seem to justify. A more active participation by the lumbermen in the system of protection should lead to better results, and, without their co-operation, it is difficult for the department to accomplish all that should be done. A scheme for co-operation by the lumbermen in this work should be heartily welcomed.

The organization of the permanent forest reserves so as to make them fire-proof and to provide proper management is work that requires a good permanent staff and a system of permanent improvements, such as forest-ranger stations, trails, roads, bridges, telephone lines, &c. In my report of last year I called attention to the necessity for choosing the forest-ranger staff on a basis of special qualifications for the work, and outlined the qualifications necessary. As the forest-ranger staff is the groundwork of all the organization for handling the reserves, the choice of the right kind of men is a factor of the greatest moment. The improvement work above referred to, as required on the reserves, is necessary if there is to be an effective protection and management, and, as all this work is yet to be done, it will be seen that there must be a large initial expenditure which cannot be expected to be returned by the forest immediately. The work on permanent improvements is in fact a capital expenditure and should be considered as such. A proper system of roads, trails, buildings, &c., throughout the reserves will cost a large amount of money, the incidence of which should be distributed through a series of years. These works,

Photo G. H. Edgecombe, 1911.
Brazeau Forest: High Stumps and Slash Left by Unregulated Lumbering.

once done, will require a comparatively small expenditure for maintenance in addition to such work as may be done by the permanent ranger staff. So long, however, as this work remains undone, the forests are exposed to danger which cannot be coped with in seasons of light rainfall, and which renders much of the expenditure that is being made for fire patrol finally nugatory, as the history of the dry years so eloquently testifies.

It must be expected, therefore, that the expenditure on the forests for a considerable period will exceed the revenues. A permanent policy, in the present condition of our forests, cannot be worked out on any other expectation. The waste of years of unchecked fires cannot be repaired in a day. When the fire danger has been eliminated and a proper system of cutting timber introduced, the condition of the forests will steadily improve, and finally will reach the stage where a sustained annual yield can be obtained which will give revenue sufficient to cover the costs of

administration and furnish as reasonable a profit as a government would be expected to obtain.

The collection of statistics in regard to forest products is an important corollary to the other work of this branch. Previous to the starting of this work by this branch in 1908, there were no reliable records of the yield of the forests of Canada or of the value of the forest as a producer of wealth and a support of native industries. These reports, combined with the export and import returns of the Department of Customs, have revealed our strength and our weakness. They show an annual value of Canadian forest products of $166,000,000, second only to the agricultural production; that, as far as pulpwood is concerned, Canada is the greatest producer and supplies not only Canadian requirements but a large part of those of the United States, but that as far as the more valuable woods are concerned, especially hardwoods, the supply is steadily approaching the point of exhaustion and in most hardwoods has already practically reached it. A strengthening of the staff handling this work would make the reports still more valuable and useful.

A further development that would properly round out the natural work of the Forestry Division of this branch would be the investigation of waste in the forest and in the manufacture of wood and experimentation in new processes to prevent waste. Unquestionably one of the developments in the direction of economy must be in the elimination of waste outside the forest as well as inside. The drain upon our wood supplies will become so great that they must not only be protected when standing in the forest, but must be followed all along the line of use and made to spread as far as possible both in quantity and time. The work of this branch cannot be considered as complete until it can follow the products of the forest through this whole cycle and assist in economizing them to the end. Provision for investigations on the lines indicated should be made without delay.

TREE PLANTING.

That the interest in the planting of trees on farms on the prairies of the West has been well sustained is shown by the number of applicants who received trees, namely, 3,285, as compared with 3,173 of the previous year. The number of applicants to whom trees will be sent in the spring of 1912 is 3,618, and the number of trees to be distributed 2,729,135, as compared with 2,636,100 in the previous year. One good feature of the class of applications which is now being received is that, as a rule, the land is being well prepared in accordance with the requirements of the department, before applications are submitted. The educational work in this respect is, therefore, beginning to have effect.

The office-work necessary in connection with the handling of the correspondence, in the preparing of planting plans and distribution lists, is becoming larger as the work develops, and it would seem almost necessary that in a very short time better office accommodation than that which is now supplied should be provided at Indian Head. At present the offices are in the second story of the business block, and the records would not be very safe in case of fire. In other ways the space provided is not very satisfactory, and it might be well to consider the question of erecting a special office building for the accommodation of this work, which will undoubtedly continue to develop for a good many years to come.

Although the present forest nursery station was enlarged recently by the addition of a quarter section, the land is somewhat broken and not very well suited for the growing of nursery stock, consequently it is not likely that an output greater than three million to three and a half million trees can be provided at that place. As the demand for trees continues to increase, it was decided that it was necessary to provide additional nursery accommodation. In deciding where additional nursery accommodation should be obtained the factors to be considered were: First, suitable

climatic conditions; second, facilities for shipping, and third, a labour market. In order to grow trees in the nursery so that they will be satisfactory under any climatic conditions, it is best to grow them without having to apply water for irrigation, and, therefore, sufficient rainfall to water the nurseries naturally would be required. A district which was free from hail storms was also desirable, as such storms would do a great deal of damage to a forest nursery. As millions of trees are shipped out at one time in the spring and have to be delivered within a short period, if they are to be planted successfully, shipping facilities are of the greatest consequence. A good supply of labour is also a necessity, as the nature of the forest nursery work requires that at special periods when stock is being prepared and heeled in in the fall and when it is being shipped in the spring, an additional supply of labour should be easily available. On considering the whole question it was finally decided that these conditions would probably be best met in the vicinity of Saskatoon, and arrangements were finally made for the purchase of lands at that place. The lands selected were

Photo W. J. Vandusen, 1911.
Porcupine Forest Reserve: Slash and High Stumps Left after Lumbering.
Sec. 35, Tp. 38, Rg. 28, west of 1st Meridian.

the north-east quarter of section 1, and the south-east quarter of section 12, township 37, range 5 west of the 3rd meridian. This land is a light loamy soil, is level and practically all of it can be used for the growing of trees except a few acres in one corner which are somewhat stony. This portion can be used for pasture purposes and for the location of buildings. It is expected that this nursery will be in order inside of two years so that stock can be obtained from it to provide for the increasing demand.

As soon as a stock of coniferous trees could be worked up, it was decided to arrange for their distribution, but as it would not be possible at any time to provide a very large stock, it was thought better to make a charge for them instead of distributing them free as has been done with species of deciduous trees. In spite of this charge the demand for coniferous trees has been great, and all that were provided have been applied for.

FIRE-RANGING.

The season of 1911 was generally wet throughout the western provinces so that, fortunately, after the first few weeks in the spring, little difficulty was experienced. In British Columbia only was the danger of fire continuous throughout the summer.

In the dry weather of the spring there were several serious fires. One occurred at Mafeking on the line of the Canadian Northern Railway, in the Province of Manitoba, and caused damage to timber limits amounting to probably fifty million feet. There is considerable evidence to show that the fire started from the railway, although the evidence is not conclusive, and it is also stated that the fire was started from the lumbering operations.

There were several serious fires also in the vicinity of Prince Albert and several of the lumbering firms lost heavily. The merchantable timber killed by the fires in that district is estimated at one hundred and ten million feet, board measure, of which seventy two million feet have been taken out and manufactured during the past year. At the best, however, this still leaves a heavy loss to the lumbermen, and has made necessary the throwing of a large quantity of timber on the market at a time when good business management would not have determined on such a course.

Three of the most destructive fires came from settlements, and one may have been due to the railway. In spite of all the warnings that are given in regard to the danger of fire there is a great deal of carelessness in the handling of it and apparently a long process of education is yet necessary before there will be such an appreciation of the danger as to give any assurance of security.

The number of fires which occurred and their causes are as follows:—

Railways—under construction	33	
Railways—in operation	84	
	—	117
Hunters and travellers		115
Clearing land		55
Lightning		26
Indians		16
Lumbering operations		7
Cause unknown		102
Total		438

The number of fire-rangers employed was 129, distributed as follows: British Columbia, 46; Edmonton, 28, including 9 along line of construction of Grand Trunk Pacific and Canadian Northern; Athabaska and Peace Rivers, 18; Battleford, 4; Prince Albert, 24; Eastern Manitoba, 4; Keewatin, 5.

In the Keewatin district north of Lake Winnipeg a chief ranger was located at Norway House and one at Split Lake, these being specially required on account of the increase of travel by the canoe routes through this district consequent on the survey and proposed construction of the Hudson Bay Railway. The population of the district are mostly Indians and freighters and canoemen for the Hudson's Bay Company and others. Along the canoe routes the timber has been burned, leaving only islands of good timber among vast stretches of burned or immature forest. Special efforts have been made to interest the Indians in the prevention of fires and a special fire-ranger's badge was made for them. The efforts of the rangers are having a good effect, as will be seen by the following extract from the report of the chief ranger, J. T. Blackford, dated at Norway House, the 10th September, 1911:—

'With few exceptions the Indians have all been very careful this summer. Not a single report of fire has been received by me. On my way to Split Lake I was eye-witness to one of which I will relate later on in this letter.

Cross Lake Indians

σϟᓀ ΔσσΔ·x σᑎᑕᑯᐃᓀ ᑲᑕᐅᐊϟx ΔPLΔᐃ ᐅP ᑲᑕᐃᑕL·x ᑲᑕᑲ·PΛᖇᑕϟ ᐃ·ᑯᑌ° σᑕ·Pᓀx σϟᓀ σᑎᑕᖇᓀΔᑲᓀ ᑲᑕᑲ·-ᑲ^PᑕϟxᑲᑕΔ·ᖇᑕϟx ᐁᑯᖇ σᑕᖇᑌᓀ ᑲᑕᑲ·Δ·ᑕᐅᐊLx σᑎ·ᑯᑌᖇᓀᓀ ᑕ"ᑕ° ᑲᑯᑕᐅ·ϟP ᐁL·ϟᓀᑲᑕL x σᑎᑭᓀᑐᑌᓀ' ᐁᑯᖇ ᑲᑕᑲ·Δᖇᓀᑲᵡ Δ·ᓀ ΔᖇPP ᐅPLΔ·Δ·> ᐁᑯL ᐁᑕᖇᐅ·'

We Indians appreciate the work the Government is doing to prevent forest fires in our district We pledge ourselves to do all we can to help. We promise to put out our own camp fires every time before leaving camp We accept the badges given by the Government as a pledge

Names	Band	Names	Band
ΛᖇᖇᑲL·ᐅᖇ ᐁϟᐊ·ᑕL·	Cross Lake	ᑲ·ᑐᑕᐅ/	ΛᖇᖇᑲLx
ᑲᓄᖇP·		ϟᖇ·P LᑲL·	ΛᖇᖇᑲL·/
Λϟᐃᑲ· Δ·ᑲ·ΛᖇᖇᑲL	Δᑕᑭᐅᓄ·	Jϟᐃᑕᑲ<	ΛPᑲL·
ϟᖇ· <· ΛᖇᖇᑲLΛᑲᑲ·		ᐁᓄᑕ·ᐯᖇᖇL	ΛᖇᖇᑲLᓄᐅ·ᓄ
Albert Smalleo	ΛᖇᖇᑲL·	Δ·ϟϟ, Δ·P ᑲx· ᐊϟᑕ·ᐅᑕϟ>	ΛᖇᖇᑲLᐃ ΛᖇᖇᑲᑲLx
Δ;P· LᑲxX	ΛᖇᖇᑲL·	L·P <ϟ·ᓄ·ϟᓄ°	ΛᖇᖇᑲLx
J· <Σ·x	ΛᖇᖇᑲL·	Δϟϟϟϟϟϟϟ	ΛᖇᑭᑲL'·
Jᑎᐃᐅᐃ	ΛᖇᖇᑲLL·	ϟΣᓀ ΔCΔᑲL·	ΣΛᖇᖇᑲLx
ᐊΣPϟ'LᑲxX	ΛᖇᖇLL·	ᑲ·ᐊᐟ	ΛᖇᖇᑲLx
J· ᐊΣᐁᐅ ᵛx	ΛᖇᖇᑲL·	ΛΣ' Λϟᐃᑭᖇᖇx	ΛᖇᖇᑭᑲLY
ΛᐸΣΔ ᑕΣ x	ΛᖇᖇᑲL·	ᐁCΣΔ ᐊΣ°	ΛᖇᖇᑲLx
ᐸϟᐸᑎ· ᑐΣ·x	ΛᖇᖇᑲL·	Δϟϟϟϟϟ	ΛᖇᖇᑲLx
ϟᑲΣΔ· ᒍᑐϟ·x	ΛᖇᖇᑲL·	ϟᐃ·ᓀΣ'	
ΔΣx ᖇΣ· x	ΛᖇᑎᑲL·	ᑌΣ· ᑯ-	ΛᖇᖇᑲL·
ᖇΣ° Δ·ᑲ·X	ΛᖇᖇᑲL·	ᐊC·ΔΣᑎ—	ΛᖇᖇᑲLx
ᑲϟΔ·ᑭᓪΣ·+	ΛᖇᖇᑲL·	ϟᖇ· ΛCϟ·	ΛᖇᖇᑲLx
ᐊΛᑐ'	ΛᖇᖇᑲL'	ᐟC ΛΣᑎ	ΛᖇᖇᑲLx
σᑭᑕΔC·σᑕ	ΛᖇᖇᑲL·	ᑭᑕϟVσ·ᐊϟᐅ°	ΛᖇᖇᑲLx
σϟJϟ·—ᒪᑐᑕ JΔΣᒍᑯ·—	ΛᖇᖇᑭLx	ᐁσᐸΣᐃΣ ΔᓪLᑲ ᑲΣ Λ-ᑲ	CΣΛᖇᖇᑕᑲL
ᑕϟϟ ᑭᑭᑲ·	ΛᖇᑕᑲL·	ᑲ ᐊΣᐸ· ᐸΣ	ΛᖇᖇᑲLx
ΔΣᓀ Lᑲ	ΛᖇᑭᑲL·	ᑲ·ΛᑕΣ,	ΛᖇᖇᑲL
ϟᑎᒪLᑲ·,,,,	ΛᖇᑕᑫᑲLx	Jϟᐃᒪᑲ	ΛᖇᑭᑲL
ᑐᒪᑎ ϟᐅᑎ	Λᖇᖇᑲᐸx	ϟᖇ° ᑯ· ᑲ·ᐅᐯᑕᑎ	ΛᖇᖇᑲLx
		ᑲϟΔᑎ ᐁᑎᐯᑕᑎ	ᔕᑎᑕΔᓀᑲᑎ

'We had no trouble getting the Indians to sign the enclosed pledges. Before I would let them sign I made sure they thoroughly understood the nature of their pledge. One and all were very much pleased with the badges given them. They pinned them in all sorts of places on their clothing, where each one's fancy thought the most conspicuous place. One man would not take his badge until he had first washed himself and changed his shirt, and then the badge was used as a collar button or brooch. Hats and shirts were the favourite spots for adornment but not a few—after carefully polishing them—would fold them in cloth to keep them for some special occasion.

'A great percentage of them feel they are thus, having received the badge from the government, constituted minor chiefs and guardians of the forest.

'Some, not many, refused to sign the pledge and it is these whom we have to watch.

Photo J. T. Blackford, June, 1911.

Norway House Indians Taking the Pledge to Help in the Prevention of Forest Fires. Chief Councillors in the Foreground.

'It is generally expressed around Norway House that this is the first summer for many years that there has been no forest fire visible from here. This may not altogether be due to our presence and work here, but I think in a large measure it is.

'It may not be out of place here to write concerning my trip to Split Lake. This was in the forepart of August. On my way down I travelled for two days with about twenty Cross Lake Indians. These men talked freely of the "Big Fires" in the past, always seeking to impress upon me that *not they,* but some other band, were responsible for these.

'The timber around Pipestone lake is some of the best I have seen in the north here. How far it extends I cannot say. At Sipiwesk lake (by the way, there must be nearly 2,000 islands in the lake) I saw where one of the islands had just been burnt over. Some Nelson House men had camped there the day previous, and although they had undoubtedly drowned the main body of their camp fire (we could still see the wet coals) some fire must have still been allowed to remain in the moss from which the bush fire started.

'On Sunday, August 6th, I camped with about fifty five Split Lake Indians (Indians as a rule do not travel on Sundays). I took the opportunity on this occasion to speak to them with reference to the prevention of forest fires. They all seemed interested and the chief spoke to his men, telling them to heed what I had told them. I had few badges with me on this trip, so did not give any to other than the chief. He seemed to appreciate the honour. I also took photographs of these men pledging themselves by the raising of hands to put out their own camp fires, and one of the chief.

'On our return we met eight York boats taking the last of the summer's freight to outposts.

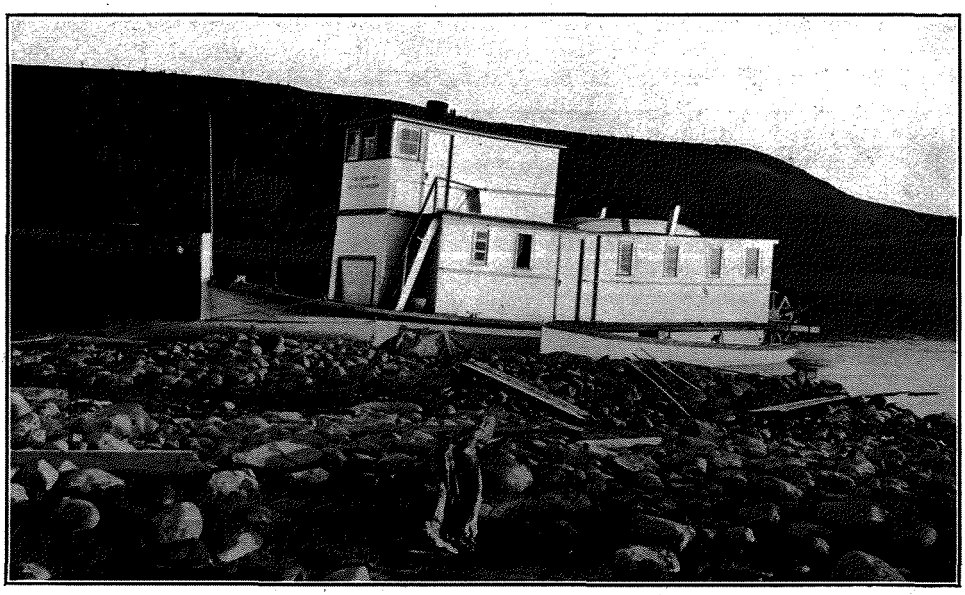


Photo E. F. Drake Oct., 1911.
Fire Patrol Boat No. 1 at Athabaska Landing.

'At Devil's river on the Nelson we put out what would, in a short time, have been a big fire. Some careless Indians had built a fire inland some distance the previous day, and as it was raining some neglected to put water on it on leaving. It had rained some during the night, but when we arrived there at about 2 p.m. the next day the moss and underbrush were just commencing to blaze up for a hundred yards or so. I took a photo of this as best I could, showing a fine specimen of spruce tree whose roots had been burnt to a depth of eighteen inches.'

Attached hereto is also a report of an exploratory trip made by Mr. Blackford during the winter.

In the Battleford district the chief ranger, Mr. George Douglas, worked out an arrangement with the provincial authorities whereby local rangers were authorized by them to take charge in districts that were not timber districts in order to act as an auxiliary force to the regular rangers. These men were to take charge of the fighting of fires that occurred in their districts, being paid only for the time they were so engaged. This arrangement was of considerable assistance in preventing fires.

In the Edmonton district it was arranged to place a steamer on the Athabaska river to assist in the fire patrol. From Grand Rapids to the mouth of the McLeod

river is a stretch of water navigation where the current is so strong as to make navigation by canoe difficult and at times impossible and where the country is accessible only by the river. Strong representations were made to the department that there should be some better method of patrolling this district than that previously followed, and it was decided to place a patrol boat on the river. The boat is 42 feet in length and has a draught of 10 inches. The engines are powerful enough to force the boat upstream against the strongest current and it has been pronounced well equipped for the work required. The boat rendered good service through the season after she was launched.

Another boat was ordered for similar work on the Mackenzie river, but owing to the late date at which the order was given, necessitating late delivery, and the necessity for giving all attention to getting the reindeer shipment down the river, this boat was not forwarded but is available for service in the coming season. Several boats of this kind on the Lesser Slave Lake, Peace River and Mackenzie River waters would be of much advantage in fire-fighting in those isolated districts where the rivers are the highways.

In the Coast district of British Columbia the most serious fire which occurred was at Coquitlam lake on land which was being cleared by the Vancouver Power Company. This fire burned for six weeks in spite of the efforts of the fire-rangers, and resulted in damage to fourteen million feet of timber, of which five million feet was a total loss. The patrol would be assisted very much by the erection of huts at points where the rangers should be constantly on the watch and by the opening up of new trails to give quicker access to paths of the patrols which can now be reached only by roundabout routes. As there are water stretches of considerable length in this district the work of the rangers would be greatly assisted by more boats on some of these water routes.

In the mountain districts of British Columbia there were a large number of fires and it is noticeable that in many cases lightning is given as the cause. The loss caused by these fires was 1,555,000 feet of timber. The most serious fire was on the railway line from Revelstoke to Arrowhead. Lumbering has been carried on all along this line and there is a great deal of débris which makes this a specially dangerous district, and there has been trouble with fire there almost every year. As the railway company proposes to adopt oil for fuel in its locomotives on this line during the coming year the danger should be greatly reduced.

PATROLS ALONG RAILWAY LINES.

A patrol of rangers under charge of J. A. Dunn was maintained along the line of the Grand Trunk Pacific Railway west of Edmonton, and on the Canadian Northern Railway after construction to the Yellowhead Pass began. On the Alberta Central Railway and on the Canadian Northern Railway in the railway belt in British Columbia patrols were also maintained. As a result no fires escaped from the right of way and it was cleared of débris in all cases so as to leave little danger of fire.

A number of railways into the northern forest districts are projected. The Hudson Bay Railway will pass for most of its course through a continuous tract of immature forest. Other railways in Saskatchewan and Alberta have been chartered to construct lines into the north country and for some years to come there will be great danger from this source. Arrangements are being made to guard all these lines of construction.

Patrols have been maintained along the railway lines in operation which undoubtedly form a chief point of danger. Several of the worst fires of last season occurred along railway lines and in some cases the railway was probably responsible for the fires starting. The railway companies have shown willingness to co-operate in measures for the prevention of fires and have taken steps to clear their rights of way of infiammable material. The Canadian Pacific Railway has been doing this work through the mountain sections.

This railway is also changing its locomotive fuel through the mountains from coal to oil which will greatly reduce the danger on the steep grades in that section.

As the cost of the fire patrol along the lines of railway is a heavy charge on the department, I recommended that the Forest Reserves Act should be amended so as to provide for charging one-half of the cost against the companies. As, however, an amendment to the Railway Act which has since become law had been proposed, by which the railways were to be required to furnish a fire patrol under regulations of the Board of Railway Commissioners, the recommendation was not proceeded with. Since the amendment to the Act has become effective, recommendations have been submitted to the Board of Railway Commissioners as to the patrol which should be required of the railways passing through forests on Dominion Lands.

TIMBER SURVEYS.

The inspection of the timber along the proposed route of the Hudson Bay Railway was continued from Split lake eastward to Hudson Bay along the Nelson river, and the report of Mr. F. W. Beard thereon is appended hereto. No large timber was found on the route except in a few places along the river where small clumps of mature spruce, aggregating only a few square miles, were found. In the remainder of the district traversed the timber is mainly small-sized black spruce, with some tamarack growing in the muskegs. The cold, wet soil of the muskeg makes the growth of the trees very slow, and as one goes towards Hudson Bay, the forest degenerates into an alpine type in which the trees are small and stunted and grow so slowly that the forest cannot be reproduced in one thousand years.

A timber survey under charge of W. J. Vandusen was carried out in the Porcupine Hills district in Manitoba in order to determine what additions, if any, should be made to the Forest Reserve. The district to the south, east and north of the reserve was examined and a large area not now included therein was found to be rough and hilly, with a clay soil mixed with boulders, subsiding as it approaches the Canadian Northern Railway on the east into a fairly level plateau, the soil on which consists mainly of sand with intervening muskegs. The timber is mainly spruce and jack pine, and several large tracts are held under timber licence. Being of poor agricultural value a recommendation was made for the inclusion in this reserve of an additional area of 272,640 acres.

Mr. D. R. Cameron made an examination of the timber areas in the vicinity of Lesser Slave lake and the report submitted is being published as a Bulletin, No. 29, of this branch. The Lesser Slave Lake district is on the line of travel to the Peace River district, and with the interest which has developed in the opening of that new district will be on the line of travel by river and trail for the increasing numbers that are entering the country. Railway construction will also be begun, and it was, therefore, considered important that an examination should be made of the timber of this district and plans outlined for its protection.

Generally speaking, the rivers were taken as bases for the survey, but in parts of the territory it was found necessary to send out sub-parties across the muskegs, the members 'packing' their supplies on their backs.

From Sawridge (at the east end of Lesser Slave lake) the party worked along the north shore of the lake to The Narrows, then returned to Sawridge and worked along the south shore of the lake in the Swan Hills country. The exploration of this country could not be finished, but will be completed during the coming summer.

Lesser Slave lake is very shallow and the north shore is very stony. It is drained by the Lesser Slave river, which flows through a valley eight to ten miles wide, consisting of flat, burned muskeg country, with interspersed gravel and boulder-clay ridges, and joins the Athabaska river at Mirror Landing.

Northeast of the lake lies a plateau known as Martin Mountain, and to the south is another plateau known as the Swan Hills. West of The Narrows the distance between the lake and the plateau increases and large areas of agricultural land are found.

Generally speaking, the soil of the agricultural areas consists of loam (clay or sandy) underlain by boulder-clay. Agricultural areas are found north of the Athabaska and east of Mirror Landing (about 75 square miles), from Muskeg Creek to Mirror Landing along the Lesser Slave river (about 15 square miles), in township 73, ranges 2 and 3 (25 square miles), adjacent to Sawridge (9 square miles), south of Martin Mountain between Muskeg and Martin creeks (45 square miles), in township 72, range 6 (10 square miles) and along Swan river (25 square miles). West of the Swan river and north of the Swan Hills is a larger area, most of which will be good farming land. There are, perhaps, 360 square miles of this land.

The great areas of non-agricultural land fall into two divisions, viz., (1) undrained, and (2) broken. Areas of the former class consist of muskeg; the latter are included in the broken plateau country.

Of the 6,700 square miles examined, about 2,000 square miles consist of muskeg. On some 923,000 acres aspen poplar predominates, forming eighty per cent of the total stand. The average yield of pulpwood in forest of this description is about twenty cords per acre. This poplar country is capable of being reforested with spruce.

Along the Swan river some cottonwood is also found. There is also a small quantity of birch along the Assineau river. Stands of young jack pine occur on sandy soils, especially along the Athabaska and Lesser Slave rivers.

On the valley slopes of the Swan Hills much lodgepole pine is found. The total area of this type amounts to about 1,900 square miles. On over ninety per cent of this area the present growth has not attained tie size, being useful, however, as a protective covering and for a possible future supply of pulpwood. Some 1,500,000 ties may be obtained from this area. The present yield of pulpwood would be about 5,780,000 cords; this quantity will in all likelihood be doubled if the timber is allowed to grow for twenty years.

In the Martin Mountain district an additional supply of pulpwood (mainly balsam fir) can be obtained.

Of the total area of land examined, fourteen per cent has been burned over within the last twenty-five years. The poplar tracts have not been visited severely, but the muskeg has suffered very much. Within the period specified (that is, the last twenty-five years) over 300 square miles have been burned along the Lesser Slave river, 230 square miles east of Martin Mountain, 90 square miles north of The Narrows, 140 square miles in the Swan Hills, 45 square miles near the head-waters of the Otauwau, besides other smaller fires. The most serious of these is that in the Swan Hills, where probably 350,000,000 (three hundred and fifty million) feet of timber was destroyed in the two fires that, at an interval of thirteen years, ran over the area—a quantity of timber sufficient to have supplied the needs of a large community for years.

There has been very little reproduction on these areas.

For convenience the country may be divided into ten districts, as below, and the timber summed up as follows:—

Photo D. Roy Cameron, 1911.

Lesser Slave Lake District: Lodgepole Pine Reproduction
Tp. 63, Rg. 7, west of 5th Meridian.

Photo D. Roy Cameron, 1911.

Lesser Slave Lake District: Part of Great Brulé at Head-waters of Assineau River.
Tp. 72, Rg. 8, west of 5th Meridian.

District.	Ties.	Pulpwood.	Timber.
		Cords.	Ft. B. M.
Moose Lake	16,000	4,320,000	4,820,000
Lesser Slave River Valley	5,000	.....	2,500,000
Martin Mountain	227,000	14,288,000	12,700,000
The Narrows	.....	734,000	1,720,000
Otauwau	2,000	108,000	53,000,000
North Slopes	.....	2,592,000	207,722,000
Swan Hills	1,500,000	5,780,000	10,000,000
Upper Saulteux	.....	4,680,000	56,150,000
Vermilion Creek	.....	.....	.....
Coutts River	2,250,000	522,000	.....
Total	4,000,000	33,024,000	348,612,000

Mr. Cameron recommends that the Swan Hills country and the Martin Mountain region be set aside as forest reserves. They are, he points out, unsuitable for farming purposes, and in addition to the providing of a future timber supply the forests must be preserved in order to regulate the water-supply of the rivers and to prevent their eroding their banks. Of late years the continual denudation of the country at the head-waters of the Lesser Slave River tributaries by fire has given rise to alternating conditions of very low and very high water, which have proved very harmful to navigation. Indeed, things have come already to such a pass that every bad storm means a miniature freshet, and a week's rain a swollen torrent, bringing down trees and driftwood of all kinds which are a menace to navigation. Moreover, erosion is rapidly filling with silt the channels of the rivers and forming sand and gravel-bars. In a district whose development depends largely on water communication, the advisability of remedying this state of affairs by the preservation of the forests is obvious.

Much better protection of the forests against fire is essential, and Mr. Cameron has submitted a scheme of patrol districts and lookout stations which should, if carried out, go far to meet this need.

Mr. E. G. McDougall had charge of the inspection of the Porcupine Hills in the province of Alberta. This range of hills, of an elevation 4,000 feet to 5,800 feet above sea-level, lies in proximity to the Rocky mountains and is surrounded by a well developed agricultural and grazing country. The hillsides are partly timbered with a scattering growth of Douglas fir, spruce and pine, which occasionally forms merchantable stands. The timbered area has been much reduced in recent years by logging operations and fires, but these hills have long been the chief source of timber supply to the adjacent country and small towns. A number of important streams already much used for irrigation have their sources in these hills. For these reasons it was considered advisable to recommend the reservation for forest purposes of an area of 194 square miles.

Later in the season Mr. McDougall made an examination of the sandy tract of land on the north side of the North Saskatchewan river opposite to Prince Albert in the vicinity of the Pines and Nisbet Forest Reserves. The land examined consists of sand-hills and muskegs and is not suitable for agriculture. The trees, while not of large dimension, are of quick growth and provide valuable material for fuel, fencing and ties. One hundred and thirty-six square miles north of the river were recommended as an addition to the Nisbet Forest Reserve, and thirteen square miles south of the river were recommended to be added to the Pines Forest Reserve. An inspection was also made of a tract in the vicinity of Fort à la Corne, east of Prince Albert on the Saskatchewan river, which was reported to be non-agricultural. This district differed from that in the vicinity of Prince Albert, chiefly in the larger proportion of muskeg. As the season was late and there was considerable snow on

the ground, a thorough examination could not be made and the district will have to be further inspected. The non-agricultural area will, however, include some 512 square miles.

Mr. G. H. Edgecombe had charge of two parties which continued the examination of the boundary of the Rocky Mountains Forest Reserve northward from the North Saskatchewan river, that being the point to which the survey of the boundary was carried in the previous year. The mountain range broadens and the foothills extend farther out into the prairie as they go northward and there is a broad expanse of muskeg and broken country that makes the eastern boundary of the reserve difficult to determine. It was found that, to include the absolute forest land, it would be necessary to fix the boundary along a considerable part of its course to the east of the line previously determined on and this will involve an addition of 2,483 square miles to the reserve.

The timber here, as elsewhere, has suffered seriously from fire, and the windfalls and muskeg make the work of exploration difficult and arduous. Mature timber occurs only in small areas and consists of spruce, lodgepole pine and a few patches of Douglas fir. The rivers are large and important tributaries of the Saskatchewan and Athabaska rivers and the watershed is a not less important one than that in the southern part of the reserve. Coal seams of great value occur in this part of the reserve and mines are now being rapidly developed. The demand for timber for the operation of the mines will be so large that it is doubtful if, in their present depleted condition, the forests can supply what will be required.

In the Coast district of British Columbia, Mr. H. Claughton-Wallin made a special examination of the Anderson River district in addition to smaller inspections. The stand of timber on this river was rather a disappointment, as it was found to have been largely damaged by fire; so that, with the expensive construction that would be necessary to take the timber out by railway—the only possible means—the cost would make present operations unprofitable.

Under Mr. J. W. Curry an examination of the timber on the English river was made and his report is attached hereto. The stand was found to be disappointing. This territory will hereafter be included in the province of Ontario.

FOREST RESERVES.

The Dominion Forest Reserves and Parks Act, assented to on May 19, 1911, besides making some changes in the wording of the Act, made an addition to the forest reserve area of 13,403,600 acres, the principal part of which is the Rocky Mountains Forest Reserve. The total area included in the reserves is now 16,128,920 acres and the list of reserves is as follows:—

British Columbia:—

	Area.
Long Lake	121,600 acres.
Monte Hills	67,840 "
Martin Mountain	11,360 "
Niskonlith	80,000 "
Tranquille	95,360 "
Hat Creek	131,200 "
Larch Hills	16,000 "
Yoho Park	463,040 "
Glacier Park	367,360 "

Manitoba:—

	Area.
Riding Mountain	982,400 acres.
Turtle Mountain	69,920 "
Spruce Woods	143,680 "
Duck Mountain No. 1	898,560 "
Porcupine No. 1	199,680 "

Saskatchewan:—

Beaver Hills	63,360 "
Pines	98,560 "
Moose Mountain	99,840 "
Porcupine No. 2	230,400 "
Duck Mountain No. 2	51,840 "
Cypress Hills No. 2	46,080 "
Nisbet	9,560 "

Alberta:—

Cooking Lake	71,360 "
Cypress Hills No. 1	51,840 "
Rocky Mountains	11,656,320 "
Buffalo Park	101,760 "

The organization of the reserves has not been altogether satisfactory, partly due to the fact that the appropriations available were not sufficient to provide a proper organization or the facilities necessary to have the rangers live in their districts in the reserves or to provide for quick communications, and partly on account of the failure of some of the rangers to properly administer their districts. A more adequate appropriation has been provided for the coming year and with some reorganization which has already been partially carried into effect it is expected that during the coming year considerable progress will be made in overcoming these defects.

The form of organization adopted is to have each reserve divided into permanent ranger-districts with a permanent ranger in charge who will be required to live in his district in a house to be provided by the department. He will be required to patrol his district, to protect it from fire and trespass, to open up trails and roads through it, and to keep in order any telephone lines that may connect his district with others. He will also look after any lumbering operations carried on in his district so as to see that the regulations of the reserves are being properly observed and to check up the cut. He will report to and receive instructions from the supervisor, who will be in charge of the whole reserve.

The supervisor will be responsible for the laying out of the work on the reserve, for the work of the forest rangers, for payment for work done, and in most matters will report directly to the head office at Ottawa and receive instructions therefrom. While the supervisor is the better for technical training it is not absolutely required, if he has good executive ability. On the larger reserves there is also a forest assistant, who is a technically trained man, a graduate of a forest school, and who acts as technical adviser to the supervisor and under his instructions.

A system of inspection of the forest reserves is provided. The inspector must be a technically trained man with executive ability and experience. His work is to advise with the supervisors and rangers as to the best methods of handling their work and as to new work to be undertaken, to see that the regulations are being observed by these officers and to check their work and expenditures generally. While

the organization is in process of development the work of inspection is of special necessity, and heretofore the provision for it has not been adequate.

The staff on the reserves is as follows:—Supervisors, 5; permanent rangers, 35; temporary rangers, 11.

In order to carry out the work of the reserves effectively it will be necessary to make better provision for handling the office end of the work. Records of correspondence, instructions, expenditures and revenues should be in much better order, and for this purpose office accommodation and equipment are required.

The only fire causing serious loss was one on the south side of the Riding Mountain Forest Reserve which came in from settlement in the vicinity. This fire killed a quantity of spruce, estimated at 1,870,000 feet board measure. In consequence of this fire it was necessary to dispose of the timber immediately to prevent its becoming a total loss. The tract was divided up into ten berths and put up for sale by competition and prices of $2 to $2.10 per thousand on the stump were received. The timber was sold on the condition that no green trees should be cut except those that were marked by a forester for removal, that stumps should be cut not higher than eighteen inches, and that the débris of operations should be piled or otherwise disposed of under the instructions of the forest officers.

It was also considered desirable to permit a few mills to locate in the Riding Mountain Forest Reserve as the timber near the boundaries of the reserve was largely cut out and it would convenience the settlers to be able to have their logs sawn in the bush so that they would need to haul out only the lumber. The right to locate three mills in the reserve was put up to competition on the 23rd day of December on the basis of the rate to be charged for logging and sawing for the settlers. The tenders received were from $9 to $10 per thousand feet. Although the season was then late for commencing operations the millmen took hold of the work and on the whole have carried out the regulations well.

The trees were utilized fully and the bush piled on the operations of the millmen, both in the dead timber and the green, and the work of the past season was a distinct advance on that of the previous year. The millmen begin to understand better what is wanted and to see the purpose of the methods followed. Similar operations were conducted on the Rocky Mountains Forest Reserve.

The settlers cutting their own logs under permit were also required to utilize the trees more fully and dispose of the brush, but their operations, being individual and scattered, were more difficult to watch. There was a distinct advance here also in the improvement of methods.

Some criticism was heard from both the settlers and the small millmen that these regulations were not enforced on license berths within the reserves. The provisions of the licenses provide fully for such regulations being enforced, but a question has been raised as to the jurisdiction of this Branch in the matter which has prevented consideration of the action that should be taken.

On the Turtle Mountain Forest Reserve in Southern Manitoba a portion of the reserve was fenced, as it was thought that, if it were grazed over, the keeping down of the grass would assist in preventing fires. Regulations were adopted for handling such grazing, the provisions being as follows:—

Grazing Permits in Turtle Mountain Forest Reserve.

1. Permits for the grazing of cattle or horses within such portions of township 1, range 21, and township 1, range 22, west of the principal meridian, as lie within the boundaries of the Turtle Mountain Forest Reserve may be granted subject to the regulations hereinafter provided.

2. The number of stock which may be grazed upon the said tract and the period during which grazing will be permitted shall be determined for each year by the Director of Forestry.

3. Subject to the approval of the Director of Forestry, the forest ranger or other officer in charge of the reserve shall fix a date before which all applications for grazing permits shall be submitted, and any applications received after the date fixed shall be entitled to consideration only after the applications received prior to such date have been satisfied or disposed of. Due notice of the date fixed shall be given at least thirty days before such date of advertisement in a newspaper circulating in the district.

4. Applications for grazing permits must be made on the form prescribed for that purpose and must give a sufficient description for identification of the stock, including the marks and brands, when there are such.

5. Bona fide residents in the vicinity of the reserve will be given preference in the granting of permits.

6. The dues for a grazing permit shall be twenty-five cents per head of stock per month, or one dollar per head of stock for the season, payable in advance. Only stock six months old, or over, will be counted in the determination of the dues for a permit.

7. Permits will be granted only for the exclusive use and benefit of the owners of stock, and will be forfeited if sold or transferred in any manner or for any consideration.

8. When a permittee is ready to drive stock into the grazing tract on the reserve, he must notify the forest ranger or other officer in charge of the reserve, by mail or otherwise, stating the number of stock to be driven in. Similar notice must also be given when the stock are to be removed. Any stock removed before the expiration of the permit may be replaced by other stock, to an equal number, which are owned by the permittee.

9. At the expiration of the permit, the permittee shall remove his stock from the reserve, and if this is not done within seven days after the expiration of the permit the officer in charge of the reserve may have the stock removed and the department will assume no responsibility for the loss of the stock or for damage occasioned by them.

10. Whenever the forest reserve officer requires it, all stock grazed under permit must be salted regularly at such places and in such manner as he may designate.

11. The carcases of any animals which die within the reserve must be removed by the owner immediately and buried or burned.

12. All permittees are required to aid in extinguishing fires in the tract within which permits are granted.

13. The department will not be responsible for damage which may be caused by stock escaping from the enclosure.

14. If upon examination it is evident that grazing is damaging the forest and interfering with the production of wood, the Minister of the Interior may order that grazing shall cease.

The experience of the past year is not sufficient to give information as to the success of the experiment.

Heretofore the regulations for forest reserves have provided only for the granting of permits for timber for the use of settlers, the settler being a person living on a farm. It would seem, however, that, as the reserves are the property of the public, persons living in towns and villages (many of whom are less able to obtain timber otherwise than are the farmers) are as much entitled to consideration as the latter, and there does not seem to be sufficient reason why this restriction on the use of the reserve should be continued. Timber permits might also be allowed for schools, churches and municipal works.

The reserves might also furnish the supply for small manufacturing establishments. In the vicinity of each of the reserves there might very well be, in the future, many industries carried on which would assist local trade and furnish a considerable source of wealth.

There are tracts within the reserves which have a good growth of grass and upon which grazing could be carried on without damage to the forest. This is particularly true of the Rocky Mountain Forest Reserve. Regulations similar to those established for the Turtle Mountain Forest Reserve would enable the handling of this question on a satisfactory basis.

LICENSED TIMBER BERTHS.

In order to protect the rights granted to licensees of timber berths granted under the Dominion Lands Act prior to enacting of the Forest Reserves Act and the setting apart of the reserves, Section 11 of the Forest Reserves Act enacts that 'nothing in this Act shall affect or prejudice any right or interest which has heretofore been acquired, under any lease or license, for cutting timber or for any other purpose in respect of any lands within a reserve.'

This saving clause has now been legally interpreted to have the effect of withholding from the forest reserve and the operations of the Forest Reserves Act the timber covered by license with the result that this timber which forms the main body of mature timber in the forest reserves and which should be operated with a view to conserving a future supply will be out of the control of the forest reserve administration, and only the bare and unproductive portions are to be administered for the purposes for which the reserves were set apart, and only the settlers and small operators will be subject to proper regulation and protection. The Act could easily be amended to remove such an anomaly without affecting injuriously the rights of the licensees, and unless it is removed the purposes for which the forest reserves have been set apart will be largely nullified.

SPECIAL INVESTIGATIONS.

As, in providing for the reproduction of the forests, natural processes will have to be the great dependence, it was considered necessary that a special investigation should be begun of the reproduction following fires and cutting so that the methods to be adopted in regulating cutting might be carried out on lines which would give the desired results. The importance of this investigation may be illustrated by pointing out that in the Rocky Mountains a difference in seed-trees left, or in the condition of the seed-bed, may mean the difference between a reproduction of spruce or of balsam, and under almost all conditions spruce is the more valuable species.

Mr. T. W. Dwight, a graduate of the Forest School of the University of Toronto, was given charge of this investigation, and the report thereon is published as a bulletin (No. 33 of this Branch).

Mr. H. Claughton-Wallin also made a special investigation of the rate of growth of Douglas fir in the coast district. It was found that at the age of fifty years the average diameter at breast-height (4½ ft. from the ground) was 18·9 inches and the average height 101 feet; at one hundred years the diameter at breast height was 32·4 inches and the height 166 feet. Yield tables have been compiled from these measurements, and are found to agree substantially with those compiled by the United States Forest Service for Douglas fir in the United States.

WATER ADMINISTRATION.

The administration of the water-supply of the country is closely associated with that of the forest. The forest reserves are the source of the rivers and streams, and in them are located great natural reservoirs and sites for artificial ones which may regulate and control the flow of the streams. The forests and the water-supply have, therefore, a close connection and are very suitably administered as one system.

The waters in the provinces of Alberta and Saskatchewan are administered by the federal government under the Irrigation Act. It may be pointed out that although the Act is designated the Irrigation Act, it covers all uses of water and might be designated, as the similar Act is in British Columbia, the 'Water-Users' Act.' The stream measurements, surveys of storage reservoirs, and matters that affect the control of water supply generally, as well as the inspection of works for the use of water for domestic, municipal, industrial and engineering purposes, the construction of drainage works and the granting of licenses for such purposes are dealt with thereunder. The only matter of water-supply not now finally dealt with by the office of the Commissioner of Irrigation is water-power, which has only recently been withdrawn from the operations of the Irrigation Act, and it is somewhat difficult to understand how such withdrawal has made for efficiency in administration. The work of the office of the Commissioner of Irrigation at Calgary is, therefore, the basis for all administration of the uses of water within the territory where the Act has scope. To keep up with the development of the West and the inspection of the increasing number of water applications requires an addition both to the inside and outside staff of the office of the Commissioner of Irrigation if the whole of the work is to be kept up with efficiency.

INSPECTION OF THE CANADIAN PACIFIC RAILWAY COMPANY'S IRRIGATION PROJECT.

Authority was given to the Canadian Pacific Railway Company, in 1904, to construct a system of canals, &c., for the irrigation of a tract of some 3,000,000 acres of land lying along the main line of the company's railway east of Calgary, Alberta. A period of fifteen years was allowed for the completion of the system of works.

The water for this project is taken from Bow river at two points, viz.: on section 13, township 24, range 1, west of the 5th meridian, near the city of Calgary, and at Horseshoe Bend, in township 21, range 18, west of the 4th meridian. For convenience of operation the company has divided its irrigation block by north and south lines into three nearly equal portions. The western section and the small proportion of the central section which is to be irrigated are supplied with water from the canal system tapping the river near Calgary, while the eastern section will be supplied from Horseshoe Bend.

The western section, lying nearest to Calgary, was the first to be constructed and the partially completed works have been used to some extent for two or three years. The company applied in August, 1911, for an inspection of the works constructed in the western section and for the issue of a license authorizing the diversion and use of sufficient water for the irrigable land in this section, estimated at about 370,000 acres. The season was too far advanced to permit of the necessary inspection being made last season, but arrangements have been made to have a thorough inspection made during the season of 1912.

The work of inspection will probably occupy the entire season, as there are about 17 miles of main canal, 254 miles of secondary canals and some 1,300, or more, miles of distributing ditches, all of which will have to be carefully examined so as to determine whether the system is capable of supplying water to all of the irrigable land, and in sufficient volume to permit of beneficial use being made of the water during the limited period when required. Upon the completion of the inspection, if the works have been found to be in satisfactory condition, a license will be issued to the company authorizing it to divert and use, or lease to others, a quantity of water sufficient to irrigate the irrigable land in this section, or as much of it as the works are capable of irrigating. On the other hand, if the inspection shows that the works are not adequate for the purpose intended, the company will be required to make such changes as may be found necessary and the issue of the water license will be withheld until such changes have been made.

ST. MARY AND MILK RIVERS.

Under the provisions of the International Waterways Treaty the waters of the St. Mary and Milk rivers, and all their tributaries in Canada and in the United States, are to be treated as one stream system and the waters are to be divided equally between the two countries, under the supervision of an International Joint Commission.

Hydrographic surveys, or stream measurements, have been carried on systematically by this department for several years and especial attention has been given to obtaining records of the flow of the streams affected by this treaty, but these measurements must be continued for several more years before any reasonably accurate estimate can be made of the volume of water carried by the several streams throughout the year, or at any particular period. Steps are now being taken to secure the co-operation of the United States Geological Survey, or the Reclamation Service, in the establishment of gauging stations on the St. Mary and Milk rivers at, or near, the international boundary. It is proposed that automatic gauges shall be established on both streams and that observations shall be taken by the officers of both countries, so that the records so obtained shall not only be as accurate as possible but that they shall be accepted as such by both countries. Under present conditions separate gauging stations are maintained by each country and conditions may arise where the accuracy of the records may be challenged.

There has been a considerable development of irrigated farming, particularly the growing of hay, in the valleys of some of the tributaries of the Milk river in Alberta and Saskatchewan and this development would undoubtedly continue were it not for uncertainty as to the quantity of water which Canada is entitled to divert from these streams under the provisions of the treaty. This question has also been referred to the International Joint Commission for adjustment.

THE SOUTHERN ALBERTA LAND COMPANY.

This company has been authorized to construct a system of works for the diversion of water from Bow river at a point on section 31, township 21, range 25, west of the 4th meridian, for the irrigation of a tract of some 380,000 acres of land between the Bow and Belly rivers, near their confluence, and eastward from that point towards Medicine Hat, Alberta. This land was sold to the company upon the condition that it should irrigate at least twenty five per cent of the tract, and the company has also purchased a considerable additional area from other sources, so that it now owns over 400,000 acres, nearly half of which can be irrigated from the works now planned or under construction.

The works have previously been described and it may suffice to say that they consist of a very large diversion canal by means of which water is taken from the Bow river, during high and flood stages of the stream, and carried to a reservoir known as Lake McGregor. This reservoir has a capacity of some 360,000 acre-feet, or sufficient to provide for the irrigation of about 180,000 acres. From this reservoir the water is carried eastward by one large canal for a distance of some forty miles to the westerly boundary of the tract to be irrigated and from this point onward the main canal is tapped at several points by subsidiary canals. The main canal continues in an easterly direction to the Bow river, which is crossed by means of a siphon. An additional reservoir has been located some fifteen miles east of the river crossing and provision has been made, by a system of subsidiary canals, for the irrigation of land which the company owns in the vicinity of Suffield.

The company's dam across the Bow river at the point of diversion has been completed and the canal from this point to the main reservoir is now approaching completion. The huge earthen dams at either end of the reservoir and the outlet gates at

the lower end are ready for use, but considerable work remains to be done on the canal system east of the reservoir. The siphon across Bow river has not yet been built. The company expects to have the system in partial operation within a year from this date, although its contract with the government does not call for the completion of the works until March, 1919.

THE ALBERTA LAND COMPANY.

The Alberta Land Company has purchased from the government a tract of some 67,000 acres lying northeast of the tract of the Southern Alberta Land Company and has been authorized to construct works taking water from Bow river, through the works of the latter company, for its irrigation. It is required to irrigate at least twenty-five per cent of the tract sold, but can, and probably will, irrigate fifty per cent. Its canal system has all been located and it is expected that a considerable proportion of the work will be completed during the present year. Authorization for the construction of the works was granted on February 29, 1912, and a period of three years was allowed for their completion. It will probably be necessary to somewhat extend the time allowed for the construction of these works, and, according to the provisions of the agreement for the sale of the land, the company has until February, 1919, to complete its works and have them in operation.

HYDROGRAPHIC SURVEYS.

Hydrographic survey work, or stream measurement and reservoir surveys, have been carried on by the Irrigation Branch of the department since 1894. For a few years considerable attention was given to this work and much valuable information was collected, notably that which demonstrated the feasibility of irrigating the district between Lethbridge and Cardston, which is now served from the canal system of the Alberta Railway and Irrigation Company, and the larger tract near Calgary now being irrigated from works constructed by the Canadian Pacific Railway Company. After a few years the limited appropriation and the increasing work of inspection in connection with irrigation projects brought about a partial abandonment of hydrographic work and for several years no systematic measurement of stream flow was attempted and reservoir survey work was entirely discontinued.

The increasing demands for water for irrigation, industrial and domestic purposes, due to the rapid settlement of the West, finally made it imperative that more accurate information should be obtained of the water available for such uses, and, in 1908, a small appropriation was made for the purpose of taking up the work of stream measurement in a systematic manner. Little actual field-work was done in that year, but the necessary instruments and equipment were purchased and in 1909 several parties were sent out for the purpose of installing gauging stations at suitable points on the principal streams in the irrigation district. This work has been systematically continued since 1909 and has gradually been extended as far as funds permitted until we now have a fairly accurate knowledge of the flow of these streams. It will be necessary, however, to continue these observations for several years more before the records can be considered reliable.

The increasing demand for water for domestic uses in the rapidly growing towns in the provinces of Alberta and Saskatchewan has very forcibly demonstrated the necessity of extending the work of stream measurements beyond the limits of the irrigation district, but it has not been found possible to very materially extend the scope of the work within the limits of the present appropriation. The appropriation for hydrographic work, including the special work on St. Mary and Milk rivers in connection with the International Waterways Treaty, has been as follows:—

1908-9	$10,000
1909-10	20,000
1910-11	25,000
1911-12	51,500

For the year 1912-13 the hydrographic work has been placed under the supervision of the Commissioner of Irrigation, instead of being conducted as a separate organization as was formerly the case, and an appropriation of $100,000 has been voted for carrying on the whole work. While this is in excess of the total appropriation for both services in the past year, it is not sufficient to permit of all the really important work being taken up, and little, if any, new work can be undertaken. The limited appropriation will permit only of continuing the work of irrigation inspections and observations of stream flow at stations already established.

CONTOUR SURVEYS.

The importance of this work cannot be over-estimated, but it has been impossible to carry on the work in an adequate manner with the limited appropriation available for irrigation administration. The importance of this branch of the work seems to have been clearly realized in the years immediately following the enactment of the first Irrigation Act and much valuable work was done. The inception of the three great irrigation projects—the Alberta Railway and Irrigation Company, the Canadian Pacific Railway Irrigation Company and the Southern Alberta Land Company —was due, primarily, to the pioneer work done by this branch in developing contour surveys. The importance of the work is no less pressing to-day, and it is greatly to be regretted that funds are not available for carrying it on systematically.

At present there are no available data regarding elevations, except the old irrigation survey bench-marks and the railway elevations and these are meagre. It is absolutely impossible to intelligently study any general or large question of water-supply, or water conservation, unless a good general idea of the topography of the country has first been gained; that is, the relative elevations of the various streams and the interlying country must be determined. Two instances may be cited to illustrate this:

The government of the province of Saskatchewan has applied, under the provisions of the Irrigation Act, for permission to divert a very large volume of water from the South Saskatchewan river to supply the domestic requirements of the cities of Moosejaw and Regina and a considerable tract in that vicinity. These cities, along with other towns and villages in the same neighbourhood, are confronted with a serious water problem and the only adequate and permanent source from which they can be supplied seems to be the South Saskatchewan river. The project will involve the expenditure of millions of dollars and it is not safe to decide upon any definite line of work in connection with it until the topography and critical elevations of an enormous tract of country have been developed. Had the work of contour surveys been thoroughly developed in this section it would be possible to make an office study of the more important features and to select the most feasible general location for the necessary works. Field development work could then be confined to a comparatively small area. As the matter stands to-day a large amount of money must be spent on surveys to determine whether or not the project is economically feasible.

Under the provisions of the International Waterways Treaty this government will probably not be in a position to deliver to the Alberta Railway and Irrigation Company the full quantity of water which it is entitled to divert from St. Mary and Milk rivers. The deficiency should be supplied from some other source and a reservation has been made against the flow of Belly river. Owing to lack of knowledge of the topography of the interlying country it is impossible to say at present whether or

not it is feasible to divert the required quantity of water from Belly river to the land to be irrigated within reasonable cost limits.

There are large tracts of land in Southern Alberta and Saskatchewan, the value of which can be enormously increased by irrigation, but the cost of the necessary works is entirely beyond the reach of individual land-owners and it is doubtful whether it would be good public policy to permit companies to acquire these lands and to construct the works necessary for their fullest development. Water must be conveyed long distances and drawn from streams whose normal flow has, in most cases, been already fully appropriated. Resort must be had to reservoiring on the head-waters of these streams, and, as this will affect many other interests, such as water-power, the domestic supply of cities and other irrigation projects, the privilege of constructing such reservoirs should be sparingly granted. A better plan would be for the government to construct and operate such reservoirs in the general interest of all the district that may be served by them.

DUTY OF WATER.

One of the most important questions to be settled in connection with irrigation administration is the 'duty of water;' that is, the area of land which can be sufficiently irrigated by one cubic foot of water per second flowing constantly throughout the irrigation season, or the equivalent of such flow applied to the land during a shorter period of time.

The duty of water as defined in the Irrigation Act was never intended to be the final word on the subject, in fact it was to some extent an experiment, and the time has now arrived when experimental work should be undertaken to determine with some degree of exactness the quantity of water required for the production of the various crops grown within the irrigation district, under the varying conditions of soil and climate.

The question of fixing, or readjusting, the 'duty' has often been discussed and at the last convention of the 'Western Canada Irrigation Association,' held at Calgary in August, 1911, the following resolution was adopted:

> 'Whereas a knowledge of the practical duty of water for various crops has a most important bearing on irrigation development; and whereas information upon this important question available in any of the provinces of Alberta, Saskatchewan and British Columbia is vague and incomplete;
>
> 'Therefore, be it resolved that the attention of the governments interested should be directed to this important matter, and that they should be urged to carry out a thorough system of investigation to determine the duty of water in the different provinces and for the different crops, so that such duty may then be determined with approximate exactness.'

DRAINAGE.

A great many applications have been received for permission to drain lakes, sloughs or other bodies of water controlled by this department under the provisions of the Irrigation Act, and to acquire, by purchase or otherwise, the lands to be so reclaimed. These applications fall naturally into three general classes:—

1. The drainage of large tracts of marshy land, or areas of combined land and water. Some of these applications cover hundreds of thousands of acres.
2. The drainage of small lakes or sloughs.
3. The reclamation of fractional quarter-sections of land abutting upon a lake or slough.

With respect to the first class the applicants have not, as a rule, furnished sufficiently precise information as to the feasibility of the proposed undertakings to

warrant the sale to them of the large tracts affected. Before the department would be justified in disposing of such considerable bodies of land it should be shown clearly that the land in its present condition is not fit for cultivation; that its reclamation is feasible within reasonable limits of cost; that the character of the soil is such as to make it suitable for cultivation when drained and that the draining away of the bodies of water will not injuriously affect any other interests—in other words, that the absence of the water is of more benefit than its presence.

An additional difficulty in dealing with such applications is the fact that full control of the drainage of land is by law vested in the provincial governments, while the water and the land are controlled by the Dominion. The proper method of procedure would appear to be for applicants for drainage rights to first secure the approval of the provincial government and a formal authorization for the construction of the proposed works under the provincial drainage laws and then to apply to this department for permission to drain away the bodies of water affected and to purchase the land to be reclaimed. In the event of failure to secure authority from the province for the construction of the works application might be made direct to this department and it would then become necessary to ascertain to what extent the Dominion government has the right to reclaim, or improve, its own lands in order to promote the settlement and development of the country.

In connection with the drainage of small lakes, or sloughs, sufficient information is usually given by the applicants to permit of determining the feasibility of the project from an engineering point of view. The chief difficulties in dealing with these applications are: (1) Uncertainty as to whether the works are to be constructed under provincial legislation respecting drainage; (2) similar uncertainty respecting the attitude of the provincial governments towards the projects, and (3) objections raised by owners of adjacent lands. In cases where the projects are opposed by other land-owners in the vicinity, and where authorization has not been granted by the province for the construction of the required works, this department would appear to be stopped from granting approval for the draining away of the bodies of water affected, and, consequently, from disposing of the land subject to any conditions as to its drainage.

The drainage of fractional quarter-sections and the disposal of the land so reclaimed present few difficulties from an administrative point of view. The provincial governments do not, as a rule, require that such works be constructed in accordance with their laws, and, except where objections are raised by neighbours, this department usually approves of the plans and authorizes the draining away of the water. If the remainder of the quarter-section has been patented to the applicant as a homestead or pre-emption, supplementary patent is usually issued without cost for the reclaimed area, but where the land is not so held the area reclaimed is sold at a fair valuation.

WOOD BUFFALO.

In the vicinity of the Great Slave river is a herd of wood buffalo which has been variously estimated at from one hundred to three hundred head. It was decided last year that this Department should take some steps directly to protect this herd in addition to the work of the Mounted Police. Two men were therefore appointed for the purpose of trying to locate and number the buffalo herd, to determine what were the causes of destruction of these animals and to destroy the wolves that might be found preying upon the herd. An experienced trapper, Mr. Peter McCallum, and Mr. G. A. Mulloy were appointed, Mr. Mulloy being a young man of education who would be able to report on the work done. Attached are copies of reports received from Mr. Mulloy. Up to the last reports it had not been possible to get any estimate of the herd. As they range over a large territory which is largely wooded it will be extremely difficult

to get an accurate enumeration. Little sign of wolves was seen and none were captured.

A proposal is made by Mr. A. J. Bell, the Government Agent in that district, that the buffalo should be confined by a fence in the peninsula between the Peace and Great Slave rivers where they could be better protected. Some such plan may be the best final solution of the question. For a fence of sufficient strength to confine the buffalo the cost would be large. The cost of the fence around the Buffalo Park in Saskatchewan was on the average $828.50 per mile, and such a fence could hardly be erected more cheaply, and at this price the fence required, estimated by Mr. Bell at 125 miles, would cost $103,562.50.

REINDEER HERD.

At the suggestion of His Excellency Earl Grey, the Governor General, the then Minister of the Interior took up with Dr. W. T. Grenfell a proposal for sending to the Mackenzie river a shipment of reindeer from the herd in Newfoundland under charge of Dr. Grenfell. It was considered that the deer would prove much more valuable than dogs for transportation purposes, and, as they could feed themselves on the moss which grows in the northern districts and would themselves be of value for food, they would become not only a most useful adjunct to travel in such districts but also a source of wealth. In Lapland, the home of the domesticated reindeer, a man's wealth is reckoned by the number of deer he owns, and a similar state of affairs is developing in Alaska where reindeer were introduced by the government of the United States. Alaska is now exporting reindeer meat to the markets of the United States, a shipment of two thousand carcasses having been received recently in Chicago.

Under instructions I discussed the matter with Dr. Grenfell, and on the 9th June, 1911, he submitted a written statement of the terms on which he would supply fifty deer from his herd to the Department. The terms were $51.30 per head, young and strong breeding does and stags to be supplied. Three herders were also to be supplied and three herd dogs. This offer was submitted and authority given for its acceptance. The purchase was, therefore, made and the shipment carried out under charge of Mr. E. F. Drake, whose report attached hereto gives full particulars in regard thereto.

The loss of deer on the route was nineteen. While this was a heavy loss, part of which might have been avoided, it may be pointed out that the shipment had to be made in a rush and that it will have to be done in the same way in any future shipment. The deer cannot be taken across Canadian summer weather, as they will not stand the heat. They cannot be taken across in winter unless provision is made for a supply of reindeer moss near Edmonton, as the rivers are frozen and they cannot be transported beyond that point. They cannot be moved in the spring, as that is the fawning season. There is, therefore, only the short season left between the close of summer and the 'freeze-up' of the northern rivers.

At last accounts in March the herd were doing well and the prospects are that the experiment will be fully successful. As the herd is a small one and in order to develop a herd large enough for stocking the northern districts in a reasonable time, a considerably larger herd should be started, it would seem advisable that an addition to the herd should be made in 1913, as the success of the experimental shipment would then be fully determined, and that the shipment should be large enough to furnish the stock necessary for future development. The Government of the United States imported twelve hundred and eighty reindeer to Alaska to start the industry there, and the herd introduced into Newfoundland by Dr. Grenfell numbered three hundred.

CORRESPONDENCE.

Statement of letters, etc., received and sent out by the Forestry Branch during the fiscal year beginning April 1st, 1911, and ending March 31st, 1912:—

Number of letters received		17,815
Mail sent out:—		
Letters, circulars, etc	68,615	
Bulletins and reports	143,926	
Parcels	3,781	
Total		216,322

Respectfully submitted,

R. H. CAMPBELL,
Director of Forestry.

No. 2.

REPORT OF H. R. MacMILLAN.

DEPARTMENT OF THE INTERIOR,
FORESTRY BRANCH,
OTTAWA, June 20, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—In submitting herewith my report on the work with which I have been connected during the past year, I wish to draw attention particularly to the fact that the greatest difficulty which now faces the Forestry Branch is the difficulty of getting a class of men to take charge of the executive work in the field who are capable of doing the work required by the Forestry Branch, and who are willing to exert themselves to get it done.

The area of the forest reserves at present actually administered by the Forestry Branch is about 14,948,000 acres, or slightly greater than the combined areas of the two provinces of Nova Scotia and Prince Edward Island.

The Forest Reserves and Parks Act places upon the Forestry Branch the responsibility of protecting this area from fire, and provides that no use shall be made of any of this area except upon terms which require the personal attention of a forest officer.

Not only is the forest reserve area as large as a principality, but it is widely scattered and consists of the most inaccessible and impenetrable brulé, muskeg, mountain and forest land in the west. The great distances to be covered and the impassable nature of a large proportion of the country at different seasons of the year render it impossible for any inspecting officer to personally initiate, execute or supervise the work on the whole area.

During the past year the Dominion Forest Reserves were divided into three inspection districts, as follows: Manitoba, including all the forest reserves in Manitoba and the Beaver Hills and Moose Mountain in Saskatchewan, a total area of 2,739,000 acres; Alberta, including all the forest reserves in Alberta and the Cypress Hills and Pines in Saskatchewan, a total area of 11,816,000 acres; and British Columbia, including all the forest reserves in the railway belt, a total area of 392,000 acres. Each inspection district is in charge of an inspector who spends his whole time in the district, and who is responsible to the head office for the planning, supervision and inspection of the work in his district.

Within each inspection district the actual administrative units are the forest reserve. Large reserved areas, such as the eastern slope of the Rocky Mountains, are divided into administrative units of from 1,000,000 to 4,000,000 acres each. Thus the original Rocky Mountain Forest Reserve has been subdivided into the Crowsnest, Bow River, Clearwater, Brazeau and Athabaska Forests.

The executive head of each forest reserve is the forest supervisor. The forest supervisor is held responsible to the District Inspector and to the head office for the planning and execution of all the work which must be done in order to make the reserve accessible and safe from fire ; for the training of a staff of forest rangers, and the personal direction of the examination and survey of surface rights applied for, timber to be sold, and the handling of grazing business. When it is understood that the Forestry Branch at present, in the work of making the reserves accessible and in improving fire protection, requires supervisors to locate and build wagon roads, pack-trails, and telephone lines through swampy and mountainous country, to build ranger stations, to transact a large volume of public business, and to keep accurate records, it will be understood that the position of forest supervisor cannot be satisfactorily filled except by a man who has had a thorough training in handling men or in some executive position of a similar nature, and who possesses energy, initiative and high ideals of public service.

The forest reserves are together larger than Nova Scotia. In one inspection district alone, that in Alberta, the inspector could not cover his whole district once a year in detail if he travelled the whole time. Therefore, inspection alone cannot be relied upon to prevent a loss or misdirection of time and money in the work on the reserves. The forest supervisor, who is on the forest reserve all the time, is the one man whom the Forestry Branch can depend upon to see that every measure is being taken to prevent forest fires, that trespass is being prevented, and that the resources of the forest reserve are being administered in accordance with the terms of the Forest Reserves Act. If the loss of money and the loss of timber are to be prevented, if the whole forest reserve policy is not to be rendered farcical, the forest supervisor must be a man who will be led to do his best because of his interest in his work and not because of any fear of inspection. In case he is not such a man, he should be amenable to discipline by his inspector.

For convenience in administration each forest reserve is divided into ranger districts, varying in size according to the needs of the country from 20,000 to 500,000 acres. The forest rangers are really the fingers of the organization. The supervisor is the business manager of the forest reserve, but the forest ranger must do the work. If the forest ranger for a particular district is unable to do the work required of him, it immediately becomes necessary to neglect that district or to hire another man; to follow the first course frequently involves hundreds of thousands of dollars loss by trespass or fire, and to follow the second course involves an otherwise needless yearly expenditure of several hundred dollars for each unsatisfactory ranger.

The forest ranger who is not accustomed to life and work in the woods, who is not physically equal to hard manual labour, to travel, or to fighting fire under adverse conditions, and who is not qualified by experience and ability to manage men, to estimate timber, to do compass surveying, to locate and build trails and bridges, and who has not sufficient education to make intelligent reports is not capable of performing the duties of a forest ranger and is an impediment to the work of the Forestry Branch.

Men who have the above qualifications can be secured in every district in which Dominion Forest Reserves are located, and can be secured for the salaries now paid forest rangers. The only way in which they can be secured is by competitive examination, conducted under civil service regulations. The only way such men can be kept is by giving them permanent employment, and by making it clear that the efficient men will be promoted and that no others will.

The above principles of forest reserve organization are so well recognized that Canada is now the only country in the world which does not select forest rangers by competitive examination and promote them for efficiency.

The average supervisor in the Forestry Branch has charge of an area of over 1,000,000 acres of land. The average forest ranger has charge of over 200,000 acres of land. This land, including the young and mature timber, is worth at least ten dollars per acre. Supervisors are solely responsible for the protection and improvement of over $10,000,000 worth of government property and so long as forest rangers are the only agents upon whom they may rely to get the work done, it will be impossible to throw too many safeguards about the position of forest ranger and of forest supervisor, or to select too carefully the men chosen for the work.

The Dominion Government is lagging behind the Provinces in this respect. The Province of Quebec has established a school for the training of forest rangers. The Province of British Columbia has passed a law providing that all appointments to the Provincial Forest Branch shall be made by a civil service commission and that all appointees shall serve under civil service regulations. It has further been provided that the superior officers of the local Forest Branch shall constitute a civil service commission to appoint and govern all changes in rank, whether to a higher or a lower grade, of the employees of the Forest Branch.

Respectfully submitted,

H. R. MacMILLAN.

No. 3.

REPORT OF A. KNECHTEL.

DEPARTMENT OF THE INTERIOR,
FORESTRY BRANCH,
OTTAWA, March 31, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I have the honour to submit hereby my fourth annual report, which describes the work done on the Dominion Forest Reserves during the year ending March 31, 1912.

There were employed on the reserves four forest surpervisors, eighteen permanent rangers, twenty eight temporary rangers, who were employed only for the summer months, six forest engineers who are university graduates in forestry, and seven undergraduates in forestry, who assisted in making certain forest surveys. Labourers and fire-fighters were employed as necessities required.

FOREST FIRES.

Generally speaking the summer was rather favourable for the forest reserves in regard to fires. In the danger months of the spring the precipitation was in excess of, and the mean temperature was below, the normal. In September and October there was deficiency of rain-fall, but during August there were exceptionally heavy rains, which saturated the ground in the woods so that it remained moist during the fall months.

There were local drouths, however, during which fires occurred in several places. In western Manitoba there was a dry period in the latter part of April and the first part of May, and at this time fire broke out in the Riding Mountain, Duck Mountain and Turtle Mountain reserves.

In May and during the first part of June, there was wet weather in Saskatchewan and Alberta, but this did not extend to the Cypress Hills in the south, and fires there destroyed a large acreage of grass. Nor did the heavy rains of May extend to the northern part of the Rocky Mountains, and there a fire occurred destroying 50,000 feet of spruce timber.

The weather in Manitoba was wet in July, yet during that month four fires broke out on the Turtle Mountain reserve. This reserve is not well wooded. It is mostly covered with grass, with patches of young poplar here and there. There is a comparatively small area covered with large trees, and therefore there is little break to the wind, which in all the prairie provinces has great velocity, and a few fine days at any time during the summer cause the grass to become very dry and fires run through it easily. In the West, on any reserve not well timbered, a fire may occur even when the weather may be considered wet.

NUMBER AND LOCATION OF FIRES.

The forest rangers reported 73 fires as having occurred on the forest reserves during the year as follows: In Manitoba—Riding Mountain, 42, Duck Mountain, 10, Turtle Mountain, 16; in Saskatchewan—Cypress Hills, 3; in Alberta—Rocky Mountain Reserve, 1; in British Columbia—Tranquille Reserve, 1.

The fires in the Riding Mountains occurred in the months of April and May in the following districts: Township 18, ranges 15 and 17; township 19, ranges 16, 17 and 18; township 22, range 26; township 23, ranges 25 and 26; township 24, ranges 25, 26 and 27; and township 25, range 25.

Altogether about 136 square miles were burned over and 2,525,000 feet of saw timber was killed consisting of spruce, tamarack, jack pine and poplar. Young growth, mostly poplar, was destroyed to the extent of twenty square miles. Labour in fighting these fires cost $295.25 as wages, and $132.62 for provisions.

In the Duck Mountains the fires occurred in April and May in the following localities: Township 25, range 28; township 26, range 26; township 27, range 27; township 28, range 27; township 32, range 30; and township 33, range 29. Fourteen thousand three hundred and twenty acres were burned over, 35,000 feet of spruce were killed, and 4,500 acres of young poplar scrub were destroyed.

Besides the above mentioned fires which were on forest reserve property, a fire occurred on Timber Berth No. 986. It burned over an area of about sixteen square miles, but destroyed no merchantable timber. It began in township 26, about the line between ranges 24 and 25, and took a northeasterly course, burning a strip somewhat over a mile wide until it reached township 28, range 24, when it then took an easterly course and stopped close to the range line. Eighty-six men were employed in fighting this fire. The expense was $529 for labour and $198.25 for board.

The total cost of fighting fires during the year on the Duck Mountains was $1,265.05 in wages, $80.75 in provisions and $108.25 in board.

On the Turtle Mountain Reserve fires occurred in April in township 1, ranges 19, 21 and 22, and in July in township 1, ranges 20 and 21. About 4,000 acres of grass was burned. No saw timber was killed, but scattering young poplar which stood over the area was destroyed. The cost of fighting the fires was $45.

On the Beaver Hills Reserve in Saskatchewan a fire broke out, but was fortunately extinguished by the forest ranger before it had done any damage. Two men were prosecuted and fined $100 and costs.

The Cypress Hills in Alberta had three fires on the following areas: Township 8, range 24, west of the 3rd meridian; township 7, range 1, west of the 4th meridian; and township 7, range 8, west of the 4th meridian; 15,740 acres of grass were burned. One man was prosecuted and fined $25 and costs for carelessness in leaving a camp fire unextinguished. The cost of fighting the fires was $63.

On the Rocky Mountains Reserve a fire broke out one and a half miles south of Prairie Creek in township 50, range 25, west of the 5th meridian. It covered twenty acres and destroyed 50,000 feet of spruce timber. The ranger extinguished this fire without extra help.

Only one fire is reported from the reserves of British Columbia. On the Tranquille Reserve a small fire broke out but was extinguished before it had caused any destruction of timber. The cost was $78.50 for wages and $17.10 for provisions.

EFFECT OF FIRES.

Fire running through young growth almost invariably kills it. Trees about six inches in diameter at the stump are usually killed, if there is much grass or shrubbery among them, or if they stand close together. They are always killed, as are also much larger trees, if there is much heavy, dry material on the ground. Otherwise, trees twelve inches and over, if they belong to thick-barked species such as pine and spruce, frequently escape a ground-fire.

In travelling last summer over the Long Lake and Hat Creek Reserves in British Columbia, I observed that such thick-barked species as Douglas fir and bull pine had their bases much blackened by repeated fires; but they were still alive and their foliage was of a healthy colour. There was an absence of trees of pole-wood size; but the ground was in many places covered with a fine growth of young reproduction material. This is evidently repeatedly damaged by fire before it reaches the dimensions of pole-wood.

In the Dominion forest reserves fires run usually on the ground. Crown-fires are by no means frequent. However, a crown-fire sometimes gets started in the foliage of young jack pine and spruce standing close together and causes much damage. Some large areas of fine young lodgepole pine in the Rocky Mountains were thus destroyed in 1910.

With repeated fires running through the forest, only trees with strong advantages can survive. Spruce is rather weak. Conifers are reproduced only from seed, and spruce does not bear every year. Besides, the species does not seed early in the life of the tree. Fire makes a good seed-bed, but if it occurs in a year when spruce is not throwing seed, the good bed is of no avail. In the following year the ground will be grown over with grass and various kinds of shrubs. Trees left alive by the fire may then throw seed, but this, falling among grass, leaves and shrubs, is likely to perish. Fire going through spruce woods, therefore, often destroys it so that the ground is not again covered with the same species.

Jack pine and lodgepole pine have advantages which permit them to hold possession of the soil for a much longer period than spruce. They bear seed early. The cones remain on the trees for a long time, sometimes ten years, without shedding the seed, which retains its vitality. A fire going through the woods may kill every tree, but it makes a good seed-bed and opens the cones, and soon the ground becomes covered with a growth of young pines so dense that one can penetrate the thicket only with great difficulty. On account of these advantages the jack pine in Northern Ontario and the lodgepole pine in the Rocky mountains have taken possession of very large areas formerly occupied by spruces, firs and other pines.

Poplars and white birch trees have some strong advantages over the evergreens. They seed oftener. The seeds germinate and grow freely, while the evergreens require a good seed-bed. But the greatest advantage they have is that they reproduce from

the root. Therefore, if poplar and white birch get full possession of the ground they are likely to hold it. They have a great disadvantage, however. They are very subject to attack by fungi. This is especially true of the poplar. Therefore, if an even mixture of these and evergreens gets started, the evergreens are likely to persist, and by throwing much shade give good conditions for the fungi to attack the broad-leaved trees. Under such circumstances the mixture is likely to become gradually more evergreen.

RANGERS' PATROLS.

The rangers' duties necessitate that they should do much travelling. Besides superintending development work on the reserves, as described in this report, they moved about on the lookout for fires and trespass. In the spring of 1911, they also granted requisitions for timber to be taken from the reserves and for this purpose they met the settlers at appointed places. During the year the average distance travelled in the discharge of such duties was 3,489 miles per ranger.

FIRE NOTICES POSTED.

During the year, fire notices were posted on the forest reserves as follows: Riding Mountain, 575; Duck Mountain, 719; Porcupine, 44; Spruce Woods, 19; Turtle Mountain, 120; Moose Mountain, 11; Beaver Hills, 290; Cooking Lake, 54; Rocky Mountain, 593; Long Lake, 43. Total, 2,468.

BURNED GUARDS.

During the spring of 1911, one hundred and twenty nine miles of fire-guard were made along the boundaries of the reserves by burning out the sloughs, as follows: Along the Riding Mountain Reserve, 8 miles; Duck Mountain, 12 miles; Porcupine, 84 miles; Beaver Hills, 18 miles; Pines Reserve, 7 miles. The cost of burning was $50.

PLOUGHED GUARDS.

One hundred and eighty eight and one quarter miles of ploughed guard were made along the boundaries of the forest reserves at an average cost of $11.10 per mile, the average width being 11·5 feet as indicated in the following table:—

TABLE OF PLOUGHED GUARDS.

Name of Reserve.	Miles of Guard.	Width in Feet.	Cost.
			$ cts.
Riding Mountain	36¾	10	802 20
Spruce Woods	32	16	359 30
Beaver Hills	16½	8	172 50
Cypress Hills	83	10	617 00
Cooking Lake	13	20	65 00
Rocky Mountains	7	10	63 75
Totals	188¼	Avg. 11½	2,079 75

TRAILS.

Eight hundred and fifty nine miles of trail were made on the reserves during the summer of 1911 as follows: Riding Mountain, 14½ miles; Duck Mountain, 4; Porcu-

pine Mountain, 63; Moose Mountain, 21; Beaver Hills, 15; the Pines, 28; Cooking Lake, 20; Rocky Mountains, 688½; Long Lake, 5. Trail-making consisted mostly in cleaning out old trails, which in many places was equivalent to making them new, as so many trees had fallen across them and so much brush had grown up. These trails facilitate patrol by the rangers and are therefore a means of guarding the forest against fire and trespass. The cost of cleaning out old trails was $1,825.45, of making new, $224.08.

ROADS.

Ninety nine and one-half miles of wagon road were made through the following reserves: Riding Mountain, 10 miles; Duck Mountain, 10; Moose Mountain, 8; Beaver Hills, 9½; The Pines, 17; Cooking Lake, 1½; Rocky Mountains, 43½. The average width is about 10 feet. On the Moose Mountain, 1,607 yards of grading was done, and on the Rocky Mountains Reserve, 210 yards. Sixteen small bridges were constructed and 92 culverts. The money spent was $2,923.32.

BOUNDARIES LOCATED.

Four hundred and seventy four and one quarter miles of boundary line of the reserves were located by the forest rangers. On the Riding Mountain, 122¼ miles; Duck Mountain, 48; Porcupine, 7; Turtle Mountain, 6; Moose Mountain, 1½; The Pines, 42; Cooking Lake, 9; Rocky Mountains, 236½; Long Lake, 2. These lines had been surveyed previously, but many stakes were missing and mounds destroyed.

Triangular reserve stakes marking the boundaries were driven as follows: Riding Mountain, 47, Duck Mountain, 26, Spruce Woods, 10, Turtle Mountain, 11, The Pines, 14; total, 108.

BOUNDARY LINES CUT OUT.

During the year the rangers cut out 76½ miles, 16 feet wide; 11 miles, 12 feet wide; 11 miles, 9 feet wide; and 34¼ miles, 8 feet wide. A ploughed guard ten feet wide was put along 36¾ miles of the 16-foot line. The cutting was distributed on the reserves as follows:—Riding Mountain, 41½ miles, 16 feet wide and 11 miles, 9 feet wide; Duck Mountain, 23 miles, 16 feet wide and 32 miles, 8 feet wide; Spruce Woods, 6 miles, 16 feet wide; Turtle Mountain, 8 miles, 12 feet wide; The Pines, 3 miles, 12 feet wide; Cooking Lake, 6 miles, 16 feet wide; Rocky Mountains, 2¼ miles, 8 feet wide. This gives a total length of 132¾ miles with average width 12·2 feet. The cost was $4,534.25, or $34.16 per mile 12·2 feet wide.

BUILDINGS.

During the summer of 1911 eighteen cabins were built on the reserves for forest rangers. These were erected by the rangers themselves, sixteen on the Rocky Mountains Reserve, one on the Duck Mountain Reserve, and one on the Cooking Lake Reserve. They are made of logs, each 14 feet by 16 feet floor measurement, and have walls 8 feet high. There is a good board floor and board roof, the latter covered with progress sheathing.

There are two cabins, however, so far removed from lumber that the ranger was obliged to hew all the material for the floors and roof. These are in the Rocky Mountains Reserve, in a northerly district which lies between the Clearwater and White Goat rivers.

Each cabin contains a stove with cooking utensils, a table, bed, tent, and tools for fighting fire.

In the Rocky Mountains, the cabins are located as nearly as possible thirty miles apart, which is a good day's journey in that mountainous country. Each ranger can, therefore, manage to pass the night with another either north or south of his district.

The cost of erecting these buildings was as follows:—Lumber, $432.76; plaster and paint, $195; labour, $477.97; equipment, $1,367.52; teaming, $417.25. Total, $2,890.50. The average cost per cabin with equipment was $149.86.

A forest ranger's house was repaired in the Riding Mountains, the cost being $295.84. In 1910, the southwest quarter of section 3, township 19, range 18, west of the principal meridian, which lay adjacent to the Riding Mountain Reserve was purchased as a ranger's headquarters. The house, however, was in rather bad condition, but these repairs have made it quite comfortable.

Two houses on the Cypress Hills have, since last spring, been occupied by forest rangers. These formerly belonged to settlers who, with a number of others, were removed from the reserve, the department allowing them recompense for their holdings. So there are now twenty-one buildings on the reserves inhabited by forest rangers.

THE SAWMILLS.

Previous to the winter of 1911 sawmills were not permitted to locate on the forest reserves. My report of 1909 recommended that portable mills should be allowed to enter under certain restrictions stated therein. In the fall of 1910 the department made an attempt to carry the recommendation into effect. The form of contract, however, though allowing a millman to place his mill inside the reserve, did not allow him to do his logging or run his mill before he had received permits from the settlers. As settlers do not, as a rule, apply for permits before February, the mill would have to stand idle until that month. Hence the millmen rejected the contract.

In the fall of 1911, mills were permitted to enter the Riding Mountain Reserve for the purpose of cutting timber that had been killed by fire in the preceding spring. There were about 900 acres in all, in 6 parcels, in township 19, ranges 17 and 18, west of the principal meridian, containing timber estimated at 1,870,000 feet, board measure. The timber was disposed of by tender at an upset price of $2 per thousand feet, and this was about the price bid for it. It was put up in ten lots and disposed of to four purchasers, who were allowed to place their mills within the boundaries of the reserve. No restrictions were placed upon the sale of the lumber.

A sawmill was admitted, also, to cut green spruce on the northwest quarter of section 16, township 22, range 21 west of the principal meridian. This mill is allowed to dispose of lumber only on settlers' permits, but it was permitted to log and saw a quantity of timber not exceeding 100,000 feet board measure in advance of the receipts of permits. This allows the millman to do some of his logging and sawing in early winter.

The privilege to locate this mill was put up by tender, and was disposed of for $50, the successful bidder agreeing to saw spruce, pine, tamarack and balsam fir for $9 per thousand feet, poplar for $10, and other species for $9. As the settler pays for his permit $1.50 per thousand for poplar, and $3 for other species, this, with the millman's charges for logging and sawing, allows the settler his lumber at $11.50 for poplar and $12 for other species—pine, spruce, tamarack and balsam fir.

The mill is under supervision by the department and the logging and sawing are carried on according to approved forestry methods.

A mill in the Cypress Hills Reserve, in Alberta, has been under forestry regulation for three years. I visited this mill in July and found the work being well done.

Only such trees as had been previously marked by the Forestry Branch were being cut; they were being cut down with a saw; stumps were being cut low; tops were being taken out of the woods; the brush was being piled and burned; and altogether the operation was satisfactory. The millman informed me that he was suited with the regulations.

A sawmill was operated also in the Rocky Mountain Reserve under forestry regulations. This was located in Section 28, Township 8, Range 4, west of the 5th

meridian. On July 27, 1911, I inspected this milling operation. Although the stumps were not being cut as low as the regulation required, altogether the operation was an improvement upon the old way of lumbering.

LICENSE BERTHS.

The license berths operated on the forest reserves yield to the Department an annual ground-rent of five dollars per square mile, except for lands situated west of Yale in the province of British Columbia, in which case the yearly ground rent is five cents per acre. The dues on timber cut are: sawn lumber, 50 cents per thousand feet, board measure; railway ties 8 feet long, 1½ cents each, 9 feet long, 1¾ cents; shingle bolts, 25 cents per cord; 5 per cent on the sale of all other products excepting slabs and sawdust on which there is no royalty. The following table gives a statement of these berths:—

LICENSE BERTHS.

Reserve.	Province.	Number of Berths.	Area.	Lumber.	Laths.	Royalty.
			Sq. Miles.	Ft. B. M.		$ cts.
Duck Mountain	Manitoba	14	152·66	11,448,804		5,742 36
Riding Mountain	"	6	43·75	342,482		49 64
Rocky Mountain	Alberta	32	692 50	11,864,017	815,700	5,151 69
Long Lake	British Columbia	1 pt.	38·50			
Totals		53	927·41	23,655,303	815,700	10,943 69

SAWMILL PERMITS.

In the province of Alberta, permits were granted to cut timber over a definitely described tract not exceeding one square mile on payment of a fee at the rate of $100 per square mile for each permit, a permit being good for one year from date of issue and renewable only once. The royalty dues are the same as those of license berths.

The Rocky Mountain Forest Reserve contains six of these berths, having a total area of 6·87 square miles. From these berths there were cut, during the year, a total of 1,412,667 feet, board measure, of lumber, the royalty from which amounted to $685.74.

SETTLERS' PERMITS.

The following tables give statement regarding the settlers' permits issued on the reserves during the year:—

MANITOBA AGENCIES.

Reserve.	No. of permits.	Lumber.	Logs.	Cord-wood.	Fence posts.	Fence rails.	Roof poles.	Receipts.
Dauphin Agency.		Ft. B.M.	Lineal ft.	Cords.	No.	No.	No.	$ cts.
Riding Mountain	780	3,756,613	15,590	4,500	17,550	17,320	8,000	2,176 90
Duck Mountain	296	1,484,523	13,530	820	18,150	5,200	10,400	875 97
Brandon Agency.								
Riding Mountain	5	38,000		15				115 25
Turtle Mountain	73	23,000	2,064	1,003	500			105 64
Spruce Woods	108	5,000	1,700	1,834	700		550	131 75
Total	1,262	5,307,136	32,884	8,172	36,900	22,520	18,950	3,405 51

Saskatchewan Agencies.

Reserve.	No. of permits.	Lumber.	Logs.	Cord-wood.	Fence posts.	Fence rails.	Roof poles.	Receipts.
Yorkton Agency.		Ft. B.M.	Lineal ft.	Cords.	No.	No.	No.	$ cts.
Duck Mountain	27	107,070	5,300	20	600	.....	.....	21 75
Beaver Hills	35	.....	3,000	378	.....	.....	.....	12 25
Estevan Agency.								
Moose Mountain	84	.....	8?0	1,259	750	900	1,050	121 10
Moose Mountain	2	.....	.....	14	.....	.....	.....	4 00
[1]*Prince Albert*	.....	.....	.....	.....	.....	.....	.....	.....
Total	148	107,070	9,120	1,671	1,350	900	1,050	159 10

[1] Not reported.

Alberta Agencies.

Reserve.	No. of permits.	Lumber.	Logs.	Cord-wood.	Fence posts.	Fence rails.	Roof poles.	Receipts.
Edmonton Agency.		Ft. B.M.	Lineal ft.	Cords.	No.	No.	No.	$ cts.
Cooking Lake	20	18,500	14,750	120	2,820	8,200	1,900	15 00
Lethbridge Agency.								
Rocky Mountain	14	.....	11,500	85	1,700	3,900	1,850	23 50
Medicine Hat Agency.								
Cypress Hills	308	.....	423,665	4,908	75,500	160,995	61,558	90 00
Total	342	18,500	449,915	5,113	80,020	173,095	65,308	128 50

Summary of Settlers' Permits.

Reserve.	No. of permits.	Lumber.	Logs.	Cord-wood.	Fence posts.	Fence rails.	Roof poles.	Receipts.
		Ft. B.M.	Lineal ft.	Cords.	No.	No.	No.	$ cts.
Manitoba Agencies	1,262	5,307,136	32,884	8,172	36,900	22,520	18,950	3,405 51
Saskatchewan Agencies	148	107,070	8,120	1,671	1,350	900	1,050	159 10
Alberta Agencies	342	18,500	449,915	5,113	80,020	173,095	65,308	128 50
Total	1,752	5,432,706	491,919	14,956	118,270	196,515	85,308	3,693 11

TOTAL OUTPUT OF THE DOMINION FOREST RESERVES.

—	Lumber.	Lath.	Logs.	Cord-wood.	Fence posts.	Fence rails.	Roof poles.	Receipts.
	Ft. B. M.	Pieces.	Lineal ft.	Cords.	No.	No.	No.	$ cts.
License Berths	23,655,303	815,700						10,943 69
Sawmill Permits	1,412,667							685 74
Settlers' Permits	5,432,706		491,919	14,956	118,270	196,515	85,308	3,693 11
	30,500,676	815,700	491,919	14,956	118,270	196,515	85,308	15,322 54

TIMBER SEIZURES.

The following table shows the timber seizures made by the forest rangers during the year:—

Reserve.	No. of Seizures.	Lumber.	Logs.	Cord-wood.	Fence posts.	Fence rails.	Roof poles.	Dues.
		Ft. B. M.	Lineal ft.	Cords.	Pieces.	Pieces.	Pieces.	$ cts.
Riding Mountain	33	431,976	500	173	1,970		420	3,037 00
Duck Mountain	11	112,783	1,504			9		759 63
Spruce Woods	2		26	17	500			148 00
Beaver Hills	7		1,880	5				13 00
Cooking Lake	1		560					10 00
Rocky Mountain	1			10				5 00
Total	55	544,759	5,470	205	2,470	9	420	3,972 63

HAY PERMITS ISSUED.

The following table shows the number of hay permits issued on the various reserves:—

Reserve.	No. of Permits.	Tons Cut.	Revenue.
			$ cts.
Riding Mountain	50	750	100 00
Turtle Mountain	33	615	77 00
Spruce Woods	15	260	33 50
Beaver Hills	8	104	14 40
Moose Mountain	26	660	79 00
Cooking Lake	15	2 8	170 25
Cypress Hills	48	1,848	162 00
Total	195	4,535	636 15

FOREST SURVEYS.

A forest survey of the Porcupine Hills in southern Alberta was made by Forest Engineer E. G. McDougall with a party of three forest assistants. The object of the survey was to determine what lands should be set aside as a forest reserve. Attention was given, therefore, chiefly to the location of a boundary line, although a cursory

description was made of the interior. As a result Mr. McDougall recommended that the reserve should consist of 198½ square miles. The fifth meridian line runs through this territory, 53 square miles lying east of that line and 145½ miles on the west side. The most southerly boundary is located two miles south, in township 9, and the most northerly, five miles north in township 13.

Sixteen quarter-sections are described as homestead sales and patents, and four as irrigation lands. Thirty-seven and one-quarter square miles are in grazing leases. Six square miles are otherwise disposed of. The cost of this survey was $2,021.82.

Mr. W. J. Van Dusen, of the Forestry School of the University of Toronto, supported by three forestry undergraduates, made a survey of a tract of land adjacent to the Porcupine Reserve in Manitoba with the object of determining what portions should be added to the reserve. Mr. Van Dusen's report recommends the addition of 428½ square miles of land which is wooded with jack pine, and is of no agricultural value. This area is a semi-circular strip touching the Canadian Northern Railroad at

Photo W. J. Vandusen, 1911.

Porcupine Forest Reserve: Pack Train passing through a Grove of Jack Pine.

twelve points, the arms reaching the boundary between Manitoba and Saskatchewan, the arm at the north extending into Saskatchewan three-fourths of a mile. The survey cost $2,055.58.

GRAZING.

An area of 45¾ square miles, consisting of all of township 1, range 21, and part of township 1, range 22, in the Turtle Mountain reserve, was, in the summer of 1911, fenced for grazing. This is an admirable tract for such purpose, being well watered, and covered with a dense growth of long grass and pea-vine. It is not good farming land, as it consists of heavy clay, and has an elevation of about 2,500 feet above sea-level.

Throughout the area young poplars have sprung up, but these have not been allowed to grow to large size on account of fires which have run over the ground every

two or three years. Fires have been facilitated by the long grass, and these have not been confined to this area, but have extended and destroyed much large timber. It was thought advisable, therefore, to encourage grazing and for this purpose the fence was constructed.

The fence has a length of 19¼ miles. It has four strands of heavily galvanized hard steel number 9 wire. The bottom wire is strung fifteen inches above the ground, and the wires are placed eleven inches apart with upright or stay wires 22 inches apart. At every eighty rods there is a steel post, and the fence is strongly braced at a distance of every forty rods, the braces being round oak 9½ feet long. There are 6,000 fence posts. They are of oak and willow six feet long and not less than three inches at the small end. Anchor posts are of oak, six inches at the top and eight feet long.

The total cost of constructing the fence was $3,344.52, of which $54.40 was paid for advertising; $600 for wooden posts; $40 for iron posts; $239.28 for anchor posts and bracing timber; and $2,410.84 for wire and labour.

As regards grazing regulations:—

The number of stock which may be grazed upon the said tract and the period during which grazing will be permitted shall be determined each year by the Director of Forestry.

Subject to the approval of the Director of Forestry, the forest ranger or other officer in charge of the reserve shall fix a date before which all applications for grazing permits shall be submitted, and any applications received after the date fixed shall be entitled to consideration only after the applications received prior to such date have been satisfied or disposed of. Due notice of the date fixed shall be given at least thirty days before such date by advertisement in a newspaper circulating in the district.

Applications for grazing permits must be made on the form prescribed for that purpose and must give a sufficient description for identification of the stock, including the marks and brands when there are such.

Bona fide residents in the vicinity of the reserve will be given preference in the granting of permits.

The number of stock to be grazed and the period of grazing is to be determined each year in advance by the Director of Forestry.

A date is fixed each year before which applications for grazing are received. Thirty days notice is advertised.

Marks and brands of stock must be given in application forms.

Dues are twenty five cents per head per month or one dollar for the season payable in advance, only stock six months old or over being counted.

Permits are granted only for the exclusive use of the owners of stock and are not transferable.

Any stock removed before the expiration of the permit may be replaced by other stock, to an equal number, which are owned by the permittee.

Permittees must remove their stock within seven days after the expiration of the permit.

Permittees must salt their stock regularly and must remove the carcasses of animals which die.

The Department does not hold itself responsible for damage caused by stock escaping from the enclosure.

If grazing interferes with the production of wood the Minister of the Interior may order grazing to cease.

Permittees are required to aid in extinguishing fires in the tract within which permits are granted.

There are excellent large grazing areas in the Riding Mountain, Beaver Hills, and Rocky Mountains Forest Reserves, but unlike the Turtle Mountains, settlers in the vicinity are not numerous. Hence the necessity for fencing grazing areas on these other reserves is not very apparent. Possibly on the Porcupine Hills of Alberta this might be practicable as they are now occupied by a large number of ranchers.

Grazing on all such areas should, however, be governed by the Department in such way that each permittee would be assured of having sufficient grass for his stock. On the Porcupine Hills, some arrangement should be made whereby each permittee should have the privilege of grazing a definite area. A settler, for instance, whose property adjoins the forest reserve should have the exclusive privilege of grazing a definite area close to his home. Otherwise a rancher with a large number of cattle might herd his stock upon the tract and compel the settler to graze his stock at some distant place.

HAY.

The Cypress Hills Reserve consists of two distinct portions, the larger extending from the western side of Township 8, Range 3, west of the fourth meridian, eastwardly to the eastern side of Range 29, west of the third meridian, the average width being five miles. A smaller portion lies eleven miles distant in an easterly direction and has a length of seven miles and a width of five miles. This smaller portion should have a distinctive name. It might be called, for instance, the Maple Creek Reserve, as it lies due south of Maple Creek Station. The smaller area is quite well timbered, but the larger tract is mostly denuded, the greater proportion of it consisting of hay land.

This reserve lies in a wide stretch of country, formerly occupied for ranching, but now broken up by settlers who are trying to farm it. The region has an annual precipitation of less than ten inches, which is not sufficient for successful farming. Ordinarily it does not produce grass enough for the settlers' stock. Therefore, every summer large quantities of hay are cut on the reserve and hauled down to the farms. In 1910, many settlers who fed their stock with this hay would, without it, have been obliged to sell them at a sacrifice.

It seems to me that this hay land should be left as such. The area should not be broken up in an attempt at reforestation. The requisitions and permits for hay should, however, be managed differently. The regulations now allow requisition to be made at any time after the first day of January, and permits may be granted at any time after the first day of April, though the cutting of hay is not permitted before the twenty-fifth day of July. On April 1, there is no indication as to how much hay a given area will produce during the summer, and it would seem that the first of June would be early enough for the applications to be received, and the first of July for the permits to be granted.

REFORESTING.

To obtain seed for reforesting purposes and for the Nursery Station at Indian Head, Saskatchewan, the forest rangers collected cones as follows:

In June, jack pine on the Pines Reserve and lodgepole pine on the Cypress Hills; in July, white spruce on the Pines and Spruce Woods reserves and jack pine on the Riding Mountains; in August, spruce cones on the Spruce Woods, Riding Mountain and Duck Mountain; and in September, tamarack on the Porcupine Reserve in Manitoba and bull pine on the Monte Hills in British Columbia. The jack pine and lodgepole pine cones were those of the previous year. All others were cones of 1911.

It will be observed that cones mature earlier in the prairie provinces than in the East. In Manitoba and Saskatchewan spruce cones are collected in July. In Ontario and Quebec they are obtained in September, in some years even during the latter end of the month.

The cones were nearly all shipped to the Nursery Station at Indian Head, where the seed was extracted by Mr. Norman M. Ross. His report states that the freight on the cones cost $177.33, and labour $132.22. However, Mr. J. D. Kirkwood extracted the seed on the Spruce Woods Reserve from 60 bushels of cones collected there.

The following is a summary of the cones and seed collected during the season with the cost of the same:—

Species.	Bushels of Cones.	Cost of Cones.	Cost per Bushel.	Pounds of seed.	Cost per Pound.
		$ cts.	$ cts.		$ cts.
Jack pine	186·5	267 95	1·437	47	6 70
Lodgepole Pine	100·0	90 40	0·904	28	4 23
Bull Pine	38·0	15 00	0·394	33	1 45
White Spruce	193·0	254 85	1·31	177	2 44
Tamarack	24·0	77 00	3·21	5	16 40
Total	541·5	705 20	[1]	290	[2]

[1] Average cost per bushel 91·45 cents. [2] Average cost per lb. $6·24.

The cost of seed per pound is almost as much as if it had been purchased in the market. The following prices per pound were taken from the catalogue of Thos. Meehan & Sons for 1911-12:—Jackpine, $5.50; lodgepole pine, $6; bull pine, $2.25; white spruce, $3.25; tamarack, not quoted.

In the prairie provinces, cones yield a small quantity of seed as compared with the eastern provinces and eastern states, and this is a cause of increased cost. In New York State, a bushel of green spruce cones will yield 1½ pounds of seed, while spruce collected last summer in Manitoba and Saskatchewan yielded little more than nine-tenths of a pound per bushel. It will be observed from the table above that 24 bushels of tamarack cones yielded only 5 pounds of seed.

The freight, too, being $177.33 and the quantity of seed being 290 lbs., 61 cents of the cost per pound represents freight.

Seeds of each species were sent to Mr. George H. Clark, seed commissioner, of Ottawa, who tested them for germination. The conditions in the test were arranged somewhat similarly to those which the seeds would have in a nursery bed, but much more favourably. The seeds were placed in sand a short distance below the surface. The moisture was kept uniform. The temperature was between 20 and 30 degrees centigrade (68 and 86 degrees Fahrenheit). After 16 days the germination was as follows:

Jack pine, 48 per cent; lodgepole pine, 45 per cent; bull pine, 39 per cent; white spruce, 33 per cent and tamarack, 31 per cent.

Last spring the ranger on the Spruce Woods Reserve made five nursery beds near Onah station as follows: Jack pine, 1; lodgepole pine, 2; bull pine, 1; European larch, 1, and Douglas fir, 1. At Shilo station he also made ten beds as follows: Lodgepole pine, 4; bull pine, 4; black spruce, 1; Douglas fir, 1. He sowed also 173 rows of bull pine with the garden seeder.

The beds are each 4 feet by 12 feet. They are boxed, covered with screens to keep out the birds and lath screens for shade. They were kept clean of weeds and were watered during dry spells from a well dug last summer on the nursery.

The rows of bull pine are twelve feet long and are spaced one foot apart. The ground for them was well prepared. They were kept weeded, but were not watered.

On July 1, the nursery was placed under charge of Mr. J. D. Kirkwood, who took care of it for the remainder of the year. Last fall the beds of pine were in excellent condition. There had been very little loss during the summer. Some beds began to 'damp off,' but the trouble was promptly checked by Mr. Kirkwood, who sprinkled dry wood ashes over them. The spruce was also good, but the Douglas fir and European larch had not germinated. These seeds may come through this spring.

On the Cooking Lake Reserve an acre of ground was ploughed with furrows placed about four feet apart, the soil being turned to the north side. These were sown alternately with the seed of bull pine and lodgepole pine. The seed was placed close in to the sharp angle of the furrow. This seeding was quite satisfactory, the little trees standing thick along the furrows excepting in very low places, where, as the season

was very wet, the trees were drowned out. This reserve is excellent ground for reforesting, and it may be possible to put evergreens upon it in this way. This, however, can be determined only by trial through three or four years.

The forester also hacked up twelve spots four feet wide by eight feet long among poplar trees. Six were sown with bull pine and six with lodgepole pine seed. The bull pine came well on high land but was poor on wet ground. The lodgepole pine was good.

A nursery made on the Cooking Lake Reserve was rather a failure owing to the soil being acid. Ash and European larch seed germinated and grew through the season, but spruce and pine seed did not germinate.

On the Moose Mountain Reserve nursery beds were made as follows: one bed of bull pine sown in rows; two beds of lodgepole pine and one bed of spruce, sown broadcast. The bull pine and spruce sowing resulted quite well. One bed of lodgepole pine was good and the other hardly fair.

On the Riding Mountain Reserve a seed-bed did not result successfully, but some seed sown with the garden seeder turned out quite well.

The total cost of nursery work was $1,583.05.

SUMMER RESORTS.

During the summer of 1910, a pleasure resort was located on the shore of Arbor Island in Lake Max, Turtle Mountain Reserve, and last summer 41 lots were surveyed under the direction of the Surveyor General. A shore allowance was left 66 feet wide. Streets were also made of a width of 66 feet. Lots were as nearly as possible laid off with a frontage towards the water of 100 feet and a depth of 150 feet. A lane was added at the rear of the lots.

Arbor Island is an excellent one as a summer resort, being densely wooded with oak, ash, birch and poplar. Eight families had, previous to the survey, erected cottages upon it. Previous to the occupancy of the island as a summer resort there was no fishing in the lake, but three years ago pike were transferred from Lake Oscar which lies a short distance from Lake Max.

On the shore of Fish Lake in the Moose Mountain Reserve a resort was laid off in three portions, on Arcola Bay, Sandy Beach and Moose Bay, respectively. The one on Arcola Bay is the largest, consisting of 65 lots. Along the shore is a road allowance of 66 feet or more, called Arcola Avenue. Parallel with this and back from it about 150 feet runs Arbor Avenue, also 66 feet wide. Still 150 feet further back runs a lane 20 feet wide parallel with the avenues. Extending from the lane to the shore are six cross streets 66 feet wide named after trees: Elm, Birch, Aspen, Ash, Maple. The lots are about 50 feet wide by 150 feet deep.

The Sandy Beach portion is laid off in 30 lots adjoining Sandy Beach Avenue, which is 66 feet wide and runs along the shore. There is just one row of lots, at the rear of which runs a lane. Five cross streets are named after various species of fish —Jackfish, Pickerel, Pike, Minnow, Bass.

Moose Bay portion consists of 42 lots in two rows. Moose Avenue runs along the shore, Elk Avenue behind the first row of lots, and a lane behind the second row. Three cross streets are called Beaver, Mink and Porcupine.

On the Moose Mountain Reserve are more than one hundred lakes and ponds of which Fish Lake is the largest. It has a length of about three miles and a width of about two miles. The outline is much broken and the shores are well wooded with poplar. Pike and pickerel abound in its waters. Good roads lead to it from Carlyle and Arcola. The shore has been used as a tenting ground by pleasure seekers for several years.

Respectfully submitted,

A. KNECHTEL,
Inspector of Forest Reserves.

No. 4.

REPORT OF N. M. ROSS.

DEPARTMENT OF THE INTERIOR,
FOREST NURSERY STATION,
INDIAN HEAD, SASKATCHEWAN, March 31, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I have the honour to submit herewith my twelfth annual report, dating from March 31, 1911.

Throughout the three prairie provinces the weather conditions during the past season have been exceptionally favourable to the work of the Tree Planting Division. With the exception of a comparatively small portion in Southern Manitoba, the precipitation throughout the West was above the average. In all districts, with the exception of part of Southern Manitoba—which suffered again from drought,—the plantations, especially those newly set out, have, from the inspectors' reports, done exceptionally well. The season of 1910, it will be remembered, was a very trying one, nearly all districts suffering badly from lack of rain, and, as a consequence, trees set out in that season made practically no growth and the percentage of failures was high. These plantations, however, all came along splendidly last summer; the snowfall last winter (1910-11) was extremely heavy, providing ample moisture for all spring planting, while during and immediately after the planting season frequent rains and cool weather produced ideal conditions. Although the fall was exceptionally wet, for some reason active growth did not continue too late, and there appears to have been no damage caused by freezing of immature growth. The soil throughout the West generally was well soaked with moisture at the time of freezing up. It is fortunate that this was the case as the snowfall during the winter has, as a general thing, been very scant, exposing large bare surfaces from which a great deal of moisture must have evaporated. We do not anticipate any abnormal damage from winter-killing as a consequence of the light snowfall, except perhaps in the case of half-hardy stock.

On the Nursery Station growth both in the nursery plots and in the various plantations was exceptionally good. The transplanting operations with seedling conifers were, this year, particularly successful.

At the end of March, 1911, Mr. Arch. Mitchell, who had been connected with the Tree Planting Division for several years, first as Tree Planting Inspector and later as Assistant in the Tree Planting Division, resigned his position. Mr. Mitchell is probably more familiar with general conditions affecting tree-culture in Alberta than any other person, and, as these conditions are particularly trying and of peculiar local character, his resignation will be particularly felt in connection with our work in that province.

Mr. S. S. Sadler, a graduate of the University of Toronto Forest School, was appointed a month or so later to fill the position left vacant by Mr. Mitchell's resignation.

INSPECTION WORK.

During the summer months, inspection work was undertaken by the following members of the staff: Messrs. S. S. Sadler, A. P. Stevenson, John Caldwell, Angus Mackintosh, W. Guiton, Jas. Kay, Jas. N. B. McDonald, Wm. Macdonald, Jas. Cowie and Geo. Kennedy. The reports of these inspectors are appended herewith.

The following table gives a comparative statement, for the past three years, of the number of trees distributed and the number of applicants:—

—	1910.	1911.	1912.
Number of applicants on inspectors' books	8,318	8,036	7,375
Number of applicants to receive trees	3,173	3,285	3,618
Number of trees distributed	2,533,600	2,636,100	2,729,135
Number of new applicants	3,832	2,656	1,649

From this table it will be seen that, though the number of new applicants is decreasing, the number of settlers supplied with trees is increasing and the number of trees sent out is also slightly increasing. Settlers are becoming more familiar with the regulations governing our distribution and are realizing that their ground must be in a certain condition before trees will be granted. Therefore, a very much smaller percentage of applications is received now from those not having soil properly prepared than has been the case in past seasons. Undoubtedly, too, more applications would have been received had the conditions of the past season been more favourable for farming operations.

OFFICE WORK.

The table given below summarizes the work done in the Indian Head office of the Branch:—

—	April 1, 1910 to Mar. 31, 1911.	April 1, 1911 to Mar. 31, 1912.
Number of planting plans prepared	2,778	3,004
Number of pieces of mail received	14,492	12,249
Number of pieces of mail sent out	[1] 19,402	[1] 20,382
Number of new files added	3,969	2,696

[1] This does not include bulletins, these being sent out from the office at Ottawa.

This table shows work handled in the office during the past two seasons. It will be noted that there has been a falling off in the number of pieces of mail received, and, naturally, a corresponding decrease in the number of new files added. This, we think, is not due to any lack of interest in the work but to two causes, viz.: the exceptionally unfortunate conditions affecting farm operations during the latter part of the season, and the fact that the usual advertisements and posters calling attention to the free distribution were not published until very late and the agricultural papers were not used as freely for advertising purposes as in past seasons.

The position in which a majority of western farmers are placed, owing to the late harvest and unfavourable threshing season, followed by extreme difficulties in marketing their crops, has undoubtedly had its effect in reducing the number of new applications. The average farmer has, this spring, more than the usual amount of work to overtake, and in many cases financial considerations due to the loss of crop or low-grade grain make it almost impossible to devote time or money to tree planting this season.

EXHIBITS.

As in past seasons exhibits were made at the summer fairs held at Calgary and Brandon, the inside exhibits being supplemented by small plots planted to show varieties best adapted to the local conditions and simple nursery operations suitable to farm requirements.

LECTURES.

Mr. A. P. Stevenson attended a number of Farmers' Meetings in Saskatchewan during the months of January and February, delivering lectures on the work of the Tree Planting Division and tree-culture generally. I personally attended meetings at Gull Lake, Wolseley and Winnipeg.

NURSERY WORK.

For general nursery work at this point conditions on the whole have been particularly favourable. The growth of all stock was strong and slightly above the average. Our acreage to maple was considerably smaller than usual, but, as it was absolutely impossible to obtain seed of this species, this was unavoidable. The crop of ash seedlings (two years old) is very small as compared with the acreage. The reason for this, as mentioned on page 95 of last year's report, is the very severe frosts which occurred late in the spring of 1910. These frosts destroyed at least fifty per cent of the freshly germinated seedlings.

The worst feature of the past season in relation to the nursery work was the exceptionally early freeze-up. It was impossible to work on the land after October 24, which is about the date we have heretofore commenced sowing our fall seeds, such as ash. We find it a great advantage to sow this species in the fall, not only because it makes less work in the spring, but particularly for the reason that we get a very much better germination than from spring sowing, and usually the stock is larger and better rooted.

The following areas were devoted to the different varieties:—

Broad-leaved—		
Maple, 1 year	10 acres.	
Ash, 1 year	20 acres.	
Ash, 2 years	20 acres.	
Caragana, 1 year	2 acres.	
Willow (cutting stock)	5 acres.	
Russian poplar (cutting stock)	2 acres.	
Ornamental stock[1]	½ acre.	
		59½ acres.
Conifers—		
Transplanted tamarack	1 acre.	
Transplanted evergreen conifers	5 acres	
Conifer seed-beds	1½ acres.	7½ acres.
Total area under nursery		66¾ acres.

[1] Shrubs being grown are for shipment to Buffalo Park, Wainwright, for ornamental planting there.

The following stock is available for distribution this spring:—

Deciduous—		
Maple, 1 year	559,100	
Ash, 2 years	255,675	
Caragana, 1 year	212,500	
Russian Poplar (cuttings)	195,400	
Willow (cuttings)	1,218,625	
Cottonwood (imported)	300,000	
Tamarack	24,460	
Siberian Larch	3,820	
Norway Poplar (cuttings)	3,850	
		2,773,430
Evergreen—		
White Spruce, 5 years, transplants	25,006	
Norway Spruce,[2] 5 years, transplants	24,870	
Colorado Spruce, 7 years, transplants	3,354	
Lodgepole Pine, 4 years, transplants	10,017	
Jack Pine, 4 years, transplants	9,242	
Balsam Fir	320	72,809
Total		2,846,239

Some of the above stock will be required for extending our own plantations.

Tree-digging was commenced September 23, and completed October 21.

All Russian poplar cuttings and over 600,000 willow cuttings were made up before winter set in. These are counted and tied in small bundles and completely buried outside for winter storage. About 600,000 willow cuttings will remain to be made this spring before the packing season opens.

COLLECTION OF SEED.

The past season was a particularly good seed-year for practically all species, and every endeavour was made to procure as large stocks of seed as possible, particularly maple and ash, in case of a short seed-crop this year.

Elm.—In the month of June, 35 lbs. of this seed were secured from Winnipeg, while 40 lbs. were collected from trees growing on the Experimental Farm. We have experienced considerable difficulty in recent seasons, in getting this seed collected at a proper stage of maturity. In nearly every case seed is picked too green, and, as a consequence, poor stands in the nursery plots are the result. The great trouble in this connection is the fact that our strong winds strip most of the seed from the trees before it actually has a chance to ripen.

Caragana.—One hundred and ten pounds of this variety were collected from the shrubs on the Nursery Station. This was sown on three acres, at the rate of about 37 lbs. per acre.

Maple.—Three hundred and twenty-seven bushels of this seed were collected in the Qu'Appelle valley, in the neighbourhood of Fort Qu'Appelle.

Green Ash.—Two hundred and forty-eight bushels were collected in the Qu'Appelle valley.

[2] Variety of Norway spruce (Picea excelsa septentrionalis) seed, supposed to have been collected in Northern Finland, and should therefore prove a considerably more hardy strain than the common Picea excelsa.

Lesser Slave Lake District: Lodgepole Pine, Slopes Type.
Head-waters of Assineau River

Photo D. Roy Cameron, 1911.

Cones of the following conifers were collected on the various reserves under the direction of the forest rangers and shipped to this point, where seed was extracted during the past winter:—

	Number of Bushels received.	Lbs. of Seed extracted.	Average per Bushel.
	Bush.	Lbs.	Lbs.
Lodgepole Pine	97	38	0·39
Jack Pine	182	57	0·31
Bull Pine	27	33	1·22
White Spruce	135	170	1·33
Tamarack[1]	15	10	0·60

[1] Cones in poor condition when picked, many seeds having already been lost.

CONIFERS.

Seed-Beds.—Four thousand five hundred square feet of seed-beds were sown, the varieties being Scots, jack and lodgepole pine and white spruce. Small quantities of *Picea obovata, Picea excelsa borealis, Abies siberica, Juniperus communis* and Tyrolese larch were also sown for experimental purposes.

Seed-beds sown in 1910 all show particularly good stands of strong, vigorous seedlings. The majority of these will be transplanted this spring (1912).

Transplants.—Last spring was very much more favourable for transplanting than that of 1910. As a consequence the percentage of failures was very low.

The following are the varieties and numbers of seedlings transplanted, practically all two-year stock:—

Scots pine	5,380	
Lodgepole pine (P. Murrayana)	96,790	
Jackpine (P. Banksiana)	66,240	
Bull pine (P. ponderosa)	9,510	
White spruce	18,760	
Abies concolor	1,700	
Flexilis pine	245	
Siberian larch	555	
Norway spruce (Russian seed)	4,280	
		203,460

PERMANENT PLANTATIONS.

The trees in the permanent plantations are making excellent growth. These plantations were started in 1904 and have been added to each season. At present these plantations occupy 78¼ acres. The separate plantations vary in size from one-half acre to over four acres. Twenty-three species and varieties are represented in these plantations.

Measurements were again made in these plantations in November, 1911, of the varieties planted in 1906. Of the varieties planted in 1906 it is interesting to note the relative growths made to date under similar conditions of soil and cultivation. The measurements are averages of from 100 to 150 individual specimens in each case. The average and maximum measurements are given below:—

GROWTH OF PLANTATION SET OUT IN 1906.

Species.	Size when planted.	Average Height, Nov., 1911.		Maximum Height, Nov., 1911.	
		Ft.	In.	Ft.	In.
Tamarack	15-in. forest seedlings	12	11	16	0
Scots Pine	10-in. 4-yr. transplant	5	11	9	10
White Spruce	10-in. 5-yr. transplant	3	0	6	8
Cottonwood	18-in. seedlings	18	2	22	6
Manitoba Maple	14-in. 1-yr. seedlings	13	9	18	2
White Birch	18-in. 2-yr. "	12	4	16	0
Green Ash	12-in. 2-yr. "	8	3¾	11	0
American Elm	15-in. 2-yr. "	8	2	10	6
Russian Poplar	24-in. 1-yr. rooted cuttings	18	10	22	6

Last spring the following plantations were set out:—

4 acres Colorado spruce equally mixed with caragana.
2 acres red or Norway pine equally mixed with caragana.
1 acre jack pine equally mixed with Manitoba maple.

The spacing throughout was 4 feet by 3 feet 6 inches.

If time permits, plantations of Siberian larch and Norway poplar will be set out this spring.

It is very generally supposed that the transplanting of evergreens is more difficult than that of deciduous varieties, and that there is usually a much greater percentage of loss. In this connection the figures given in the table below may be of interest. Actual count was made in November, 1911, of every individual tree planted in 1910 and 1911, with the following result:—

		Total Number planted.	Number dead in Nov., 1911.
Trees planted, 1910:	Caragana	3,960	758
	Scots Pine	4,050	455
	Manitoba Maple	2,340	390
	Scots Pine	2,430	224
	Caragana	5,012	717
	Norway Spruce	5,272	131
Trees planted, 1911:	Colorado Spruce	2,300	0
	Manitoba Maple	2,300	35
	Colorado Spruce	3,629	0
	Caragana	3,629	28
	Jackpine	1,250	232
	Maple	1,256	7

In the last plantation (jack pine and maple) the comparatively large number of deaths was due to the effects of alkali in the soil. It would appear from experience covering the past eight years that the very slightest trace of alkali in the soil is fatal to all the pines (Scots, jack and lodgepole). The spruces on the same soil do not seem to be affected, though it is not suggested that they would be suitable for what is usually known as alkali soil. Even the smallest trace of alkali—so slight in fact as to be quite unnoticeable from its effects on grain crops, or other trees—will immediately cause the needles of the pines to become yellow; the growth is stunted and sickly and the tree rarely survives more than a few seasons.

VARIETY PLOTS.

The following were added to the variety plots last season:—

Manitoba maple *(Acer Negundo).*
Soft maple *(Acer saccharinum).*
Green ash *(Fraxinus pennsylvanica* var. *lanceolata).*
American elm *(Ulmus americana).*
Aspen poplar *(Populus tremuloides).*
Balsam poplar *(Populus balsamifera).*
Lombardy poplar *(Populus nigra* var. *pyramidalis).*
Norway poplar *(Populus deltoides* var.*).*
Carolina poplar *(Populus deltoides* var.*)*
Cottonwood *(Populus deltoides).*
Russian poplar *(Populus certinensis).*
Russian poplar *(Populus Petrofski).*
Golden willow *(Salix alba vitellina; salix Voronesh).*
Acute-leaf willow *(Salix daphnoides).*
Diamond willow.
French laurel-leaf willow *(Salix pentandra).*
Purple willow *(Salix purpurea).*
Britzensis willow *(Salix alba britzensis).*
White willow *(Salix alba).*
Russian laurel willow *(Salix pentandra* var.*).*
Austrian pine *(Pinus laricio austriaca).*
Japanese larch *(Larix leptolepis).*

These plots contain 100 specimens of each variety planted four feet apart each way.

ORNAMENTAL GROUNDS AND SHRUBBERY.

Owing to the unusual precipitation, the lawns and flower-borders presented a splendid appearance throughout the season. There was a particularly fine show of bloom on the early flowering shrubs, such as lilac, Tartarian honeysuckle, spirea arguta, etc.

PLOUGHING AND FARM WORK.

Work last season was commenced on the southwest quarter of the section, this quarter having been turned over to the nursery in the fall of 1910. That fall a good woven-wire fence on cedar posts was erected and part of the ground, largely covered with a growth of wolf willow, cleaned for breaking. In 1911, sixty acres of this land was broken and backset. Part of this will be seeded to oats during the coming summer and the remainder will be summer-fallowed in order to put it in condition for sowing tree seeds in the fall.

The usual amount of summer-fallow and ploughing was done. Twenty to twenty-five tons of rye grass hay was cut and cured; twenty-two acres was grown to oats, which yielded over 2,000 bushels of grain.

DISTRIBUTION OF CONIFERS.

As stated in my last report it was decided to commence a limited distribution of evergreen conifers, which may be obtained for farm planting at the rate of $1 per 100. Information in regard to this distribution was prepared in the form of a circular, which was sent out as widely as possible. The circular is as follows:—

'DEPARTMENT OF THE INTERIOR, FORESTRY BRANCH.

'It has been decided to distribute, from the Forest Nursery Station, evergreen conifers in limited quantities for planting by farmers in Manitoba, Saskatchewan and Alberta. These conifers will be furnished under the following conditions:—

'1. The applicant must be a bona fide owner of a farm in one of the three provinces mentioned above.

'2. The trees if supplied must be planted on such farm property, and on no account may all or any part of the trees be used for planting on town or village lots, or within the limits of any city, town or village.

'3. The applicant, before any trees are granted, will be required to sign an affidavit that the trees are for planting on his own farm property and will not at any time in the future be removed from the farm for planting elsewhere, nor offered for sale for planting within town or village limits.

'4. The stock offered will be limited in quantity and applications will be booked in the order in which they are received; all applications must be made upon the forms supplied by the Forestry Branch, which may be obtained by writing to the Forest Nursery Station at Indian Head, Sask. The application must be accompanied by a post office or express money order sufficient to cover the number of trees applied for.

'5. The young trees will be supplied at a cost of $1 (one dollar) per hundred, f.o.b., Indian Head. The trees will be packed and delivered at the station for shipment to applicant's express office, the express charges to be paid by applicant upon delivery.

'6. No application will be entertained for less than 100 of any variety; that is, orders will not be filled for, say, 50 spruce and 50 pine; but if both spruce and pine should be desired, at least 100 of each must be ordered. No order will be filled for more than a total of 500 trees in one season.

'7. The department does not assume any responsibility regarding the delivery or subsequent growth of the young trees. Every effort will be made to supply first-class stock true to name, and every care will be taken to have the trees well packed and delivered to the express company at Indian Head in good condition for shipping.

'8. All stock is grown from seed at Indian Head; the trees will be from four to six years old, at least once transplanted, and will be of a suitable size for permanent planting. The average height will be twelve inches, though some may possibly run under this and others over.

'READ THE FOLLOWING CAREFULLY.

'Before sending a request for an application form with a view to placing a definite order for evergreens, the applicant should be reasonably sure that his conditions are favourable to growing the trees successfully.

'The ground must be in the best possible state of cultivation, preferably summer-fallow.

'Evergreens should be planted as soon as possible after they are dug; they will not stand the same amount of neglect as will the ordinary deciduous varieties. If the applicant lives at a considerable distance from an express office, so that he cannot be promptly notified as to the arrival of the trees, there would be every likelihood of the trees either drying out or becoming heated before delivery could be made, and consequently the purchase price would be so much wasted. This would apply in localities where mail is delivered only once a week, or perhaps only once in two weeks. It is not practicable when shipping to send out notices of intended shipment more than three or four days in advance of the actual shipping date, as the time of shipping depends altogether upon the local weather conditions over which we can have no control.

'Evergreens of the right varieties, though perfectly hardy when once thoroughly established, seem to require some protection for at least two or three years after planting. In most cases it would be a waste of time and money to plant on the open prairie.

'The most favourable situation for planting would be in the vicinity of a well established shelter-belt of the ordinary native trees, where the young evergreens may be protected during the winter and early spring by the covering of snow held by the older belt. The trees should not, however, be planted within several feet of the established belt, as during the first few years the growth is small and young evergreens are very sensitive to over-crowding or too close shading by larger trees.

'Evergreens to be most successful should be planted close together, not more than three and a half or four feet apart. Isolated specimens set out singly in the centre of a lawn, or in some other equally exposed situation, are placed under most unfavourable conditions for healthy growth, and unless given special protection during the first few winters will usually fail to survive.

'For further particulars regarding the varieties available for distribution in 1912, and for regular application blanks, apply to:

THE FOREST NURSERY STATION,
INDIAN HEAD, SASK.

'IMPORTANT—No money should be sent to pay for evergreens unless accompanied by application made out on official form. These forms will be supplied upon request. Any money received without an order on the official blank will be returned.'

The demand for these evergreens has been so great that our total stock was very quickly applied for, without any advertising on the part of the department. Many applications latterly had to be refused owing to the supply of stock being exhausted.

Respectfully submitted,

NORMAN M. ROSS,
Chief, Tree Planting Division.

No. 5.

REPORT OF S. S. SADLER.

DEPARTMENT OF THE INTERIOR,
FORESTRY BRANCH,
NURSERY STATION, INDIAN HEAD, SASKATCHEWAN, March 31, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I have the honour to submit herewith my first annual report, which is a summary of my work as Assistant in the Tree Planting Division of the Forestry Branch.

I reported to Norman M. Ross, Chief of the Tree Planting Division, on the 9th of May and proceeded to take over the work of my predecessor, Mr. Archibald Mitchell.

The last shipment of trees was forwarded from Indian Head on May 8; therefore, the work of compiling the packing and shipping lists was completed upon my arrival. From the 9th until the 26th of May was spent checking the shipping lists to obtain correct data for the number of trees, considered by species, shipped to the various express offices and the proportionate number shipped into the three provinces. On the 26th of May I went to Calgary, accompanied by one of the inspectors, Mr. Cowie, to put in order the demonstration plots at Victoria Park for the Calgary Provincial Fair. In 1910 the Board of Directors of the Fair placed at the disposal of the Tree Planting Division approximately one acre of ground directly inside the main entrance and constructed around it a substantial panel fence. In the spring of 1910 Mr. Ross drew up a planting plan for the above plot and also a plan for an ornamental border on each side of the main entrance to the industrial building. Mr. Mitchell supervised the planting of these areas in the spring of 1910 and the material used was grown at the Nursery Station, Indian Head. The plot in the enclosure contains plantations of the various species recommended by the Forestry Branch as suitable to western Alberta. There are also coniferous and deciduous seed-beds and coniferous transplant beds, to demonstrate the manner in which trees are propagated. As the demand for planting material is increasing so much more rapidly than the facilities for producing the supply, I believe the propagation by seed of the broad-leaved trees suitable for plantation in the prairie provinces should be emphasized, as far as possible, and encouragement given to farmers to raise their own stock. There are places in nearly every district where the seed of maple and ash could be secured at little expense, and where not locally available this seed could be purchased from commercial dealers. With a few pounds of seed and several square rods in the home garden, a sufficient nuuber of trees could be grown to extend the shelter-belts already established under the direction of the Forestry Branch.

On account of the very dry season in 1910 there were numerous failures in the plantations at Victoria Park, especially amongst the conifers. After I had replaced

all the dead trees and sown the seed of the coniferous and broad-leaved species, I returned to Indian Head. A few days were spent in June with several of the inspectors gathering elm seed on the Experimental Farm. On the 21st of June I met Mr. Stevenson at Sanford, Manitoba. From here I accompanied him for four days visiting the people in that district who have received trees from the Forestry Branch and those who had applied for trees. Several older plantations were visited which had made a remarkable growth and are an evidence of what may be expected of tree-planting in Manitoba. On the 27th June I returned to Calgary to take charge of the Forestry Exhibit during the Provincial Fair. Beside the demonstration plots there was a collection of enlarged photographs showing what has been accomplished in the way of tree-planting at Indian Head and in the various localities throughout the provinces of Manitoba, Saskatchewan and Alberta. There was considerable interest taken in the photographs, but more especially so in the demonstration plantations and the ornamental planting around the Industrial Building. All during the Fair a number of the shrubs and perennials were in bloom, which added a great deal to the attractiveness of the grounds. As the trees in the plantations become larger they will increase in value as examples of shelter belts and also form a very pretty group of trees in the Fair Grounds. I had an opportunity of visiting the Fair Grounds while passing through Calgary later in the summer and found but few failures in any of the plots. There was a very satisfactory stand of maple and ash seedlings, and not more than five per cent loss in the coniferous transplants. After the closing of the Fair I met one of the new inspectors, Mr. Cowie, at Lethbridge, and spent a week with him inspecting the plantations in that locality. Although this is considered a dry section of Alberta, there have been very satisfactory results obtained from tree-planting. Many of the recipients are in a position to irrigate, which is a great protection against drought.

During the latter part of July, I attended the Brandon Fair and had charge of the Forestry Exhibit in the Agriculture Building. The exhibit at Brandon was somewhat similar to the one in Calgary, excepting the collection of native woods from Manitoba. These consisted of sections about three feet long taken from the log and having a portion of the face polished to demonstrate the different grains and textures of the various species. The demonstration plots around the building were not laid off in regular blocks as at Calgary, but consisted of irregular groups separated by driveways. A small area directly at the back of the building contained a small nursery of coniferous and hardwood seed and transplant beds. There were several thousand people who visited the exhibit and a great many of them had questions to ask regarding the growing of trees on the prairie. From interest shown, it is certain that a considerable amount of information regarding tree-culture was carried away by the visitors and no doubt it has stimulated an increased desire to establish shelter-belts around the prairie homes. On the 1st of August I met Mr. MacDonald at Moosejaw, and spent several days with him along the Soo Line. A very luxuriant growth of all varieties of trees supplied by the Forestry Branch was the most noticeable feature in this district. This growth was due to the very heavy soil, high in nitrogenous matter, and to the abundance of moisture present. I made growth measurements on several plantations and found a maximum current growth for maple to be over five feet. On account of the heavy clay soil cultivation was more difficult in this district and where it had been neglected there was a heavy growth of weeds and grass which stunted the growth of the trees and gave them an unhealthy appearance. In a very heavy soil cultivation is of paramount importance; during dry seasons the top soil bakes and cracks, increasing evaporation from the subsoil; while in very wet seasons the top soil is saturated, giving little opportunity for the proper circulation of air around the roots of the trees.

On the 7th of August I met Mr. Kennedy at North Battleford and spent several days north of the Canadian Northern Railway and several days south, in the vicinity of the Eagle Hills. In both of these localities the soil and climatic conditions seem to be very favourable to tree growth. The soil is a rich sandy loam and there was

little evidence of damage from winter-killing. Both the cottonwood and the Russian poplar seem to do exceptionally well in this part of the province. The remaining part of August was spent in Northern Alberta, along the Lacombe Branch of the Canadian Pacific railway, with J. N. B. MacDonald. This being a comparatively new country, the majority of the plantations are quite young, although all varieties supplied by the department seem to be making as good a growth as those farther east. The principal feature was that a great many of the settlers are not ready for tree-planting. The buildings are only temporary, and, in the majority of cases, those who had applied for trees have not had sufficient time to properly prepare the soil. As the farms become better established there will be more time available to properly cultivate the ground and care for the young trees which are to form the shelter-belts in the future. Railway facilities are not developed as they are farther east, which makes inspection work more difficult, necessitating long drives by livery to reach the recipients.

From northern Alberta I returned to Indian Head to check over the forms received at the office, which had been sent out by the inspectors where it was inconvenient to visit the applicants personally, and to answer inquiries regarding the arrangement of plantations and the distribution of planting material.

On September 1, I met Mr. Mackintosh at Watrous, Sask., and spent several days on inspection with him in the country south of the Grand Trunk Pacific. From Watrous I went to Dauphin, Manitoba, where I met Mr. Kay and spent several days in that locality. The largest annual growth I saw during the summer took place around Dauphin. In several cases the maple had made a growth of six feet, and cottonwood ovr seven feet, during the season of 1910. The soil is a black loam and generally contains a sufficient amount of moisture to produce a vigorous growth. The occurrence of bluffs and natural tree growth is very noticeable through this part of Manitoba, and there is not the need of planted shelter-belts, as in the treeless areas farther west.

The first two weeks in October were spent in Alberta completing the inspection district assigned to Mr. Cowie, who returned to the Nursery Station the last of September to assist with the lifting and bunching of seedlings. I worked from Calgary north on the Edmonton branch of the Canadian Pacific Railway as far as Carstairs, visiting fifty-six applicants. The district along the foothills of the Rockies from Macleod to Olds has been found to be less favourable to tree growth than any part of the prairie provinces. All the varieties supplied by the department have been planted in this part of Alberta, and all, with the exception of the caragana, have been winter-killed. By the above I do not intend to convey the impression that such species as the willow, Russian poplar, or even the Manitoba maple cannot be grown along the foothills; but, if planted on a rich soil and a southern aspect, there is danger of a setback by early and late frosts. Several peculiar incidents relative to tree growth were seen in the vicinity of Airdrie, Alta. A plantation four miles southwest of the town, consisting of maple, Russian poplar, elm and willow, was damaged more or less by late frosts in the spring of 1911, while another plantation twelve miles east, consisting of the same species, and planted on similar soil, showed no effect of winter-killing. The first plantation lay on a southern aspect, while the latter lay on a northeastern aspect. Whether or not this degree of hardiness can be accounted for by the change of aspect alone is not certain with the amount of data at hand. After completing the inspection work in Alberta I returned to Indian Head and since then I have been occupied with the general office-work relative to the shipping, packing and inspection lists for 1912.

My work during the summer has given me the opportunity of seeing the different conditions which influence tree growth in the various districts and to make comparisons of the results obtained under these conditions. The method of inspecting is somewhat different with each inspector, and by accompanying them for a few days comparisons can be made as to the most efficient and practical system. Some of the districts are entirely too large for the amount of time available and it is essential that

the inspectors cover their territory in the quickest time possible without omitting any necessary data and giving each applicant all the assistance desired in the way of suggestions and advice regarding tree-planting.

Taking the three provinces as a whole, and including all the plantations from those first established to the ones more recently set out, it is certain that the results obtained have been exceedingly satisfactory. In all except the newer districts there are thrifty plantations which are a stimulus to the community and will do a great deal towards the advancement of tree planting on the prairies.

Your obedient servant,

S. S. SADLER,

Assistant in Tree Planting Division.

No. 6.

REPORT OF A. P. STEVENSON.

DUNSTON, MANITOBA, December 21, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I have the honour to submit herewith my eleventh annual report on the work done by me as inspector of tree plantations in the Tree Planting Division of the Forestry Branch.

The district assigned to me this year was that traversed by the main line of the Canadian Pacific Railway from Brandon to Winnipeg and eastward to the eastern boundary of the Province of Manitoba, embracing all of Manitoba lying between that line south to the International boundary, together with the territory served by the Oak Point branch of the Canadian Northern Railway and the Stonewall, Arborg and Winnipeg Beach branches of the Canadian Pacific Railway.

The total number of applicants on my list was 704. Of that number 471 had received trees previously, and 106 are again receiving trees. There are 233 new men, of whom 156 will receive trees in the spring of 1912, making a total of 255 men who will receive trees to the amount of 165,800.

In nearly all cases where new applicants were not granted trees in the spring of 1912 the reason was due entirely to the lack of proper preparation of the soil for trees; in a few other cases where the necessary preparation had been unsuitable on account of being made too close to the farm buildings, trees were not granted. It is a great mistake to allow trees for a shelter-belt to be planted too close to buildings. Sixty yards distance from building wherever possible should be insisted on, even if the planter should think it a hardship to put off planting for another year. Afterwards he will always be glad this was insisted on by the inspector.

The plantations set out in the spring of 1911 in the southeastern, south central and central portions of Manitoba have done remarkably well. Fully 85 per cent of maple and ash, 80 per cent of Russian willow and poplar and 45 per cent of the cottonwood are growing and in a thrifty condition.

The growth of the trees set out in 1910 in the district mentioned was above the average of other years. Some of the growths on the maple measured three and one-half feet and over, ash three feet, willow three and one-half feet, cottonwood four feet. In fact the growth was surprising when it is considered that last year an extended

drought prevailed through the larger portion of the district mentioned, the young trees planted in 1910 barely holding their own.

The spring of 1911 was one of the most favourable for tree planting in Manitoba. During the entire summer abundance of rain fell, the precipitation being above the average, except in some parts of southwestern Manitoba. In some part of that district the drought this year was very severe, this being the second year of the dry period. It extended about fifty miles along the International boundary taking a strip twelve to fifteen miles wide in Manitoba. The young plantations in this dry strip were looking fairly well, notwithstanding the extremely dry weather, and, while the growth was small, it was remarkable to note the number that still had life and apparently are ready for business as soon as the necessary rains come.

The wisdom of the rule insisted on by the Forestry Branch, that the land must be properly prepared before trees are planted, has been abundantly proved throughout this district during the past two seasons.

No injury from late or early frosts was noticed in my district during the season, and as there was an average amount of snow during the past winter little or no injury from winter-killing was noticed.

In the Souris district some injury was done to the maples by the tent caterpillar, and I regret to say little or no effort was being made to overcome the pest.

Very little damage was done this year by the vagabond gall, and that only in the southwestern, or dry, district.

I am pleased to report that the general care and condition of the young plantations are fully up to the average of other years. A better knowledge of the requirements of the tree-planting scheme before trees are given is now abroad among the farmers wanting trees, and the impression is gradually gaining with intending planters that if large trees are desired they will require to plant little ones.

The Russian willow is growing in popularity with the farmers. This is not surprising when we consider how easily it is propagated, its quick-growing qualities, hardiness, freedom from disease and the fact that these trees are among the first things green in spring and remain green late into fall, when everything else is brown and bare. These points appeal strongly to the farmer on the bleak, open prairie. The ash, also, is a tree much desired by the farmers when once it gets established, but to secure the best results it should always be planted with maple, never with willow, cottonwood or Russian poplar.

Old plantations are showing up more prominently as the years pass and it is always a source of satisfaction to visit, examine their growth and note their general condition, and incidentally learn some lesson therefrom, and also to hear the appreciative remarks on their benefits by the owners. One of these, and by no means the least, is the large number of singing birds of various kinds that are now noticed around their prairie farm homes that were never seen there before they grew their young plantations.

Respectfully submitted,

A. P. STEVENSON,

Inspector of Tree Plantations.

No. 7.

REPORT OF ANGUS MACKINTOSH.

GRAVESEND, DYSART, SASKATCHEWAN, December 1, 1911.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I have the honour to send you herewith my report upon the tree-planting inspection work intrusted to me for the summer and autumn season of 1911.

The territory allotted to me was that lying between the Manitoba boundary on the east and Saskatoon on the west; and from the Qu'Appelle Valley on the south to the Yorkton district on the north. The Kirkella branch of the Canadian Pacific Railway, the main line of the Grand Trunk Pacific Railway, and the Yorkton division of the Canadian Pacific Railway run through that tract of country.

The names on my list numbered 722. I visited 666 of that number, and sent circulars for the requisite information to the remainder of them. As some of the circulars sent out had not been returned at the end of the season, when I handed in my books at Indian Head, I cannot give the exact number of the people on my list to whom trees will be supplied next spring, but it will be between 160 and 170. There were sixteen on my list that were not eligible for trees, as they lived in bluffy places where nature had provided shelter.

I visited Indian Head on the 1st of June and next day began work at Manson, and I finished on the 29th of October at Churchbridge near Yorkton.

As there are now plantations of from one to six years of age dotted all over this part of Saskatchewan, and the climatic conditions all over are very much alike, a few general remarks on the present condition of the trees will suffice.

Last season I had to record many failures from drought amongst the newly planted trees, mainly in the western part of my territory; this season, I am glad to say, I have a better account to give. The early part of the season, just after the young trees were planted, was showery, and it continued throughout more moist than north-western seasons usually are. Consequently it was an excellent season for tree planting and tree growth. In my eight years inspection work I have not seen so few failures amongst the newly planted trees. In some plantations containing from 700 to 1,000 I could hardly find a dead tree, and where there were any they amounted only to two, three, or at most five per cent. There were, and I presume always will be, a few exceptions, clearly traceable to dilatoriness in removing the trees from the railway stations and careless planting. The failures, chiefly amongst the cottonwood and Russian willows, all over will not exceed four per cent.

The trees planted last year, after the blank places had been filled up, look well and have this year made good headway.

As to the older plantations I may say that many of them are now affording shelter to buildings and gardens and have covered the nakedness of many bare homes. In some of those plantations the cottonwoods are from twelve to sixteen feet in height, willows from ten to twelve, maple eight to ten, and ash from six to eight feet. It is a pity, however, that the owners of some of those plantations stop stirring the ground and keeping down the weeds too soon, and allow bad grasses to get established amongst the trees, before there is sufficient cover or shade to check them. When couch grass has spread under the trees before the branches meet, stuntedness and decline invariably follow. I estimate the failures all over, amongst the older plantations, at ten per cent. The greatest death rate is amongst the cottonwoods, and the least amongst the ash.

It is gratifying to find that some of the people that had trees from the Forestry Branch for two or three years are now growing trees from seed and cuttings themselves, and in that way extending their plantations. They should be encouraged in doing this, and I always give them advice as to the best way of thus helping themselves.

In several places that I visited the maples and cottonwoods, of one and two years' growth, had been cut back by the fall frosts, that came upon them before the shoots had ripened, and the winter storms. This, however, is a common occurrence, that retards the growth of the trees, but does not do them any lasting injury. I do not often find trees hurt in that way after the third year.

As I mentioned in my last report, about half of the conifers distributed in 1910 failed, but I am glad to say that the survivors have this year made a very satisfactory growth. The tamarack in this respect stands first, the Scots pine second and the various spruces third. I attribute the failure of last year to lack of care, and lack of knowledge on the part of the planters.

The present offer of the Forestry Branch to supply bona fide farmers with conifers at $1 per hundred has taken well, and there will doubtless be many applicants. None, however, of the farmers that I have spoken to on this subject desired as yet to form plantations of conifers, but the wish seems to be to have some evergreens on which the eye, looking from the house or its vicinity, can rest when other trees are bare and leafless. I have been often asked by intending purchasers where they should plant those trees, and my advice has been to plant them in a row—spruce and pine alternately—inside their shelter-belts; and also to dot single specimens or small clumps about their lawns, *if the lawns are sheltered and not too small.*

That American and European larch and several varieties of spruce and pine will do well on the prairies of the Northwest is no longer questionable. The flourishing plantations at the Forest Nursery Station, Indian Head, have already proved that.

Respectfully submitted,

ANGUS MACKINTOSH,
Inspector of Tree Plantations.

No. 8.

REPORT OF WALTER B. GUITON.

DEPARTMENT OF THE INTERIOR,
FOREST NURSERY STATION,
INDIAN HEAD, SASKATCHEWAN, January 18, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I have the honour to submit to you my fifth annual report on tree-planting inspection work as carried on through the co-operation of the Forestry Branch, Department of the Interior.

Since sending in my last report I was employed during the winter in the general routine of office-work until the 28th of March, when I went to the Nursery Station to assist with the planting and general distribution of trees until the 15th of May, when I went to Brandon to finish planting the exhibition plot at the Forestry Building. I then returned to the Forestry Office to arrange my books to commence inspection work on June 1.

The district assigned to me was the main line of the Canadian Pacific Railway from Fleming on the eastern border of Saskatchewan, to Maple Creek on the west. Total number of square miles over which applicants were scattered was 31,320.

On June 1, I commenced my tour of inspection at Fleming. This district, as far west as Indian Head, is more or less dotted with small bluffs of the native poplar. These trees, however, do not always afford protection where the farmer intends building, and it has been found necessary to apply to the Forestry Branch for assistance. In 1901, when the tree-planting scheme was first inaugurated, this district among others realized the benefits of a well established belt of trees. Object lessons could already be seen from the plantations on the Experimental Farm.

In the district between Indian Head and Moosejaw, both the older and more recent plantations are examples of successful tree planting and are now a feature of the landscape. The above is an evidence that the species recommended by the Forestry Branch are quite suited to meet the soil and climatic conditions existing on the prairie.

The remainder of my district (between Swift Current and Maple Creek) is sparsely settled and only within the last three years have trees been supplied to those settlements which are remote from the railroads. Here and there along the railway, older plantations may be seen which are affording very beneficial barriers against the cold winds common to a prairie country.

The following summary gives briefly the details as to applicants for trees in my district:—

Total number of applicants on list	1,191
Applicants receiving trees one or more years	577
New applicants receiving no trees	258
Both old and new applicants receiving trees in 1912	505
Applicants receiving trees one or more years to receive trees	145
New applicants receiving trees	356

Total number of trees allotted, 383,800; average per man, 760.

The reasons why more of the new applicants did not receive trees might be classed under the following headings:—

(*a*) Lack of sufficient preparation;
(*b*) Distance from railway facilities;
(*c*) Moving of buildings, and land prepared too close to buildings.

The plantations which were planted this year were a decided success in nearly every case, and few places were inspected where trees had been planted in a slovenly manner. The cuttings of the Russian poplar and willow made a splendid growth this season and many cases were seen where this year's cuttings grew three feet. The failure among these cuttings did not exceed four per cent, as the instructions were more fully carried out on the part of the applicant during the process of planting.

Plantations in 1910 were in both Saskatchewan and Alberta. The trees which were planted in Saskatchewan were one continuous example of successful planting when the instructions had been carried out with regard to the cultivation of the soil between the rows of trees during the summer, thus keeping the surface soil in a loose friable condition, with the evaporation from the soil at a minimum. Trees which were planted on well worked summer-fallow were a pronounced success, and were able to withstand the dry period which was so detrimental to all grain crops last year. The willow cuttings, which in some cases were planted shallow, met with a consequent poor result.

The trees planted in Alberta last year did well in the district which I inspected. At Lethbridge plantations are grown under two systems, namely, cultivation and irrigation, both of which have been found successful. The trees which are grown under the irrigation system are watered soon after planting and continued until the second

week in July. The water is then turned off to allow the trees to ripen up before the early frost. The ground is again flooded the last thing in the fall, so that it may freeze solid and lessen evaporation during the winter. The plantations which were planted in 1909 are now eight to ten feet high according to the species used and care which they had received since planting.

This season was a most uncommon one in the history of the west. During the winter we had a very heavy fall of snow and this did not disappear until late in the spring, which seriously hampered all work, especially the spring work of the farm.

The trees were all planted, and were taken from the station in nearly all cases within a week after notice was sent out to the applicants informing them of their shipment. I did not see a case where trees were seriously damaged either from early or late frosts. There were districts which were seriously affected with drought, but, as we are only commencing to supply this district with trees, better results are looked for in the future.

The information forms which are sent to applicants remote from the railways were in most cases correct, but a visit from the inspector is more satisfactory. It is necessary in many cases to explain the actual preparation of the soil, also the best methods of planting, as ploughing a furrow or planting with a spade. These are the methods used by most of the settlers who were visited this summer, many of whom were visited for the first time on account of the distance—100 miles or more from the railways.

In closing my report for this season's work, I would say that too much effort cannot be made to counteract the tendency of some applicants in wanting to plant too close to the buildings. Plenty of room should be allowed for in case they wish to extend their buildings at some future date. The location of many of the buildings does not always allow the forming of a snow-trap in relation to the shelter-belts which are usually planted on the north and west sides of the buildings to counteract the prevailing winds. The older trees which were inspected this season were found to have made a sufficient shade to prevent such a vigorous growth of weeds which are such a menace to the younger plantations.

The conifers which were distributed last year are doing well where the instructions were followed regarding the shading of the plants until they recovered from the strain of transportation and replanting. But the chief cause of failure seems to have been in the handling of the trees before planting, by allowing the roots to be exposed to the sun and wind.

It does not seem necessary here to enlarge further upon the benefits of tree planting. Everyone living on the prairie realizes the advantage of well established shelter-belts, not the least of which is the increased value of the property—an asset to the vicinity. Therefore it should not be necessary to seek further methods to encourage a farmer in taking up a work which he knows himself to be of value.

Respectfully submitted,

WALTER B. GUITON,
Inspector of Tree Plantations.

No. 9.

REPORT OF JAMES KAY.

DEPARTMENT OF THE INTERIOR,
FOREST NURSERY STATION,
INDIAN HEAD, SASKATCHEWAN, January 18, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I have the honour to submit my fourth annual report on the plantations set out under the direction of the Tree Planting Division of the Forestry Branch.

The districts covered by me were traversed by the following railway lines:—

Saskatchewan.—The Pheasant Hills branch of the Canadian Pacific Railway from Asquith to Macklin, and from Macklin to Bounty on the Kerr Robert and Macklin branch line; Grand Trunk Pacific Railway, Saskatoon to Artland; Goose Lake branch Canadian Northern Railway from Vanscoy to Fiske; Prince Albert branch Canadian Pacific Railway from Hague to Tisdale.

Manitoba.—Main line Canadian Pacific Railway from Kemnay to Kirkella, and all the lines north of this in Manitoba.

The number of men on my list in 1911 was 1,104; of this number 566 had received trees previously. The new applicants numbered 538. The total number of men receiving trees in 1912 is 591. Of these, 260 already had been supplied with trees one or more years and the remaining 311 were new men. The number of trees allotted to these men for the spring of 1912 is 407,100, an average of 688 trees per applicant. Two hundred and seven new men did not receive trees; the chief reasons for this may be stated as follows: (1) The land was not in a proper state of cultivation to plant trees thereon; (2) the proposed plantation was too near buildings. A few were removing to another building site through lack of water and a few had sold out, rented their farms, or for other reasons did not desire delivery of their trees.

The plantations set out in 1911 almost without exception have done remarkably well, a very small percentage of the plants having failed to root and start into growth. About 97 per cent of the 1911 planting were alive. This favourable result was no doubt due to the large amount of moisture in the soil owing to heavy rains in the fall of 1910, combined with the large amount of snow which fell during the winter and early spring months, added to ample moisture which was precipitated during planting time. The summer was unusually cold and wet, but there was no check to growth throughout the entire growing season.

The 1910 plantations were not so fortunate in certain districts. Many of them suffered severely from drought which reduced the vitality of the plants. In some instances with the fall rain there was much late growth, thereby many were damaged with frost and a good many killed out; consequently many of the 1911 plants that were meant for extensions had to be used for filling up blanks. Willows and cottonwoods suffered most, owing in part to bad planting. Drought was the main disturbing factor, however.

The plantations previous to 1910 were few in my district in Saskatchewan. I can safely say that all are in good condition, some of them, indeed, splendid, and demonstrate in a thoroughly practical manner what can be done on the prairie in beautifying the home surroundings, in addition to giving substantial shelter from the cutting winds in winter. In Manitoba, where the majority of the older plantations are, they have in most cases done well; and where ordinary care has been given, there is nothing left

to be desired. Indeed, too much credit cannot be accorded some men who have persevered in the face of many setbacks. Some of them have been repeatedly hailed, but in spite of this they have fine plantations to-day.

On the Goose Lake branch of the Canadian Northern Railway, and the Canadian Pacific and Grand Trunk Pacific railways west of Saskatoon, the 1910 trees suffered severely during the early spring and summer months from drought, owing no doubt to the dry fall of 1909 and lack of rain in the early part of the summer of 1910. The plants made little growth until after a heavy rainfall in the first week of September, which started growth afresh and kept them growing late, with the result that the maple and cottonwood were all more or less damaged by frost, thereby weakening many plants which were unable to recover and died off, causing many blanks.

Cottonwood should not be sent to the district surrounding the Goose Lake branch, or at least only sparingly, and then only when asked for, as they do not do well. I believe that the soil and rainfall have much to do with its poor showing in this locality. Hitherto the rainfall has been scanty. The soil is apparently fertile enough, but heavy, compact and inert; there is little humus in it, consequently it has to be worked deep to permit the entrance of air and moisture and enable plant roots to get away from the surface. I think that these conditions affect the cottonwood adversely. In the north country damage from frost was in evidence from too late growth. In Eastern Manitoba I observed no damage from frost; the plantations were unchecked from either frost or drought.

I have obtained data regarding the rain and snow-fall in Manitoba and the Eagle Hills district of Saskatchewan for the years 1910 and 1911. Those for Manitoba were furnished by the Manitoba Department of Agriculture at Winnipeg, and those for the Eagle Hills district by J. Saunderson, Esq., of Anglia, Sask. The following are the figures:—

Station.	Location.			March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Total.
				1910.									
	Sec.	Tp.	Rg.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Manitoba—													
Hillview	9	11	23 wP	2·25	1·46	1·63	1·52	2·55	0·63	2·38	0·35	0·08	12·85
Minnedosa	1	15	18 wP	0·72	1·30	0·98	2·63	1·60	1·73	1·48	0·16	.....	10·60
Rapid City	20	13	19 wP	0·18	0·82	1·10	3 39	1·44	0·83	1·74	0·90	.....	10·40
Swan River	21	36	27 wP	.....	0·76	2·20	3·17	1·30	4·47	0·79	0·22	.....	12·91
Average of above four Stations				.....	.....	.....	.....	.....	.....	.....	.....	.....	11·69
				1911.									
Hillview				.....	.....	3·73	2·82	4·16	6·82	1·62	2·56	.....	21·71
Minnedosa				.....	0·62	2·87	3·05	2·05	3·42	2·77	1·86	.....	18·64
Rapid City				.....	0·85	3·25	2·28	4·95	4·83	1·69	3·07	.....	20·92
Swan River				.....	0·31	2·96	3·52	2·64	3·68	2·37	1·12	.....	16·60
Average of above four Stations				.....	.....	.....	.....	.....	.....	.....	.....	.....	19·46
				1910.									
Saskatchewan—													
Anglia — J. Saunderson, observer.	30	30	16 w3	0·20	0·55	1·88	1·02	1·37	1·58	0·36	1·40	.....	8·36
				1911.									
Anglia				0·80	1·19	10·21	3·66	1·84	0·73	.....	1·14	.....	19·57

These figures may be taken as fairly representative of the districts in which my work lay. In both provinces it will be seen that there is a great difference in the amount of moisture in the two years given. It is decidedly marked, especially in Saskatchewan, where the rainfall recorded for June, 1911, was 1·85 in. more than the total recorded for the whole year of 1910. But 5·50 in. of the rain which fell in June, 1911, fell on the 30th in two hours and twenty minutes.

Naturally soil conditions varied much in the districts covered by me in western Saskatchewan. The soils ranged from a pure sand to heavy clay. Much of it is a heavy brown compact loam, difficult to work, and, unless deeply worked, difficult of penetration by plant roots. Around the country north of the Canadian Pacific Railway and Grand Trunk Pacific Railway west of Saskatoon, the country has more bluff; the soil was in consequence more free and open and, therefore, naturally adapted for tree growth. In the north of Saskatchewan and most parts of Manitoba, the soil is a heavy black loam with abundance of humus, the accumulation of herbage which had died off each year and become incorporated in the soil. Trees grow luxuriantly in such soil, and I saw some great growth in most of the plantations set out.

Planting this year (1911) has been well done. No fault could be found unless with the cuttings; some men did not plant according to plan, but these were few.

Cultivation is another matter of supreme importance, and at times it is difficult to get some men to do it thoroughly in the heavy class of soils. They object to deep ploughing on account of the horse-power it requires, and this is just the very class of soil which needs deep and thorough preparation to give plant roots a deeper and wider pasturage and to enable them to resist drought more successfully. Root-cropping bare summer-fallow as a preparation is best for this class of soil, and indeed for all soils except very light sandy ones. All vegetation has a better chance of dying out, before the trees are planted.

Sweet grass is also prevalent in low spots, and is to be found everywhere. It is especially abundant in the north country where it is favoured with more moisture. This grass and quack or twitch grass have given more trouble in the plantations, I believe, than all other harmful influences put together, and is a sure sign when found in the plantations of improper preparation of the soil. If it is not thoroughly cleaned out before planting, it will be impossible to get rid of it after setting out the trees.

I did not see any signs of insect pests or fungoid diseases of any kind this season. Hail was the only cause of damage that I saw, save the effects of drought and frost in the 1910 plantations.

The question of pruning is always turning up, but it is not encouraged except in removing broken branches and trimming damaged trees.

There is a growing demand for tree seed. This is a good sign and will prove a valuable adjunct in the formation of plantations and woodlots of large size in the future; but little is known about tree seeds by the average farmer. To those desirous of having it, I have sketched the shape of seed of maple on slips of paper, if seed was in the neighbourhood, and told them where to procure it and at the same time giving them any other information that I thought useful along these lines. Many have tree seeds in their neighbourhood and do not know it is there, but are glad enough when told about it.

Respectfully submitted,

JAMES KAY,
Inspector of Tree Plantations.

No. 10.

REPORT OF WM. MACDONALD.

DEPARTMENT OF THE INTERIOR,
FOREST NURSERY STATION,
INDIAN HEAD, SASKATCHEWAN, January 18, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I beg to submit herein my second annual report on tree planting inspection work as carried on by the Forestry Branch, Department of the Interior.

The districts assigned to me included two branches of the Canadian Pacific Railway, viz., the Soo line (Drinkwater to North Portal) and the Outlook branch (Tuxford to Outlook), and the Goose Lake branch of the Canadian Northern Railway from Fiske to Alsask.

The total number of places on my list to be visited was 1,020. Of these, 593 were old applicants who had received trees from one to three years, and the remaining 427 were new, and, therefore, were visited for the first time with a view to receiving trees in the spring of 1912.

Trees were granted to 520 applicants for the coming season. Of this number 239 received trees for the second time to continue their plantations, and a small percentage of the latter number received an allotment of a hundred or two for the third time to fill up gaps which occurred through the dry season of 1910. The remaining 281 are new applicants to whom trees were granted for planting next spring. Seven hundred and sixty trees being the average per man, 395,200 trees will, therefore, be distributed over the above districts.

Of the new applicants 146 were not granted trees, owing principally to the lack of sufficient cultivation, more especially so in the newer districts such as the country west of the Saskatchewan river from Outlook, and in the Goose Lake country. In the earlier-settled districts many are selling out and the new owners either were not aware of the distribution arrangements, or, being too busy to get the land in shape, deferred their application for a year. A common mistake is the preparation of proposed plantations too close to buildings, the idea in this respect being 'the closer to buildings, the better shelter from the prevailing winds.' No thought of snow accumulation in the enclosure is entertained until the mistake is pointed out, when the applicant immediately commences to prepare his land according to directions given for the following year's distribution.

The plantations which were set out in 1911 did exceedingly well. They were well planted and cared for, and in the districts traversed an average of 95 per cent of the trees and cuttings were found to be alive at the time of inspection. Cottonwoods seemed dry and slow of starting into growth, but from June 30, when a general rain was experienced over Western Saskatchewan, it became apparent that the larger percentage of these began to shoot from the roots.

Although the dry summer of 1910 was so unfavourable to tree growth in the case of fresh-planted stock on the prairie, yet where cultivation was persisted in, many good plantations with strong vigorous growths of three feet amongst the maple, nine inches for the ash, and from two to four feet in the case of the cottonwood and willow were to be seen. This substantiates the statement that when the work is done thoroughly there may be no fear of the results which usually follow a dry season.

Plantations set out previous to 1910 are now showing up well, and great pride is taken in them by the owners. From measurements taken of three-year-old belts, the trees average about as follows in height: Maple, 5 feet; ash, 3½ feet; cottonwood and willow, from 7 to 9 feet. These heights are not unusual, and in the older settled districts along the Soo Line, many plantations may be seen from fifteen to eighteen feet in height.

The spring of 1911 was a most favourable one for the planting of trees, owing to the amount of moisture precipitated during the fall of 1910 and the heavy snow which fell during the winter. The spring also, opening up as it did with an abundance of rain, did much to stimulate this work just when desired. A dry spell later, however, struck south Saskatchewan, and grave fears were entertained of a recurrence of the 1910 experience which was even worse owing to the appearance of late frosts. Especially was this the case in localities southwest of Weyburn. On the morning of June 26 I noticed several plantations where the young shoots of ash had been affected in consequence of frost, but no permanent damage was done. From June 30 the rainfall was more or less general and above the average of late years over Western Saskatchewan. No damage was noticed, however, from winter-killing.

Along the Soo Line the soil varies from a sandy to a heavy chocolate loam with a clay subsoil. The latter makes cultivation a difficult matter owing to the baking of the surface soil when dry and the heavy sticky nature when wet.

In the districts covered over the Outlook branch, the soil is more of a rich sandy loam with more or less of a clay subsoil. The soil being more friable, this country is well adapted to the growth of trees.

The soil in the country traversed from Fiske westward on the Canadian Northern Railway is generally a heavy clay, and in certain districts a hardpan subsoil with an open surface soil, known as 'loose top;' there being little vegetation on this, it can be easily worked up into fine shape soon after breaking, if backset deeply. This country being newly settled, there are few plantations set out from which to compare results of the various species distributed.

Owing to the heavy snowfall of 1910 and 1911, many of the old plantations were damaged to a great extent with snow-drifts. More particularly was this the case where the plantations were of a width over eight or nine rows and with no snow-trap. The damage done in this way is rather unfortunate after the time and labour expended on them. Fine gardens are now to be seen here and there with abundance of small fruits and vegetables, many now taking advantage of the snow-trap for this purpose.

No damaging effects from insect pests or disease were perceived to any extent, this being due, no doubt, to the cool, damp season of 1911.

With the extension of railways now under construction south of the Canadian Pacific Railway main line westward, and the Goose Lake Branch of the Canadian Northern Railway to Munson in Alberta, another big field is being rapidly opened, and many farmers whose places now lie remote from any existing line are already taking advantage of the co-operation of the Tree Planting Division of the Forestry Branch to shelter and beautify their new homes.

Your obedient servant,

WM. MACDONALD.
Inspector of Tree Plantations.

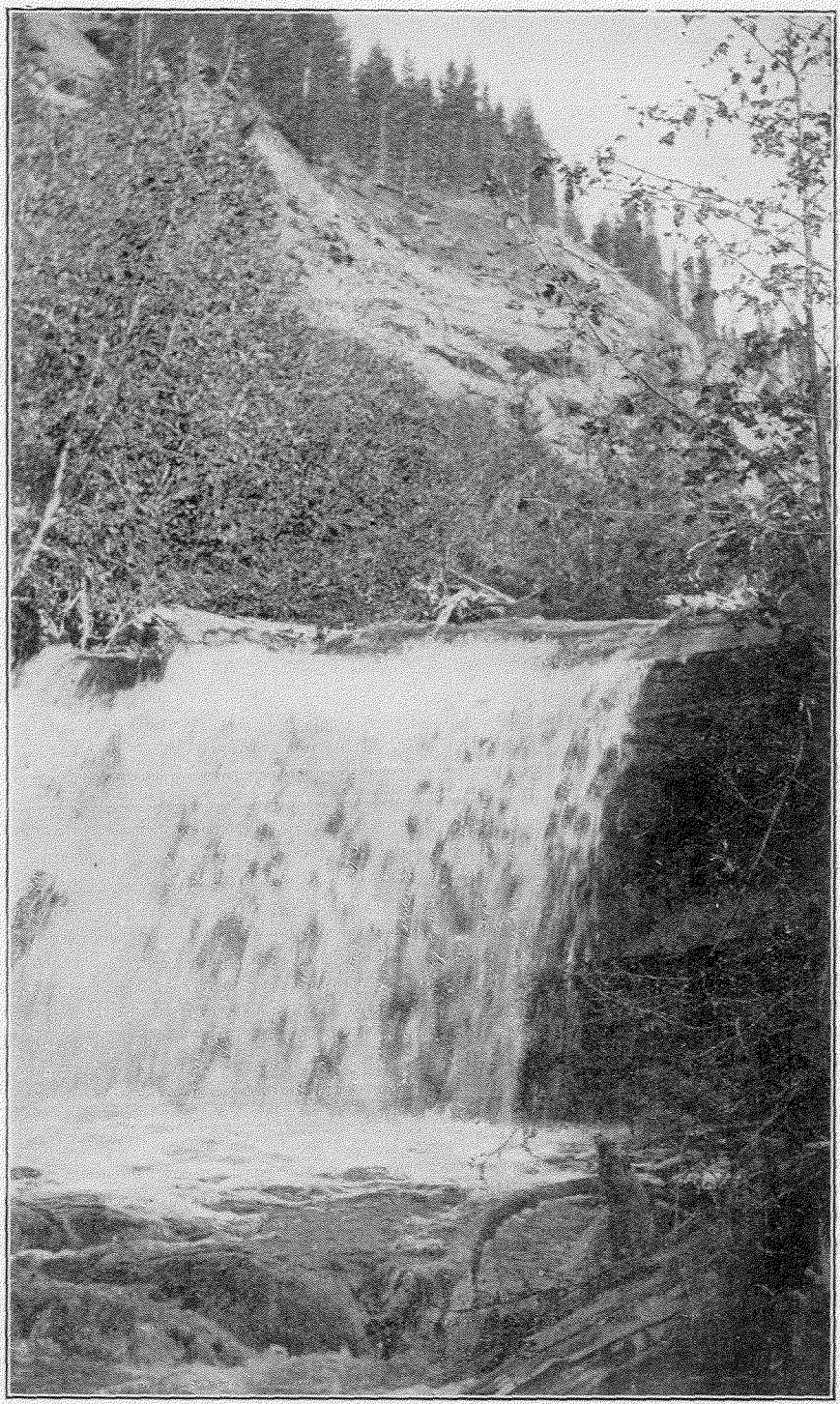


Photo G. H. Edgecombe, 1911.

Athabaska Forest: Falls on Creek running into Hay River.
Tp. 55, Rg. 25, west of 5th Meridian.

No. 11.

REPORT OF JAMES COWIE.

DEPARTMENT OF THE INTERIOR,
FOREST NURSERY STATION,
INDIAN HEAD, SASKATCHEWAN, February 13, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I have the honour to submit to you my first report as Tree Planting Inspector in connection with the Tree Planting Division of the Forestry Branch.

The districts assigned to me for inspection were those traversed by the main line of the Canadian Pacific Railway, Crowsnest line west of Medicine Hat to Hillcrest, the Alberta Railway and Irrigation Company's lines from Lethbridge south to Stirling and Cardston and from Stirling south to the International boundary line, the Lethbridge-Carmangay branch of the Canadian Pacific Railway, the Calgary-Macleod line from Macleod to Midnapore, and the Calgary-Edmonton line from Airdrie to Didsbury.

I was under orders to return to Indian Head on September 28, to assist in the digging and heeling-in of the stock for 1912, and therefore 54 applicants on the Calgary-Edmonton line were visited in October by Mr. S. S. Sadler of the Forestry Office, Indian Head.

The total number of applicants on my list to be visited was 798. Of this number, 514 had received trees one or more years, and the remaining 284 were men to be visited for the first time in connection with the distribution of trees in the spring of 1912. The total number of men to whom trees were granted for 1912 is 395. Of this number, 223 had received trees one or more years who wish to further extend their plantations and to fill up failures owing to various causes, but principally through the dry season of 1910. The remaining 172, being applicants who have their ground prepared satisfactorily and have satisfied the requirements of the Forestry Branch, were granted trees for planting in the spring of 1912.

The number of trees allotted for these 395 applicants is 300,240, an average of 760 trees per applicant. New applicants had trees withheld, chiefly for two reasons, either because their ground had not been properly prepared, consisting of spring breaking, sod not sufficiently rotted, unbroken ground, wheat or other cereal growing on land intended for trees, or because of the proximity of the intended plantation to buildings. A thorough preparation of the soil and a minimum distance of one hundred feet from the buildings was insisted on. In some instances applicants had sold out, and an application to the Forestry Branch from the new owner was necessary before trees could be granted.

The plantations set out in 1911 are a decided success with a very small percentage of failures. I estimate 97 per cent of the trees and cuttings set out in the spring of 1911 have taken root. This is very encouraging when consideration is taken of the distance some of the applicants are from a railway station and the time elapsed in the transit of the trees. Frequent complaints were made of the carelessness of the express agents; some of the shipments of trees lay for weeks and in some cases were never received by the consignee, this no doubt being accounted for by the express charges being prepaid. In every case the applicants readily endorsed the recommendation of the Forestry Branch that express charges were to be paid by the applicant on receipt

of the trees in the spring. The fact that so small a percentage of the cuttings and trees failed to take root, and the vigorous growth were due to moisture in the ground in the spring, owing to the heavy snowfalls of the previous winter and the abnormal rainfall of the summer of 1911. In many cases the cuttings of Russian poplar and willow made growths of three feet and upwards.

The plantations set out in 1910 were not so successful, with a much larger percentage of failures on the lighter soils with gravelly subsoils. The prolonged drought during the growing season of 1910 was the principal cause of failures.

It was gratifying to see that where thorough cultivation was persisted in and the air cells broken up through which any moisture in the ground was slowly evaporating, a larger percentage of trees and cuttings had taken root and in the summer of 1911 were making vigorous growth. Among the maples planted in 1910, growths of three feet were quite common, among the ash eighteen inches, and Russian poplar and willow, four feet.

From Lethbridge south on the Alberta Railway and Irrigation Co.'s lines, some of the older plantations planted previous to 1910 are to be found. These are grown under two conditions, cultivation and irrigation, and to judge by the flourishing plantations to be seen in the villages and along the road allowances, both systems have had good results. It is a common thing to see five and six-year-old plantations, twelve and fifteen feet high, enclosing gardens in which small fruits are being successfully grown. On the Macleod-Calgary line also, some of the older plantations are to be found. Around the Royal Northwest Mounted Police barracks at Macleod, an object lesson can be had. Cottonwoods and Russian poplars planted in 1907 and 1908 are from ten to twelve feet high, and the tamarack planted in 1910 are all alive notwithstanding the dry season and growing on gravelly subsoil. The beneficial effects of persistent cultivation are here thoroughly established.

West of Medicine Hat, where the soil is a light sandy loam, I saw cottonwoods and ash four and five years old, which had made vigorous growth up to 1909, killed back, root and branch, during the winter of 1910. This I attribute to the heavy rains which came early in the fall of 1910, starting growth and rushing a flow of sap. The trees were caught and killed by the first fall frost while still growing and before they had time to ripen their wood. This was the only case of killing outright I met with, and, I am glad to say, was the exception and not the rule.

From range twenty-four, west of the fourth meridian, to range two, west of the fifth, owing to the elevation and extremes of temperature, only certain varieties of trees seem to be successfully grown. Russian poplar, willow and caragana seem to grow the best. Owing to the proximity of the foothills, precipitation is greater than in the prairie country further east; hence comes a richer soil and subsoil with the accumulation of decayed vegetation. Trees such as maple and cottonwood have a tendency to grow too late in the fall on this rich soil, and the young wood, not being ripe, is cut back by the early fall frost. On September 11, I found, while visiting section 22, township 17, range 29, west of the 4th, the growths of cottonwood and maple of 1911 killed back twelve inches with an early frost on September 6. This plantation is situated in a coulée and seemed to have suffered frost-hurt worse than plantations of a higher altitude.

In view of the freezing-back of these species the proportions of trees assigned to plantations in Southern and Western Alberta for 1912 are as follows:—Maple, 11·1 per cent; ash, 7·5 per cent; Russian poplar, 15·7 per cent; willow, 31·5 per cent; and caragana 34·2 per cent. The precipitation of Southern Alberta taken at Lethbridge for the past ten years averaged 16·16 inches. The rainfall for 1910 was 7·36 inches and for 1911 was 22·03 inches, or about three times the amount of 1910 and six inches above the average for the last ten years.

I observed no damaging effects from insect pests. Cutworms partially girdled a few maples in some districts early in the season, but the damage was overcome by the

vigorous growth later on. Owing to the abnormally wet season a few cases of rust were observed on some of the older cottonwood trees.

Soil conditions vary from pure sand around Medicine Hat to a heavy black loam further west, the accumulation of years of decayed ground-herbage forming a mild humus—a soil covering of the greatest importance in tree growth. From Macleod south to the International boundary line the soil is diversified from sandy loam to clay loam, well adapted for forming fibrous roots so essential to the healthy development of young trees.

In nearly every case a larger area of land was prepared than trees could be supplied for, and in some cases where a former applicant had received trees for two or three years and was written off the list, I found land prepared for further extension to plant with the root-suckers of cottonwood and Russian poplar that had sprung up in his garden patch through the mutilation of the roots of the parent trees by cultivation. Of the districts visited by me I would say that 85 per cent of trees planted under the co-operative tree planting scheme of the Forestry Branch are alive and 75 per cent growing well.

Taken as a whole, although this was my first year of inspection, I saw ample evidence of the enthusiasm with which the co-operative tree planting scheme is being carried on, an enthusiasm which leaves no room for doubt of its ultimate success. No country in the world would be more benefited by extensive planting than the prairie provinces of western Canada, as its long and cold winters would be very much ameliorated by it, while the great heat of summer would be moderated by the same cause and the agricultural interests of the country would become vastly improved, while every other branch of industry would be strengthened in proportion.

Your obedient servant,

JAMES COWIE,
Inspector of Tree Plantations.

No. 12.

REPORT OF GEO. KENNEDY.

DEPARTMENT OF THE INTERIOR,
FOREST NURSERY STATION,
INDIAN HEAD, SASKATCHEWAN, January 18, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I beg to submit my first report as Inspector of Tree Plantations.

I started inspection duties on the 5th June, the districts assigned me being those traversed by the Canadian Northern main line from Kamsack to Lloydminster and from Regina to Warman on the same system, all in Saskatchewan. Mr. James Kay, Inspector of Tree Plantations, was sent with me to give an insight into the work.

I had 767 names on my list and out of that number I visited 751. The remainder were not visited owing to the distance of their location from the railway. To each of these I mailed a printed form for the purpose of obtaining the necessary data in regard to their proposed plantations.

For 1912 I have granted trees in 371 places, and out of that number 191 have already received trees one or more years. Those who have received trees on only one occasion are entitled to a further supply for another year, and there are 121 applicants who will get planting material for new ground in 1912. I granted trees to 179 new

applicants, their ground and distances from buildings fulfilling the Department's requirements. There are 110 of the new applicants who will not get planting material in 1912, and the reason for this arises from various causes; some of them have sold their farms, others have not sufficiently prepared their ground, others, again, have prepared their ground too near their buildings, and various other reasons also exist in consequence of which planting must be deferred. Those who remain and are still wishing trees will be visited in 1912 and will receive trees in 1913, providing their ground is in shape.

The plantations of 1911 have done splendidly and the young trees put on a good growth for the year, especially the maples. The trees could not be planted under better conditions, the weather being showery and continuing so more or less during the summer.

I should say there are 97 per cent of the 1911 trees alive; the only deaths worth mentioning are those of the cottonwoods and cuttings of Russian poplar and willow. On the whole the plantations of 1911 have done well, and, therefore, will have a good start in 1912.

Twenty-five per cent of the trees in the plantations of 1910 died owing to the small amount of precipitation during the growing season of that year. A large percentage of loss occurred among the Russian poplar and willow cuttings. The plants that were left made good progress during 1911, and are now thoroughly established. Applicants who desire to fill up failures in these 1910 plantations will receive planting material for that purpose in 1912.

Plantations set out previous to 1910 which have received proper cultivation are now fairly well established. The climatic conditions in 1911 have been very favourable to tree growth. The only district that suffered from drought was between North Battleford and Lloydminster, and consequently the trees in that district did not do so well as those in localities having a greater amount of rainfall.

I did not see any particular damage caused by late or early frosts, and insect pests and fungoid diseases were not to be seen. Around Bethune and Craik the rabbits were rather severe on the ash during the past winter.

The soil in the territory I covered is pretty much the same, being a heavy chocolate loam, but as one gets nearer the Alberta border it is lighter, being more of a sandy loam. However, it is all quite suitable for the different species sent out by the Department. Amongst some of the older plantations there are trees which have attained a height of fifteen feet, and their branches have shaded the ground sufficiently to dispense with further cultivation.

A source of great trouble to the plantations is the sweet grass, which is fairly prevalent in some districts. I do not know of any remedy for destroying this grass except to thoroughly remove the roots from the soil with a garden fork. Mulching with straw is not very successful, unless the mulch is renewed wherever the grass has not been completely smothered. I endeavoured to impress upon the new applicants the necessity of having their ground properly prepared and free of any grass roots, especially sweet and couch grass, before the trees are planted.

I had frequent inquiries for evergreen trees, and I see no reason why these should not do as well as the deciduous varieties. I saw several very good specimens of white spruce on farms during my tour, and believe if the evergreens were grown in groups, that they would do much better than if planted in rows or as single specimens.

The number of applications which were cancelled on account of neglect did not amount to more than two per cent. On the other hand I found the farmers very proud and enthusiastic over their trees, in general having fulfilled all the requirements as set forth by the Forestry Branch.

Respectfully submitted,

GEO. KENNEDY,

Inspector of Tree Plantations.

No. 13.

REPORT OF EDWARD WALMSLEY.

DEPARTMENT OF THE INTERIOR,
DOMINION LANDS AND CROWN TIMBER OFFICE,
NEW WESTMINSTER, B.C., November 15, 1911.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I have the honour to submit herewith the annual report of this agency for the season of 1911, in connection with the protection from fire of the timber in that part of the Railway Belt east from Port Moody to the boundary line between townships 10 and 11, west of the 6th meridian.

The months of May and June were not favourable to forest fires, the rainfall being sufficient to prevent fire from running. On the North Arm of Burrard Inlet, patrolled by Ranger Bray, one fire took place, this being on the townsite of Woodhaven, and no damage was done thereby to merchantable timber.

On the 15th of July a fire started at the south end of Coquitlam Lake (east side) on lands being cleared by the Vancouver Power Company at that point. This proved to be by far the most serious fire during the season, continuing to burn for some six weeks, notwithstanding the most earnest efforts put forth to subdue same by Rangers Rowland, Marshall and Martyn, assisted by men in the employ of the company mentioned. This fire ran over an area of thirteen hundred and sixty-five (1,365) acres, nine hundred and thirteen (913) acres of vacant land and four hundred and fifty-two (452) acres of land under license. The quantity of timber affected by the fire is 14,280,000 ft., board measure—10,956,000 ft., board measure, on vacant land and 3,324,000 ft., board measure, on lands under license.

Some of the timber is a total loss, but a large percentage can be saved if logged off in one or two years. The chief difficulty found in fighting this fire was the fact that it was on a steep mountain-side, where neither soil nor water was obtainable, and, although fire-breaks were cut at various points, the fire swept over them and continued to spread.

On the Coquitlam river, patrolled by Ranger Marshall (with the exception of the fire above mentioned), only two fires took place during the season, both of which were on private lands. In one case fifty cords of shingle bolts were destroyed and in the other the damage was nil. The Pitt River and Lake district, also covered by the above ranger, was by careful attention kept free from fire during the season.

With your permission I engaged a ranger this season to patrol the Lillooet river and Upper and Lower Lillooet Lakes, adjacent to which there is a large quantity of valuable timber, the greater part of which is held under license. The result of this man's work is found in the fact that, while there were a number of small fires, which consisted mostly of fires on settlers' lands and of camp-fires left unextinguished, none of these were allowed to reach the timber.

In township 1, west of the coast meridian, patrolled by Ranger Johnson, no fires occurred, nor did any fires take place in township 7, east of the coast meridian, patrolled by Ranger Gairns. In township 2, west of the coast meridian, patrolled by Rangers Jameson and Wales, ten fires, all on private lands, were attended to by these rangers, who assisted in subduing them in order to prevent their spreading to adjoining timber. In this they were successful, as no damage was done to timber under license. The only vacant Dominion Government timber in this township is the north half of

the southeast quarter of section 34, which sustained no damage from fire during the season.

In townships 13 and 16 east of the coast meridian, patrolled by Rangers Bell and Chapman, several small fires on private lands were looked after and prevented from doing any damage. In that part of township 15, east of the coast meridian, lying to the west of State river, and townships 4 and 5, range 3, west of the 7th meridian, patrolled by Ranger Gilchrist, the parties operating on Timber Berth 'X' within the first township mentioned, had a permit in the latter part of the month of April to set fire for clearing purposes. The fire got beyond their control and burned some forty cords of shingle bolts, which timber was later accounted for in the mill returns, and royalty dues paid thereon. Another fire in this district started on the 17th of July, from the operations of the Western Canada Power Company, who are clearing land to be flooded by a dam on Stave river. Two hundred thousand feet, board measure, of timber was damaged by this fire, which was fought and finally subdued by the company without any expense to the Department. A small fire on Timber Berth No. 106 on the 24th of July was subdued without any damage by the use of a pump and hose from the Western Canada Company's Plant.

In townships 18 and 21, east of the coast meridian, and township 4, range 2, west of the 7th meridian, patrolled by Ranger Hughes, no fires took place on Dominion lands. Within townships 20, 22 and 23, east of the coast meridian, in the first township there is considerable vacant Government land, in the second, Timber Berth No. 223, and in the last-named township Timber Berth No. 55. No fires took place in either of the two townships first mentioned, but several fires occurred within Timber Berth No. 55. Ranger Fadden, whose duty it was to cover this district, reported a fire on the 1st of May, in a pile of debris left by the employes of the Provincial Government in the building of a road which runs partly through this berth. This fire damaged about ten thousand feet, board measure, of timber. On the 15th June a squatter on lands within the berth, by the name of Jarabck, was found with a fire burning, for which of course he had no permit, so the provincial officials have at my request refused to issue permits to squatters on lands under license. The ranger requested Mr. Jarabck to put out the fire but he (Jarabck) refused to do so. On being informed of the circumstances I instructed the ranger to have a summons issued for violation of the Bush Fire Act. This was done and the date of the trial fixed for the 23rd of June. The defendant, however, failed to appear and it was necessary to have a bench warrant issued for his arrest. The trial was concluded on the 29th idem, the magistrate dismissing the case, as the fire did no damage. I took the decision in this case up with the Hon. the Attorney-General for this province, who agreed with me that it was not in accordance with the Act, but as I was of the opinion that the defendant was not likely to again commit himself in this way, I did not follow the matter any further.

On the 19th of July and 3rd of August, a fire started on the United States side of the line, crossed the boundary and did damage to the timber on this berth to the extent of 100,000 ft., board measure. Another fire on lands within the berth occupied by a squatter occurred on the 24th of July and damaged some 30,000 ft., board measure, of timber. In all 140,000 ft., board measure, of timber was damaged by fire on this berth during the season and about 40,000 ft. of this quantity is a total loss; the balance can be saved if logged off within a reasonable time. Timber Berth No. 55 comprises an area of 15,900 acres, and there are from one hundred to one hundred and twenty five squatters living within the berth. These require a careful watch in order to prevent them from setting fire during the dry season, and with this object in view I instructed Ranger Fadden to devote the greater part of his time to this limit, with the result that only a small quantity of timber was destroyed by fire. Ranger A. R. Hipkoe replaced former Ranger Jasper Fadden as patrol on the Chilliwack River in township 25, east of the coast meridian, and townships 1 and 2, ranges 26, 27, 28 and 29, west of the 6th meridian. The new ranger is a young man who has been brought up in

that district and is, therefore, familiar with all parts of it. Only one fire occurred there during the season, this being a large fir tree containing about 7,000 ft., board measure. Another fire, caused by lightning, started on lot No. 439, which is under the control of the provincial government, and destroyed about 50,000 ft., board measure, of timber. Under your instructions a cabin was erected during the season at Chilliwack Lake for the use of the ranger. This will prove to be very useful for the safe-keeping of tools and supplies to be used in case of a fire, as this district is very difficult to reach, and on this account it is necessary to provide as far as possible against any contingencies which might arise. Next season I propose to ask your permission to construct another building midway on the trail between Cultus and Chilliwack Lakes.

Ranger Dennison, who patrolled along the Fraser River in townships 23 and 26, east of the coast meridian, and townships 2 and 3, range 29, west of the 6th meridian, gave considerable of his attention to the right of way of the Canadian Northern Railway, and during the season only one forest fire of importance took place, this being at what is called Vedder Mountain, in township 23, east of the coast meridian; it was caused by the clearing of a part of the mountain where the provincial government is erecting a rock-crushing plant. The fire was attended to by men in the employ of the provincial government and no damage was done to merchantable timber.

Only one fire took place on Harrison Lake. This is reported by the ranger, R. Siddall, to have crossed from provincial lands into timber berth No. 534 at the extreme northern boundary of the Railway Belt. The fire ran over two acres or more of land within the berth mentioned, but was fortunately prevented from doing any damage to standing timber. Next season I propose to ask you to extend to the ranger in this district the same privilege as is accorded in two other cases, namely, to supply gasoline for the use of a power boat, which will make the services of the ranger much more valuable; at present he must use a canoe, and, as the water in this lake becomes very rough at times, the ranger is, consequently, frequently wind-bound, whereas if he had a seaworthy power-boat he would be in a position to weather any storm.

From Hope to North Bend, a distance of slightly over forty miles, three rangers, Messrs. Weaver, Manzer and Tweedell, were engaged during the greater part of the season in patrolling the right of way of the Canadian Northern Railway on the south side of the river. With the co-operation of the provincial rangers, contractors on the right of way were prevented from burning any debris during the months of July and August, and, although several small fires occurred within these months (the cause of which it was not always possible to ascertain), no damage whatever was done thereby to the timber along the right of way. The timber on the Coquihalla and Nicola rivers, which empty into the Fraser river at or near Hope, received careful attention and no damage was done to the timber in question by fire. Owing to the rush of mining prospectors via Silver Creek into what is called Steamboat Mountain on provincial lands, where a gold find was reported, the licensee of timber berths on this creek kept a ranger patrolling for some three months in order to keep a watch on the prospectors. This ranger reported from time to time to the Dominion government ranger at Hope and the foresight of the licensee in this respect is proved by the fact that, although many camp-fires were found along the trail, which had not been extinguished by the prospectors, these were attended to by the ranger and not allowed to spread as would no doubt have been the case had no person been interested therein. The rangers employed on the south side of the Fraser river, from their position, were able to keep a close watch along the line of the Canadian Pacific Railway on the north side of the river and, although some twenty-one fires occurred along this line of railway between Choate Siding and North Bend, a distance of thirty four miles (all of which were said to have been caused by sparks from locomotives), these were, with the assistance at times of the rangers mentioned, together with Ranger Teague at Yale, subdued without any damage to standing timber. It is hoped that next season arrangements will be made to take advantage of the amendment to section 30, paragraph F, of the Railway Act, by calling upon the Canadian Pacific Railway Company, through

the Board of Railway Commissioners, to establish a patrol on that part of their railway from Agassiz to North Bend, which, being upgrade, necessitates the forcing of the locomotives and the consequent emission of fire, notwithstanding the fact that such locomotives are equipped in accordance with the regulations as laid down by the Board of Railway Commissioners. In this connection I may say that under the authority of the board, a rigid inspection was made, throughout the season, of all locomotives running on the western part of this line, and in nearly all cases they were found to comply with the requirements of the regulations. The quantity of timber damaged or destroyed by fire on Dominion lands within this agency during the season is 14,627,000 ft. and 40 cords of shingle bolts. About 5,000,000 ft. of this quantity is a total loss; the remainder can be saved if logged over within one or two years. Each succeding year adds more difficulties to the work of fire-ranging in the advent of new railways and settlers, and it will be necessary to extend the service from year to year in order to meet these contingencies. I sincerely appreciate the prompt manner in which you have met any suggestions made to you during the season for the improvement of the service, and I am pleased to report that the rangers have been found willing to carry out their duties to the best of their abilities.

Respectfully submitted,

EDWARD WALMSLEY,
Acting Crown Timber Agent.

No. 14.

REPORT OF R. J. STEWART.

DEPARTMENT OF THE INTERIOR,
REVELSTOKE, B.C., January 1, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I have the honour to submit herewith my report for the season of 1911, covering the protection from fire of the forest in that part of the Railway Belt known as the Kamloops District, over which I had supervision.

In Mr. F. Abey's district south of Illecillewaet there were during August two small fires caused by lightning, in which no timber of value was destroyed. The cost of fighting these fires was $102.50. Mr. F. Ashdown, who patrolled the new Golden-Crowsnest line south of Golden, had one small fire during April and two during June. The cost of fighting these fires, in which no timber was destroyed, was $31.50. In Mr. J. Bell's district in the vicinty of Grandprairie and Spallumcheen Lake during May a small fire was caused by settlers clearing land, but no damage was done. On July 27 he fought a fire (cause unknown) at Pillar Lake, in which 10,000 ft., board measure, of timber was destroyed. The cost of fighting these fires was $69.50.

Mr. C. D. Collett, who patrolled the railway line along the Nicola river, put out a fire on July 14 at Agate Creek which covered 200 acres but burned only a small quantity of young growth. The cost of extinguishing this fire was $146.

Mr. W. J. Dickey, who patrolled the Revelstoke and Arrowhead branch south of Revelstoke, fought, in all, 24 fires during the summer, none of serious proportions. On July 8 one caused by lightning near Timber Berth No. 289 burned 3,000 ft., board measure, of timber, and on June 1 six small fires caused by railway engines

burned 3,000 ft., board measure. He expended during the summer $315.70 in fighting fire.

Mr. F. E. Forrest, who patrolled the railway line in the vicinity of Albert Canyon, put out four small fires, none of which did any damage, at a total cost of $104. In the district of Mr. R. Johnstone, who patrolled the Okanagan branch of the Canadian Pacific Railway there were two rather large fires. On June 22 a fire, starting from unknown causes, in section 35, township 19, range 9, west of the 6th meridian, covered 400 acres, and burned 100,000 ft., board measure, of timber. The cost of fighting this fire was $130. On June 18 a fire, caused by lightning, at Trinity Creek covered 1,000 acres and burned 150,000 ft., board measure. The cost of fighting this fire was $835.

Mr. J. Lidstone, who patrolled the railway line in the vicinity of Taft, had three fires in his district. Two were of no size, but one on June 1, at Craigellachie (cause unknown) burned 20,000 ft. of timber. The total cost of fighting the three fires was $20.

Mr. R. Cossaboom, who patrolled Salmon Arm and Shuswap Lake, put out one fire in Annisty Arm on August 1, which, starting from unknown causes, covered 800 acres and burned 200,000 ft., board measure, of timber. The cost of fighting this fire was $417. On August 19 he extinguished a fire caused by lightning at Seymour Arm, which covered eighty acres and burned 25,000 ft., board measure. The cost of fighting this fire was $435.

In the district of Mr. G. Lund, who patrolled the railway line west of Revelstoke, on July 17 a fire (cause unknown) twelve miles west of Revelstoke, covered two square miles, burned 100,000 ft., board measure, of timber and 500 cords of wood, and cost $620 to extinguish. He had two other fires caused by lightning, which did no damage but cost $260 to fight.

In the district of Mr. J. Mizon, who patrolled the railway line in the vicinity of Malakwa, there were in all five fires. On June 2 a fire caused by a railway engine covered 20 acres, burned 5,000 ft. of timber and cost $69 to put out. On June 13 a fire seven miles northeast of Craigellachie, caused by lightning, burned 15,000 ft. of timber and cost $121 to put out. On August 4 a fire caused by lightning covered fifty acres, burned 12,000 ft. of timber and cost $227.72 to put out. The other two fires, which did no damage, were extinguished at a cost of $380.

In Mr. H. A. Morris' district in the vicinity of Revelstoke there were two fires. On June 19 a fire near the Dominion Sawmills limits, caused by a logging engine, covered an area 5 miles long and about half a mile wide, burned 200,000 ft. logs and killed 250,000 ft., board measure, of young timber. This fire cost $353 to put out. On August 2 a fire in the same vicinity caused by lightning covered 2 acres, burned 4,000 ft. of timber and cost $76 to extinguish.

Mr. A. McGillivray, who patrolled the railway line in the vicinity of Semlin and Spence's Bridge, put out five small fires at a total cost of $135.

Mr. J. D. McGuire, who patrolled the country south of Salmon Arm, put out two small fires at a total cost of $84.25.

Mr. D. Orr, who patrolled the Revelstoke and Arrowhead branch south of Wigwam, had a series of fires caused by railway engines, during June and July, burning over an area of about two square miles which had been practically all logged over, but 500,000 ft. of cut logs were destroyed. These fires were fought at a total cost of $1,755. On August 2 he extinguished a fire near Timber Berth No. 112, caused by lightning, covering fifty acres and killing 100,000 ft., board measure, of young trees. The cost of fighting this fire was $423.50.

In the district of Mr. W. R. Peacock, who patrolled the railway line in the vicinity of Notch Hill and Shuswap, there were two fires which destroyed no timber and were extinguished at a cost of $800.

In the district of J. C. Sheirlock, who patrolled the railway line in the vicinity of Golden and Donald, there were in all four fires. On July 18 a fire six miles north

of Donald, caused by lightning, covering an area of two acres, burned 15,000 feet of timber and was put out at a cost of $18. On July 27, a small fire caused by lightning burned over one acre with no damage to timber, and was extinguished at a cost of $15. On August 22, a fire caused by lightning near Timber Berth No. 85, covering an area of 500 acres, burned up some small growth and was extinguished at a cost of $54. On September 3, a fire, caused by lightning, 23 miles north of Donald, covering an area of 35 acres, burned 20,000 feet of timber and cost $108 to put out.

In the district of Charles Todd, who patrolled the country in the vicinity of Adams Lake, a fire at Louis Creek on August 2 burned over fifteen acres with no damage to timber and was extinguished at a cost of $24. Mr. Todd put out several small fires resulting from camp-fires, which did not damage any timber, without incurring any expense.

Summing up, there were destroyed in these fires 1,555,000 feet, board measure, of timber and 500 cords of cordwood. The cost to the government of extinguishing these fires, in addition to the ranger labour, was $8,336.40.

Respectfully submitted,

R. J. STEWART,
Chief Fire Ranger.

No. 15.

REPORT OF LETELLIER O'CONNOR.

DEPARTMENT OF THE INTERIOR,
DOMINION LANDS AND CROWN TIMBER OFFICE,
MEDICINE HAT, ALBERTA, December 14, 1911.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—With reference to your communication of the 10th ultimo I beg to furnish the following report regarding my work of organizing more thoroughly the fire-ranging service on Lesser Slave lake, Lesser Slave river, the Peace river and the Grande Prairie.

As instructed by you in your communication of the 7th April last, I proceeded to Edmonton, where I interviewed Mr. J. E. McLaggan, who has general charge of the fire-ranging in the Edmonton district and northwards, and reached an understanding so that there would be no overlapping of ranger districts and that the districts of rangers working from the south under Mr. McLaggan would properly connect with those appointed by me, who would be working from the north.

I left Edmonton on May 5, and went by stage to Athabaska Landing, thence by steamer to Mirror Landing. From Mirror Landing I proceeded by pack train to Grouard, stopping at Sawridge on the way, where I interviewed Fire Ranger Lyllick and went into the matter of his district with him. At Grouard I interviewed Fire Ranger Cunningham and allotted him a district. At this latter place after careful consideration I appointed J. W. Allonby as fire ranger, and allotted him a district.

At Grouard I took a team and crossed the portage to Peace River Crossing, where I interviewed Fire Ranger Knot, and appointed Fire Ranger L. Bourassa, allotting each a district. From this place I proceeded by steamer to Fort Vermilion, where I appointed John Bourassa as fire ranger. I also interviewed Fire Ranger Southerland. I allotted both of them districts.

From Vermilion I proceeded to Red river, went up the river a short distance and then returned to Peace River Crossing; thence by team to Dunvegan, where I interviewed Fire Ranger Ferguson, and appointed Fire Ranger Martineau, giving each a district.

The list of fire rangers, their addresses and districts assigned to each will be found further on.

After visiting the Grande Prairie I returned to Edmonton, following the trail along which I had gone in. When on this journey I went into the matter of fire protection with all whose experience I considered would be of benefit to the Department and as a result I beg to submit the following observations and recommendations.

It would appear that many fires result from fires that have been smouldering in moss or muskegs throughout the winter, some caused by hunters and travellers leaving their fires in the fall after the fire-rangers are called in, that is to say, from October 30 until the snow-fall. These fires apparently smoulder all winter. Others are caused by fires which are left burning by campers in the winter, and which, after the snow is melted, work their way into the moss or muskeg and smoulder there till after the snow disappears, and after a short spell of dry weather break out into serious fires.

In this connection I beg to recommend that the fire-rangers be put on their districts between 1st and the 15th of March and continue their work till the first real snow in the fall, or till November 1, and thus stop these fires in the incipient stage.

With regard to the right of our fire-rangers to call out people to fight fires, the provincial authorities claim that our men have not this right, and while not wishing to enter into the merits of this question, I beg to suggest that steps be taken to have their powers clearly defined before someone makes a test case of the same. This I am expecting, as most of the new settlers are not very willing to go out to fight fires, and should it be decided that our fire-rangers have no authority to call out people, their usefulness would be greatly curtailed. I also beg to recommend that fire-rangers be given the power of constables.

Another thing which I consider would greatly benefit the fire-ranging service in these districts would be the construction of boats suitable for the navigation of Lesser Slave Lake and River and of Peace River. The former boat might be stationed at Sawridge, where it could be reached by wire from Mirror Landing at the mouth of the Lesser Slave River, and from Grouard at the west end of Lesser Slave Lake, when not patrolling the lake and river. The other might have its head-quarters at Peace River Crossing, the central point on the Peace River patrols, and could be reached as far west as Dunvegan by wire when the line is completed at that point, which it is expected will be next spring.

I also consider it would be advisable to have a chief fire-ranger appointed, whose duties would consist of laying out the different districts of the fire-rangers in these districts, travelling all over the different patrols and thus keeping an eye on the way in which the different fire-rangers are doing their work, certifying their diaries and accounts and making any alterations he would consider necessary for the better protection of the timber in question as would be required from time to time.

The country adjacent to the Lesser Slave Lake and River is covered with fair-sized spruce and jack pine, with a mixture of poplar.

From Grouard to Peace River Crossing the country is mostly covered with tall poplar timber of merchantable quality. There are also a certain number of clumps of good jack pine and spruce.

The Peace river is lined on both sides with small poplar, spruce and jack pine, but some distance back from the river there are good large patches of good merchantable timber—jack pine, spruce and poplar.

From Dunvegan to Grande Prairie the timber is mostly a mixture of spruce, jack-pine and poplar, some of which is of good merchantable quality.

On the Grande Prairie and the Spirit River Prairie the country is covered with poplar bluffs, with no merchantable timber except on the outer edge between the

prairie and the Smoky and Wapiti rivers where some very fine jack pine and spruce are to be found.

The following is a list of the fire rangers, their addresses and districts covered by each:—

Thomas Lyllick, Sawridge, patrols from the mouth of Lesser Slave river to its source at the east end of the Lesser Slave lake; from the east end of the Lesser Slave lake on the north shore to the Narrows and on the south shore of Lesser Slave lake to Swan river.

Sam. Cunningham, Grouard, patrols on the north side of Lesser Slave lake from The Narrows to Grouard and on the south side of Lesser Slave lake from Swan river to Grouard, and from Grouard to Sturgeon lake.

J. W. Allonby, Grouard, patrols from Grouard to Little Smoky river via Winagami Lake and from Grouard to Little Prairie and from Grouard to Whitefish lake.

Fire Ranger Knott, Peace River Crossing, patrols from Little Prairie to Peace River Crossing and from Peace River Crossing to Cadotte river, and from Peace River Crossing to Dunvegan.

Fire Ranger L. Bourassa, Fort Vermilion, patrols from Cadotte river to Fort Vermilion and from Fort Vermilion towards the Hay river and from the mouth of Keg river towards Keg River Prairie.

Fire Ranger J. Bourassa, Fort Vermilion, patrols Peace river below Fort Vermilion and along the Loon and Wabiskaw rivers to Arout lake and the Caribou Mountain trail.

Fire Ranger Southerland, Wabiskaw, patrols from Wabiskaw southeast towards Pelican Mountains and the Athabaska river and from Wabiskaw to Whitefish lake.

Fire Ranger D. McDonald, Dunvegan, patrols Peace River above Dunvegan and from Dunvegan in a northwesterly direction towards the Clear Hills.

Fire Ranger Ferguson, Spirit river, patrols from Spirit River settlement towards St. John via Pouce Coupé Prairie and from Spirit river to Smoky river south of Egg lake and from Spirit river to Grande Prairie settlement.

Fire Ranger Martineau, Spirit River, patrols from Grande Prairie on the Edson Trail to Waskigan (House River) where he meets the fire ranger working from the south—to the Smoky river, Sturgeon lake and along the south side of Grande Prairie Settlement.

In arranging these patrols I have taken into consideration the amount of travel on each as near as could be ascertained, also the quality and quantity of lumber to be protected, and arranged so that the forest rangers are not overlapping into each other's territory and at the same time have all the patrols join. A glance at the map will show this plainly.

I beg to inform you that I made an advance of $50 to each of the above fire rangers and have forwarded their receipts for same with my monthly statement of expenditure. In addition to this I also furnished each with an axe and a spade, but did not find a collapsible bucket to meet the requirements. The latter should be furnished them. I also distributed fire notices and the rangers are posting some of these articles.

Should the boats I mentioned be put on, an extra supply should be kept on board for use when a gang of men are taken to fight fires, otherwise two or three extra articles of each kind might be kept at the fire ranger's residence for each district.

I am glad to state that no fires of any great importance got away from the fire rangers during my soujourn in these districts, and from personal observation and information received from disinterested and trustworthy parties the fire ranging has been conscientiously performed by the fire rangers.

Respectfully submitted,

LETELLIER O'CONNOR,
Inspector.

No. 16.

REPORT OF H. A. CONROY.

DEPARTMENT OF INDIAN AFFAIRS, CANADA,
OTTAWA, March 18, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I beg to present my annual report on the fire ranging work in the Athabaska and Peace River districts.

It is a matter of no small difficulty to select suitable men to act as fire-rangers, as the requirements are many, and there is a comparatively small population from which to make a selection. A fire-ranger in these northern districts must be able to speak the native languages, and must be an expert in a canoe and among horses. He must know a very large tract of country like a book, for on many occasions he is called upon to make long trips inland from the rivers, where there are no trails to follow or blazes to guide him.

Some years of experience in supervising this work have led me to believe that in districts such as these, where travel is very difficult, the department would be wise in having the fire guardians work in pairs. One man, who knows the country well, with a helper or assistant under him, could cover far more territory in much less time than two men working separately. This system would allow of more frequent patrols, and consequently lessen the danger of fires in the district the men protect. A man alone in a canoe often finds it very difficult—sometimes impossible—to track against the swift current of the rivers. Two men can always travel up and down the rivers, no matter in what stage of water. The same principle applies when working inland. Two men with pack and saddle horses can divide up the work and cover more ground in shorter time than can each man working separately.

If this plan were adopted, I would suggest that the man in charge be paid $5 per day, and his assistant $3 per day. I am confident that the small increase in expenditure would be more than justified by the better service obtained.

Wherever possible, small steamers, similar to the one at Athabaska Landing, would be a great improvement over the present system of canoe and horse work. A small steamer placed below Grand Rapids on the Athabaska river could run from the rapids to Smith on the Great Slave river (some 300 miles), from the mouth of the Peace to the chutes (about 300 miles) and for some distance from McMurray up the Clearwater river. The timber along all these rivers is especially good; spruce and black-bark poplar grow to surprising sizes, and will in the future be a most valuable asset to the country.

I would also recommend a small steamer between Smith and Resolution, and one on Lesser Slave lake, both of which would prove beneficial in guarding the excellent growth of timber throughout these districts. In my opinion, a small steamer, wherever it can be used to advantage, is by far the best way of handling fire-guardian work, and, though the initial cost is considerable, the increased and better results obtained make it a saving in the end.

The fire guardians in my district are as follows:—

William Biggs. From McMurray up to Clearwater, and west from McMurray inland to the headwaters of Horse creek, a distance of some seventy miles.

John McDonald. McMurray to Grand Rapids, and, when occasion demands, from Grand Rapids to Athabaska Landing.

Tom McLelland. From McMurray down the Athabaska to Big Point.
Peter Loutit. From Big Point to Chipewyan, and the country surrounding the post.
J. Fraser. From the mouth of the Peace to Smith Landing.
A. Sutherland. West of the Athabaska river, principally in the Wabiskaw district.

Respectfully submitted,

H. A. CONROY,
Inspector, Treaty No. 8.

No. 17.

REPORT OF GEORGE DOUGLAS.

BATTLEFORD, SASKATCHEWAN, September 30, 1911.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I beg to present my annual report on forest fires in Battleford district.

The origin of the big fire in the spring was a camp-fire left by two Indians at Pelican Lake. These I directed to be prosecuted, but, owing to the unsatisfactory way in which the evidence was given, the accused were not convicted, but the fact that an Indian could be prosecuted has had a wholesome effect on all the district. I have now sent Dominion Fire Ranger Beatty to Isle à La Crosse to prosecute Revillon's and Hudson Bay men for leaving a camp-fire burning which got into the moss but was extinguished by Beatty before any damage was done. Apart from a few small areas burnt by camp-fires I have nothing to report as having been damaged by fire.

I have had no timber damaged in my district this year of any commercial value except two small berths, Nos. 14 and 16, at the south end of Green Lake belonging to the Big River Lumber Company. This is the fire that came up from Pelican Lake.

I am inaugurating in my district a system of protection in conjunction with the provincial government.

I took the matter of prairie fires up with the Deputy Minister, Mr. A. F. Mantle, at Regina and induced him to get a badge made and appoint some man in each township as voluntary Fire and Game Warden, making each man responsible for his own township. I am getting a chain of such wardens right across the country south of the timber belt and so am trying to prevent any fires getting in from the south. Most of the fires, including the late disastrous fire, came from the south and I attribute our freedom from fires this year to good work these wardens in conjunction with my fire-rangers have done this season. It is my intention to recommend for appointment to the provincial government about one hundred more such wardens and have each chain of men from east to west about twelve miles apart, so as to effectually prevent any fires coming in from the south. The men are proud of their badge (blue and gold with coat of arms of the province) and their official appointment. As to fires in the timber, only continually patrolling and cautioning hunters and prospectors will prevent them. Two of my fire-rangers, W. Venne and Pierre Morin, have been very unsatisfactory this year, and I recommend that their services be dispensed with at the end of this season. Fire-rangers Beatty and Murray are ideal fire-rangers and are satisfactory beyond expectation.

I have covered the ground from Green Lake to Portage la Loche, Cold Lake, Turtle Lake, and up to date everything is safe. The right of way on the Canadian

Northern Railway is in a very satisfactory condition; the locomotives I have inspected this year have also been in good order. Only on one occasion have I had to call the attention of the boiler-maker to a bolt-hole in the smoke-box. As I came to Prince Albert on the 29th I found locomotive 88 from Saskatoon to Prince Albert with the dampers of the ash pan open. I called the engineer's attention to the same and he closed it. I cautioned him.

I would recommend that we be allowed to have galvanized-iron ration-boxes fitted in the canoes with lock on. My fire-rangers have had their rations eaten by dogs when one hundred miles away from any post, and fortunately shot a bear which they had to eat or they would have been in a bad way. The Indians do not feed their dogs in summer, but turn them loose, and when the dogs see a camp-fire they know there is a chance of obtaining food, and loss of food in a north country is serious. One of the rangers had to shoot five dogs to protect his rations on his last journey.

Respectfully submitted,

GEORGE DOUGLAS,
Chief Fire Ranger.

No. 18.

REPORT OF A. L. ROBERTSON.

DEPARTMENT OF THE INTERIOR,
FORESTRY BRANCH,
PRINCE ALBERT, SASKATCHEWAN, March 14, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I beg to submit my annual report in connection with forest fire protection service for the season of 1911.

During the early spring season, from the time the snow disappeared (about the end of March) until May 8, the absence of rain, continuous warm weather and no growth of vegetation all tended to make the condition of all inflammable matter very dangerous in the open areas, and doubly so in the timbered belts, where abundance of dry vegetation of every description was to be found.

Between the 4th and 6th of May fires were started by ranchers in the Thick Wood Hills, a belt of hilly country stretching in a southeasterly direction from McMurray in range 10, township 88, west of the 4th meridian, to the Pas Mountain, in township 48, range 2, west of the 2nd meridian. The soil in the above range is mainly a deep black marly clay, producing a dense growth of vegetation each season. When the ranchers were preparing new hay-bearing areas, which they intended to cut over the following season, the speediest and cheapest way was to set fire to the growth when the wind was high and the vegetation perefctly dry, thus burning away the old grass. I am informed by settlers who have taken lands in the vicinity of the ranching areas that no provision is ever made to confine the burning-over of new hay lands to areas that would provide enough hay for ranchers. If the wind is sufficiently high and the vegetation dry, the fires generally run through miles of green timber, killing this timber.

On the 4th of May, 1911, fires were started in the areas described above. The wind was blowing at a moderate rate, but increased hourly until it reached a perfect gale, which carried burning tufts of grass and cinders half a mile in advance of the

line of fire. This fire swept across from range 16, west of the 3rd meridian, to range 27, west of the 2nd meridian, in an easterly direction. I am of the opinion that settlers in the vicinity of the fire greatly increased the volume of the fire by back-firing, especially those living on lands timbered with poplar scrub from two to six inches in diameter. The ground was also covered with dry leaf-mould and debris from a former forest fire that passed over the area in 1885, thus widening the front of the line of fire considerably. The fire travelled over this area at a terrific rate until it reached the coniferous timber, where wet moss and damp debris scattered through the forested area usually provide a protection to this class of timber. Owing, however, to the continued period of dry weather, the debris was very dry and contributed much in destroying the trees by reaching the roots. About half of the damage done to the timber was from fire reaching the roots. In workings where logging operations had been carried on the whole of the young timber within the boundaries of the cuttings was completely destroyed. The extent of the damage done to the timber of milling quality was approximately 110,000,000 ft., board measure. Nearly the whole of the above quantity was on areas allotted as timber berths. Of the above timber, 72,000,000 ft., board measure, was manufactured into saw-logs during the past logging seasons of 1911 and 1912. The berths mainly affected by the fire were Timber Berths 1048, 1049, 66A, a portion of 686 and 474.

During the first part of the season eight fire-rangers were employed in the forest fire protection service in the district under my supervision. This number was increased to fourteen in the latter half of the season, thus reducing the size of the areas to be patrolled.

Many small fires occurred in the settlements south of the heavily timbered belt, but these were soon got under control by the fire-rangers. During the past season an effort was made to have the settlers residing in the wooded areas co-operate with the fire-ranger in the forest protection, and during the last two months of the season no fires got away. An effort will be made, next season, to have the settlers' further co-operation, and, when they are clearing the land, to have the fire-ranger of the locality supervise the burning of the brush and keep fire under control.

Respectfully submitted,

A. L. ROBERTSON,
Chief Fire Ranger.

No. 19.

REPORT OF ANDREW FREEMAN.

DEPARTMENT OF THE INTERIOR,
DOMINION LANDS AND CROWN TIMBER OFFICE,
WINNIPEG, MANITOBA, March 22, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I have the honour to submit the following report respecting forest fires in the Winnipeg district during the season of 1911.

In accordance with your instructions, the fire-ranging service in the district northwest of Dauphin was last year placed under control of Forest Rangers W. A. Davis and A. McLeod, while I was instructed to take charge of the work in the territory north and east of Winnipeg. The only serious fire last year in the Winnipeg Crown Timber district occurred in the territory over which Messrs. Davis and McLeod had

jurisdiction as fire-rangers, and it is therefore possible that you have already been furnished with a report by one or other of them. However, as one of our timber inspectors has furnished me with information relating thereto I beg to report as follows: The fire in question started on May 6 in township 40, range 26, west of the 1st meridian, close to the Canadian Northern railway, between Birch river and Novra. No rain had fallen in that part of the country for a considerable time prior to that date, and the fire therefore spread rapidly and passed through portions of townships 41 and 42, in range 26, also part of township 42, in range 25, west of the 1st meridian. On May 8 heavy rain arrested its course, and by the following day the fires were completely extinguished. It is estimated that the fire damaged from 45 to 50 million feet, board measure, of standing timber, a large portion of which is covered by timber berths Nos. 992 and 1,101. The holders of these berths are operating this winter, and a portion of the timber damaged will thus be saved. As to the cause of the fire the inspector reports: 'It may have been started by passing trains, or from the camp-fires of trappers. I have found no way of proving its origin.' The timber inspector further reports that he had travelled to the north end of Lake Winnipegosis, and there had been no fires in that district during the season of 1911.

In the territory north of Winnipeg, between Lake Winnipeg and Lake Manitoba, and also in the district east of the Red river, no serious fire occurred last year. This territory, as in 1910, was divided into five districts, and a fire-ranger placed in charge of each, who was kept on duty until the close of the season. I am satisfied that the absence of forest fires in this territory last year was largely due to the energetic work of the rangers. Fire notices in different languages were posted throughout the several districts, and the rangers made special effort to instruct the settlers how to prevent and handle fires.

Several small fires started during the spring along the southeastern branch of the Canadian Northern Railway, but none of these did any serious damage, with the exception of one in township 5, range 10, east of the 1st meridian, where a considerable quantity of cordwood was destroyed. This wood was covered by insurance, and the owner paid the dues on it in full.

The fire-rangers whom I have employed seem to be unanimous in the opinion that the greatest danger from fire in this district is from the railways, and I would respectfully suggest that, in the northwest part of the province particularly, greater efforts should be made than hitherto by placing a staff of rangers along the railway through the timber area. During the season of 1911 the rights of way of the several railways within this district were kept in better condition than during the preceding year. There is, however, still room for improvement, and it would be well to impress on the railway companies the necessity of keeping the right of way clear of dry timber and other inflammable material.

Respectfully submitted,

ANDREW FREEMAN,

Crown Timber Agent.

No. 20.

EXTRACT FROM LETTER FROM JAMES T. BLACKFORD.

NORWAY HOUSE, N.W.T., February 26, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I have just returned from the longest of my winter trips and herewith I beg to submit my report of same.

I made several short trips, but these were taken more to ascertain the truth of statements made by some of the Indians in regard to the size and quantity of timber in the vicinity of Norway House. I found them very unreliable. The weather was very cold, ranging from 35 to 50 degrees below zero. On January 28 I left Norway House, taking with me Sandy Scribe (my regular man) who drove the dogs, and John Keeper as extra help, both Indians.

My objective point was Trout Lake, lying northeast from here and northwest from Oxford Lake, my proposed route then extending from Trout Lake southwest to Walker's Lake and Cross Lake and then south again to Norway House. I was unable to reach Trout Lake owing to a combination of circumstances which I will relate in this report.

We had some very cold days, but, taken as a whole, the weather was favourable. The first two days out we passed through spruce and poplar in various stages of growth. Fires have constantly swept over this part, and to-day small poplar and birch predominate, with some dead spruce in places. There was no merchantable timber to be seen of any description.

Crossing over the Echimamish River we passed through a muskeg country for some miles. There were some tamaracks growing in places, but often the alders grew thick and we had some difficulty getting through.

North from this muskeg a fire of some fifteen or more years ago swept over most of the country through which we passed. Not much of the killed timber is left standing, but what there is averages about seven inches in diameter at the trunk.

There are places that seem to have escaped the more recent fire and the living trees would average some eight inches in diameter. These trees seem to be about forty years old. What interested me particularly was the fact that often among these living trees were to be found some dead giant trees,—speaking comparatively as we find the timber here to-day—of the long ago. Occasionally, one such could be seen standing without bark or limb, but many can be seen in an advanced state of decomposition, stretching for one hundred and thirty feet in the undergrowth and measuring thirty-six inches in diameter at base. All over the burnt area young spruce, tamarack and pine are growing, ranging in height from a few feet to twenty and thirty feet high.

For six or seven days we passed through thousands of acres of this young growth and the thought that forced itself upon me day after day was this, that even here where the agriculturist cannot hope to do much, nature is aspiring to do great things for Canada, if only the careless miscreant can be taught to be careful and help in the prevention of forest fires.

On some occasions,—as last winter,—I have gone for days through burnt timber without seeing any living tree and I have been pessimistic as to the future of timber in this north country.

From observations this winter, I feel that though much has been lost through devastating fires in the years that have passed, there is also much left for us to care for in the young timber that is growing up and some tracts that to-day are fair timber.

At Swan Lake I camped for several days, going out each day in different directions. One day I spent looking over the timber on the islands in Gull Lake. This was all uniformly large, from eight to twenty inches in diameter, and from 75 to 120 ft. high. The day was unfavourable for taking pictures, so next day I tried again, but when I got to Gull Lake,—which, by the way, is a large lake—there seemed to be a regular blizzard blowing. I could not see very far out on the lake so did not venture out. In the bush one could hardly notice the wind. There is some merchantable timber in fairly large quantities in the vicinity of Gull lake.

From Gull lake to Carrol river and north as far as we went we passed through mostly young spruce and pine of six or eight years growth. Sometimes we came to small areas of large timber and these I tried to photograph but the results were not the best, though I trust they may be of some service.

When we were north of Carrol river and west of Oxford lake the dogs showed signs of playing out, and as John Keeper was beginning to show a little of the Indian's ugly disposition, owing to his having to break the trail for so long, I decided to turn southwest and then to Norway House.

As we came near to Carrot River again we came into some very fair timber and this extended, more or less, for forty miles or until we reached Walker's lake.

At this latter lake we saw the first hunters' camp since leaving Norway House some seventeen days previous. There were about nine families living in three small houses and one winter teepee in this camp. The houses had no windows of any description. The only light that was admitted came through a small hole in the roof near where the clay chimney found exit. Dark, dirty, overheated and overcrowded, these houses were the hotbeds of consumption that kills so large a percentage of these people.

I talked to these people of forest fires, but they were rather reticent of the past, saying there was enough dry wood to do them many years to come and promising to be very careful this coming summer. Around Walker's lake and eastern portion of Cross lake there is quite a lot of very fine timber, tall and of good dimensions and keeping its size a long way up the tree. There has been comparatively little of this timber burnt in recent years.

One evening while the men were making camp, I started off alone to break the road for the next morning. I had gone about two miles when I came to a small river. I decided to break the trail across this and then return to camp. I had just got into the middle of the stream, when, without warning, the ice gave way and I went through to the waist. Having my gun in my hand I threw myself forward and the ice held. While in this position I slipped one of my snowshoes from off my foot, the other was too tight for me to release. After about ten minutes in the water I managed to get out, but from the knees down I was soaking wet. From the waist to the knees I had only got wet on the outside, not being in the water long enough for it to penetrate. With the one snowshoe under my arm I made all haste to the camp, but the soles of my feet and all my toes were frozen to some extent. The next morning I had a large blister under each of my toes. For several days I had to travel with my feet wrapped in rabbit skins.

From Walker's lake to Cross Lake Hudson's Bay Company Post, we came across several camps of hunters, to all of whom I spoke concerning forest fires. Most of these families will not return to their respective reserves until open water.

In the immediate vicinity of Cross lake the timber is nearly all burnt, but coming on down to Pipestone lake and east from there some good timber in fair quantities is to be found. As we went, for days at a time, through country and timber of very much the same character there is no lengthy report to give.

A summary of my observations would be as follows:—

First, that there have been very large areas of fine timber (say some 75 or 100 years ago) in this north country. That considerable good timber is still to be found north and east from Pipestone lake and extending to north and east of Cross lake and Walker's lake.

Second, that, so far as I can see,—unless great climatic changes have taken place—there is no reason why (if saved from fires) ninety per cent of the timber should not attain the size and quality it undoubtedly did in the past, viz., two and three feet in diameter, and of good height.

Third, the timber is and always has been of slow growth.

Fourth, the nature of the country is such that (so far as I know) it could not be utilized for other than the production of timber.

Fifth, large areas are growing up again to spruce and pine. There are large quantities of spruce about four to six inches in diameter about fifty feet high.

Sixth, that generally speaking the Indians do not look upon forest fires with disfavour, but regard the same as the best agency in furnishing dry wood at all times in all places.

Seventh, that, while a constant patrol of the water routes will do much to minimize the danger of forest fires, there is so great a mileage to be covered that the only hope of saving our forests here, is in the education of the Indians,—who most frequent these routes in summer time—to see what it means for them especially and the country in general to prevent such fires.

I would like to have had more time around Walker's lake, but we were without dog feed and I could purchase only a few fish from the trappers.

Before getting to Norway House, the dogs took sick and with an Indian hitched on ahead of the dogs and the other pushing we had some difficulty in reaching here. I

25—vi—6½

am sending, under separate cover, a rough map of the route taken and district covered and the result of my work during the trip. I trust this will be of service to you and the department.

All of which I respectfully submit.

JAMES T. BLACKFORD,
Chief Fire Ranger.

No. 21.

REPORT OF P. Z. CAVERHILL.

DEPARTMENT OF THE INTERIOR,
FORESTRY BRANCH,
CALGARY, ALBERTA, April 1, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I beg to submit the following brief report on the work done by me, for the Forestry Branch, during the year ending March 31, 1912, acting under your instructions of February 21, 1911, to inspect the lines of railway passing through timbered lands and ascertain from personal observation and from the reports of the rangers whether the requirements of the Railway Act in regard to keeping the right of way free from inflammable material and the regulations of the Railway Commissioners and Provincial Statutes regarding fire-guards were being properly carried out.

Leaving Ottawa on March 4, I proceeded to Winnipeg, thence via Hudson Bay Junction, Melfort and Prince Albert to Edmonton, consulting with the rangers and lumbermen en route. At this time there were from two to three feet of snow along the railway and I could not gain much by personal observation.

Reaching Edmonton on March 17, I made a trip of inspection in company with Mr. McLaggan, the Chief Fire Ranger, of the right of way of the Grand Trunk Pacific Railway as far west as Jasper Lake.

During April I was engaged in organizing a patrol along the lines of the Canadian Northern Brazeau Branch and the Alberta Central west of Red Deer. Having made arrangements for the patrol, acting under special instructions from the Director, I made arrangements for starting a reconnaissance party under charge of E. G. McDougall, on a survey of the Porcupine Hills. This, in addition to assisting Mr. McLaggan in making a report on the fire patrol in the Edmonton district, occupied all my time in May.

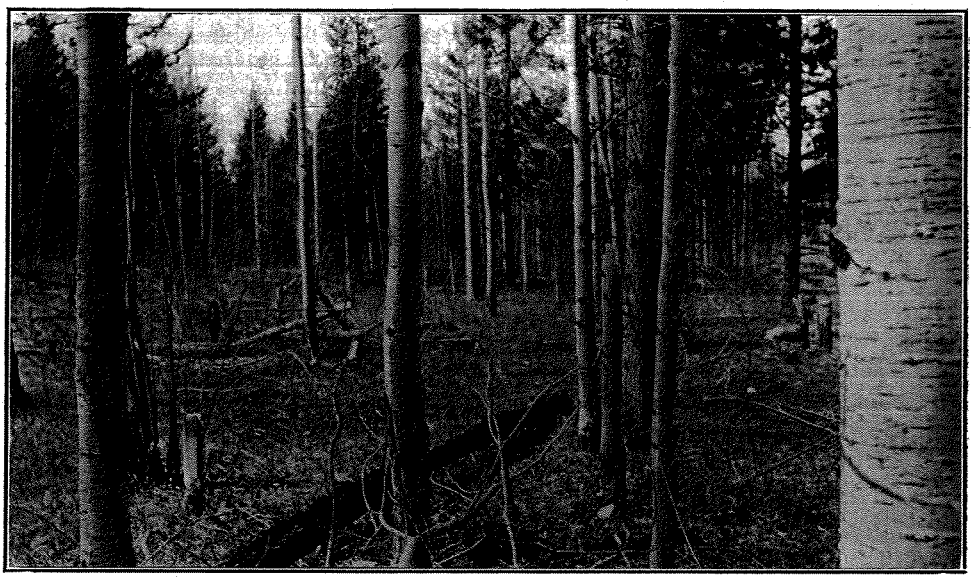


Photo E. H. Finlayson, 9111.

Athabaska Forest Reserve: Typical Poplar-pine Country above Athabaska Flats.

Again acting under special instructions from you, I, on June 5, left Edmonton for Prince Albert and Mafeking, and the following five weeks were spent at Prince Albert, Melfort, Dauphin and along the line of the Canadian Northern Railway studying and reporting on the fires which had occurred between these points early in May. These fires were very destructive, burning in the Prince Albert District approximately 1,000 square miles, containing 200,000,000 to 300,000,000 feet of timber and unlimited quantities of wood and young growth. Part of the tract has a good loam soil and will be needed in the next few years to meet the demand of settlers, but much of it is sandy and cannot be brought under profitable cultivation. It was here that the greater loss was encountered owing to the destruction of the young growth on which we must depend for our future timber-supply. This fire was caused by settlers setting out fire late in April when the surface was very dry. High winds arising drove the fires beyond control and several fires uniting caused the great damage.

At Mafeking and Baden, Manitoba, about thirty-five square miles were burned, containing 60,000,000 feet, board measure, and for some hours the property and lives of the inhabitants of the two villages were in danger of destruction, being preserved only by a change of the wind.

After completing the trip I made an inspection of the Canadian Northern Railway and Alberta Central Railway rights of way west of Red Deer; and on August 4,

acting under your instructions, I reported to A. Helmer at Calgary and worked under his instructions for the remainder of the year.

In dealing with railway fires, the great essential is a clean right of way. If the right of way has been properly cleaned at the time of construction a great step has been gained, but all brush, grass, weeds, etc., should be cleaned off once a year, preferably as soon as the grass matures in the fall. If the humid conditions are equal, the danger from railway fires is directly proportional to the weight of the ignited matter falling upon it. It has been demonstrated at Purdue University that under ordinary atmospheric conditions the greatest amount of sparks fall between thirty-five and one hundred feet from the centre of the track, and that ninety-five per cent of all railway fires originate within one hundred feet of the track. The 100-ft. right of way, therefore, is not enough for protection but an additional fifty feet on each side should be cleaned, not necessarily of green timber, but of all underbrush and dry surface matter. On the upper side of sidehill cuts a greater distance would have to be cleaned and a ground line constructed along the far side. The cost of the first cleaning would perhaps amount to from $400 to $500 per mile for the brush cleaning, and upkeep from $50 to $75 per year, becoming less each year. If the right of way is properly cleared and guarded a patrol is almost unnecessary except in very dangerous periods and on steep grades; but in order for a patrol to be effective it should cover the entire right of way at least twice each day. When equipped with a speeder a patrolman can travel ten miles per hour and should not be required to cover more than thirty-five miles of track. Special watchmen should be stationed on all steep grades and other especially dangerous points.

Respectfully submitted,

P. Z. CAVERHILL,
Forest Assistant.

No. 22.

REPORT OF H. CLAUGHTON-WALLIN.

VANCOUVER, B.C., April 1, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I beg to submit herewith my report for the fiscal year ending March 31, 1912.

Field-work was carried on continually from the commencement of the fiscal year to the end of October. From November 1 to this date occasional outside work has been done, but the most of the time has been spent in office-work, such as writing of reports, mapping and compiling of stem-analysis data.

The number of my assistants varied from one during the winter to seven during the business part of the summer. Mr. H. C. Kinghorn has been my permanent assistant from June 9 to the present time.

The work carried on in the coast district of the Railway Belt may be divided under the following headings:—

a. Examination of unsurveyed lines of timber berths.
b. Forest surveys.
c. Stem-analysis work.

EXAMINATION OF UNSURVEYED LINES OF TIMBER BERTHS.

The object of this work, which was begun during 1910, was to ascertain whether or not certain uncompleted boundary lines, stated by the surveyor to be inaccessible, could be completed, and whether it would be necessary to survey such unsurveyed portions which were found to be inaccessible.

The unsurveyed boundaries of seventy-five timber berths were examined during the year. In most cases it was found that the uncompleted surveys were on rough, rocky and sometimes inaccessible mountains, where there was little or no merchantable timber immediately outside the berth.

FOREST SURVEYS.

In accordance with your instructions a forest survey was made of the district surrounding Anderson river and its tributaries.

The Anderson river, which has its head-waters on the high mountains in township 7, range 24, west of the 6th meridian, empties into the Fraser river about three miles south of North Bend, and is one of the largest tributaries to the Fraser in the coast district, being about twenty-five miles long and, on an average, forty feet wide and one and a half feet deep during low water. It is bordered on both sides by rather steep mountains reaching a height of from 4,000 to 7,000 feet. The river is quite swift, running through many narrow canyons, some of them with nearly perpendicular walls several hundred feet high. Except for the last three or four miles of its course the Anderson river runs more or less parallel with the Fraser, being separated from the latter river by a high range of mountains.

The Anderson River district is unsurveyed, and it was necessary to find a known point to which to tie our valuation survey. A mining claim post fixed by a previous survey and situated at the fork of Siwash creek near the southwest corner of section 2, township 7, range 25, west of the 6th meridian, was chosen. With this post as a point of commencement, a point in the Anderson river situated in the southeast quarter of section 15, township 18, range 25, was established by traverse. Such traverses of the river and the main tributaries as were found necessary for the establishment of points of reference and a proper system of estimating were then run.

The strip-survey method of estimating was used.

The traverse line along the river was used as a base-line, and strips one chain wide and twenty chains apart were run at right angles to the direction of the river. All merchantable trees of a diameter at breast-height (4½ ft.) of ten inches or more on those strips, or sample areas, were calipered and the diameter at breast-height and merchantable length of each tree recorded.

Thus five per cent of the total timbered area was actually covered by the estimate. Notes on typography and on the general character of the forest and the land were made for each acre calipered, and boundaries of different types and stands were marked on sectional maps in the field note-books. Elevations were taken with aneroid barometers for the making of contour maps.

As the land along the lower course of the river had been repeatedly burned over, leaving the country practically devoid of merchantable timber, only a rough estimate and maps were prepared for this area, while a careful examination was made of the well timbered country in townships 8 and 9, range 25.

The work was delayed considerably on account of heavy rains, especially during the month of September. The rough character of the country also delayed the work, as the area which could be covered in a day's work was not very large.

GROWTH.

The list of tree species growing in the district is large. The following coniferous species were found:—

Douglas fir *(Pseudotsuga mucronata).*
Hemlock *(Tsuga heterophylla).*
Mountain hemlock *(Tsuga Mertensiana)*
Red cedar *(Thuja plicata).*
Sitka spruce *(Picea sitchensis).*
White pine *(Pinus monticola).*
Jack pine (*Pinus contorta*).
Amabilis fir *(Abies amabilis).*
Balsam fir *(Abies lasiocarpa).*
Yellow cypress (*Chamaecyparis nootkatensis*).
Yew (*Taxus brevifolia*).
Dwarf juniper *(Juniperus communis).*

Alders and poplars are common along the river bottom and vine and dwarf maple form the undergrowth on the slopes.

In relation to the distribution of the different species the Anderson River valley could be divided into the following districts:—

Upper District—Township 7, Range 24.
Altitude along river, 3,300 to 4,000 ft.
Principal species: Western hemlock, amabilis fir, balsam fir, mountain hemlock.

Upper Central District—Township 8, Range 25.
Altitude along river, 2,000 to 3,300 ft.
Principal species: Douglas fir, cedar, western hemlock.
Scattered species: White pine, Sitka spruce, amabilis fir, jackpine.

Lower Central District—North half Township 9, Range 25.
Altitude along river, 1,400 to 2,000 ft.
Principal species: Douglas fir, cedar, hemlock.
Scattered species: White pine.

Lower District—South half Township 9, Range 25, and Township 10, Range 25.
Altitude along river, 300 to 1,400 ft.
Principal species: Douglas fir.
Scattered species: Cedar, with an occasional hemlock or white pine.

The reproduction on the burns consists principally of Douglas fir, jack pine and some white pine.

FIRES.

The old Hudson's Bay trails from Boston Bar and Spuzzum to the Coldwater country go through this district and practically the whole of township 10, range 25, has been burned over, the fires probably originating from the trails. There are tracts covered with poles and young reproduction, but in the main the forest cover is far from satisfactory. The country has now a patchy appearance, there being bunches of green timber, blocks of reproduction, grassy areas and bare slides all intermixed.

The north part of township 9, range 25, has also been damaged by forest fires but the remaining part of this township as well as township 8, range 25, has been comparatively free from this enemy of the forests.

STEM ANALYSIS WORK.

With the object of obtaining data for the construction of growth and volume tables, stem-analysis work was carried on by two student assistants in the coast district during June and July. Three logging operations were followed, viz:—

1.—Timberland Lumber Co's operation at Craig's Spur, six miles southwest of New Westminster.

2.—E. H. Heaps' logging operation at Ruskin.

3.—Rat Portage Lumber Co's operation on the west shore of Harrison Lake just outside of the Dominion Railway Belt on provincial land.

Particular attention was given to Douglas fir.

The following tables based on volume and growth measurements by decades have been prepared:—

1.—Table giving average thickness of bark at different heights of Douglas fir in the coast district. (Based on 175 trees.)

2.—Table showing average thickness of bark of Douglas fir at different diameters breast-high, outside bark, in the coast district. (Based on 175 trees.)

3.—Table showing average thickness of bark of Douglas fir at different diameters breast-high, inside bark, in the coast district. (Based on 175 trees.)

4.—Table showing average heights of Douglas fir at different diameters breast-high, outside bark, in the coast district. Based on 160 trees (by decade measurements 1,460 trees).

5.—Volume table for Douglas fir in Coast forests, showing diameter at breast-height, merchantable length (16-foot logs), and available merchantable contents in board feet by the B. C. official log scale. Based on 160 trees (by decade measurements 1,323 trees).

The actual number of felled trees on which the measurements were taken may seem small, but the data obtained by the measuremnts of tree-sizes at the end of ten-year periods should be very valuable, even if not entirely equivalent to the measurements of the same number of individual trees.

The trees from which data were secured were growing on soil of good or fairly good quality in well stocked mixed-conifer stands. The tables should prove useful in stands of similar character.

The extremely rapid growth of Douglas fir under favourable conditions is astonishing. At Craig's Spur the stand is even-aged, a large fire having swept over this country 172 years ago, and consists of Douglas fir and cedar with associated hemlock and Sitka spruce. The stand is fully stocked, but not overcroweded. The soil is a well-matured, deep loam.

The rapid growth, in this particular locality, of Douglas fir is shown by the following age-diameter-at-breast-height and age-height table, based on decade measurements of seventy Douglas fir:—

GROWTH-TABLE FOR DOUGLAS FIR.

(Average diameter at breast-height, outside bark, 44·8 in.; average diameter at breast-heivht, inside bark, 39·3 in.; average total height, 199 ft.; average total age, 160 years.)

Age.	Average Diameter at Breast-height.	Average Annual Growth in each Decade.	Average Total Height.	Average Annual Height-growth in each Decade.
Years.	Inches.	Inches.	Feet.	Feet.
10	1·6	....	6	...
20	5·6	0·40	30	2·4
30	10 7	0·51	59	2·9
40	15·0	0·43	82	2·3
50	18·9	0·39	101	1·9
60	22·0	0·31	118	1·7
70	24·8	0·28	134	1·6
80	27·5	0·27	146	1·2
90	30·0	0·25	157	1·1
100	32·4	0·24	166	0·9
110	34·6	0·22	174	0·8
120	36·8	0·22	181	0·6
130	39·0	0·22	187	0·6
140	41·2	0·22	193	0·6
150	43·2	0·20	198	0·5
160	45·2	0·20	203	0·5
170	47 0	0·18	207	0·4

At Ruskin and Harrison lake the stands where the analyses were taken are many-aged, and the trees examined had been growing under such variable conditions that to construct age-height and age-diameter tables from the data secured would hardly be worth attempting. Instead, tables showing the average rate of growth of Douglas fir of different sizes will be prepared.

In both places the stand is a many-aged, well-stocked virgin and mature conifer stand, consisting of approximately sixty per cent Douglas fir and forty per cent red cedar, hemlock and white pine growing on a fairly deep sandy-gravelly soil, mixed with granite boulders.

The data compiled at the Harrison lake operation indicate that the following figures for diameter at breast-height and height-growth of dominant and co-dominant Douglas fir in that locality are fairly good averages:—

At 80 years the diameter at breast-height is 24 in. and the total height 120 feet.

At 160 years the diameter at breast-height is 36 in. and the total height 175 feet.

At 240 years the diameter at breast-height is 43 in. and the total height 190 feet.

While not as rapid as at Craig's Spur, this growth must be considered very good. It is to be remembered, however, that these figures are averages of the growth of the best trees only. It is probable that at least this average growth can be attained under proper management in this and other localities of a similar character on the coast.

The logging operation followed at Harrison lake is in a fairly representative Douglas fir type.

The investigations which have so far been carried on amongst the Douglas fir in the Coast District show:—

(1) that Douglas fir prefers a well watered, deep, loamy soil, but that it does well also on poorer soils, provided there is abundant atmospheric moisture. It does not thrive on saturated and poorly drained soils;

(2) that Douglas fir reaches its best development in even-aged stands where it can get sufficient overhead light;

(3) that Douglas fir is a prolific seeder, spreading its light, winged seeds for a considerable distance, but that it has great difficulty to gain a hold on the logged-over areas, covered with debris, which are, instead, generally restocked by cedar and hemlock which are tolerant of shade. Exposed mineral soil and direct light are necessary for Douglas fir seedlings. That is the reason why Douglas fir generally restocks the burns on the coast. To secure satisfactory reproduction —natural or artificial—after logging, it will, in nearly every case, be necessary to burn the debris.

(4) that as Douglas fir is on the coast a very rapidly growing tree, the rotation, even if fairly large saw material is desired, would be comparatively short. For the sake of comparison, I may mention that in certain parts of Northern Europe where the timber industry is the chief asset of the country, it takes from one hundred to one hundred and eighty years to grow a stand of Scots pine of an average diameter of twelve inches, while in the Coast District of British Columbia a stand of Douglas fir of the same average diameter can be produced in thirty to forty years. It must be remembered, however, that the best grades of lumber can be obtained only from old trees.

(5) that fungi and insects do very little damage to Douglas fir which are not overmature.

A volume table for Douglas fir based upon total height is now under preparation, as are also growth tables.

Stem-analyses were also taken on cedar and spruce, but the number of trees examined is much too small to enable me to construct any volume or growth tables for those species.

Respectfully submitted,

H. CLAUGHTON-WALLIN,
Forest Assistant.

No. 23.

REPORT OF G. H. EDGECOMBE.

OFFICE OF THE COMMISSIONER OF DOMINION PARKS,
EDMONTON, ALBERTA, March 30, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—Under your instructions of the 12th instant, I am submitting my annual report of the past year, which has been spent on that part of the Rocky Mountains Forest Reserve now designated as the Brazeau and Athabaska Forests.

The chief work of the year was the continuation of the eastern boundary of the Rocky Mountains Forest Reserve from the 11th baseline, at section 32, township 40, range 12, west of the 5th meridian, northwesterly to the 15th baseline, at section 33, township 56, range 25, west of the 5th meridian.

Leaving Ottawa on April 3rd, I spent the next month in outfitting for two parties and getting in supplies at various points, also in going over the country around Prairie Creek, where it was decided that work would be started.

On May 8th, the two parties that were to carry on the work started at Prairie Creek on the Grand Trunk Pacific Railway and Athabaska River, one working southerly, the other northerly under the leadership of Mr. S. H. Clark and Mr. E. H. Finlayson, respectively. The work of the whole summer was delayed by excessive rains. The months of May and June I divided between two parties, while July and the latter part of September to December I spent with the southern party. August and the first part of September were spent with the northern party. As the student assistants were obliged to return to college in September and the first part of October, the northern party was disbanded October 7, but the work of the southern party was continued on into November, when the party crossed country from the little Brazeau to Bickerdike (on the Grand Trunk Pacific Railway), where it broke up December 12 On December 20, I went to Edmonton, where, during the next month, I prepared a report and maps on the summer's work.

Photo G. H. Edgecombe, 1911.

Athabaska Forest: Black Spruce Swamp, after Fire.
Tp. 51, Rg. 25, west of 5th Meridian.

The country is one abounding in muskeg and wind-fall, the latter the result of fires twenty-five to forty-five years ago. It is more rough and broken than that to the east, increasing in height and steepness of slopes as the first range of mountains is attained, these standing abruptly above the foothills. The rivers flow in a general direction northeasterly, the Baptiste, Little, South and North Brazeau flowing into the North Saskatchewan, while the Pembina, Embarras, McLeod and Hay rivers flow into the Athabaska.

As the object of the reserve is to furnish a supply of wood to the prairies and coal mines and protection to the watershed, you will notice by the previous report that the proposed boundary practically includes the coal district and, as far as practicable, the true woodland, wherever possible natural boundaries, such as rivers, being chosen.

The factors defining the boundary were, as in the previous year's work, (1) topography, (2) soil, (3) climate, (4) elevation and (5) timber.

(1) *Topography.*—In a general classification, the hills, 250 to 500 feet above the valleys, conform to the trend of the rivers, along which alternate steep 'cut-banks'

and small hay and timber flats. Back from the rivers are a series of steep terraces and muskegs until the height of land is reached, then a similar descent to the next river. In districts, as at the Pembina River, many deep ravines cut into the hills. Thus there are no large consecutive areas of arable land that will be desired in the near future for farming.

(2) *Soil.*—The soil of the river bottoms is a sandy loam, fairly deep and underlaid with gravel. The soil of the upper slopes becomes light. Rocky exposures are common, while all through the district there are large areas where the humus has been burnt off by repeated fires. In the muskegs the top soil or decayed humus varies from fifteen inches to four feet.

(3) *Climate.*—Throughout the summer frosts were encountered almost weekly. Rain this year was excessive, while snow (ten inches) fell on September 20, but soon disappeared; snow came to stay, however, on October 24.

(4) *Elevation.*—An elevation of 4,000 feet was mostly followed but, on account of excessive muskeg or the nature of the country, this elevation was in districts lowered to 3,800 feet.

(5) *Timber.*—The following is a tabulated statement of the tree growth throughout the district through which the boundary was run, and it may be taken as a fair average of the reserve east of the first range of mountains, west of which bare limestone ridges will form a large percentage of the area.

Timber	11%
Muskeg	11%
Poplar and willow	24%
Pine and spruce, pole size and under	50%
Grazing	4%

FIRE PROTECTION.

To cope with the fires, the fire protection is a most serious, indeed the all-important question. While the plans for the coming year include a telephone system to be put in and direct trails and fire-guards to be cut out, the remoteness of districts from ready assistance has to be contended with, as everywhere the ground is strewn with dense wind-fall, which, when a fire occurs, it is next to impossible, especially for a small number of men, to control. Until the present plans can be carried out, with the country thus divided up, the protection is at a disadvantage, but with attention and co-operation in those districts where railways are being constructed, coal mines developed and trails frequented, it is hoped that success will be gained.

During the coming year the Coal branch of the Grand Trunk Pacific Railway will be completed to the Mountain Park Coal Company's mines at the head of the McLeod river, also to the Yellowhead Coal and Coke Company on the Embarras river and to the Pacific Pass Coal Company's mine on the Pembina. In the south the Canadian Northern Railway will be constructed to the Brazeau Coal Company's mines a few miles west of the Mire Creek Gap in the first range of mountains.

The above mines are developing their claims preparatory to the railways reaching them.

Under your instructions of May 10, the last ten days of June were spent in estimating the tie supply between the west and main forks of the McLeod river and north of the 13th base line.

Contrary to the reputed stories that this district is covered by virgin timber, out of the twenty-six and three-quarters square miles (17,120 ac.), 24·1 per cent bears merchantable spruce and pine, 25·5 per cent is muskeg, 49·1 per cent of young pine and

dense wind-fall, the result of fire, and 1·3 per cent of open grazing land. It was decided that this timber could be more economically used as mine material, thus avoiding the excessive waste in cutting ties.

From September 20 to October 3, I took a trip to the Kootenay Plain district on the North Saskatchewan river.

West of the Saskatchewan River Gap, particularly on the south exposures, there extends a good grazing country. About ten miles west of the The Gap several squatters are located because of this grazing.

The Kootenay Plains extend west from the Whitegoat river for about fifteen miles. They are flats a quarter of a mile to one mile wide, alternating on both sides of the Saskatchewan. Back from these plains extend the Brazeau mountains. Last fall, this district appeared to have been overstocked, as the grass was very sparse and light. Here, besides the Indians, there is a squatter located. Besides having a large

Photo G. H. Edgecombe, 1911.
Clearwater Forest: Kootenay Plains and Brazeau Range.

area fenced in, he has several well built houses. The Indians are from the Stony Indian Reserve and come to the plains because of the game as well as for the grazing.

In February a tract on the Stony river, just north of the Jasper Park boundary, was examined in regard to its tie supply. This district is mountainous, the soil is light, the district having been fire-swept twenty-five and forty years ago, though a few small areas of merchantable spruce and pine escaped the fires. As it was evident that the timber was desirable for protection of the water-shed and for reproduction purposes, it was recommended that the timber should not be cut at the present time. Again, it is likely that there would be difficulty in driving Stony river, as it is meandering, subject to floods, and, at low water, gravel-bars and boulders would add to the difficulties.

The last of February and the first week of March were spent going over areas affected by the Mountain Park Coal Company's applications for surface rights for the development of their mine, and timber and land desired for agricultural purposes, as directed in your instructions of February 10.

As regards the surface rights, 165 acres of open land along the McLeod river and at an elevation of 5,800 to 5,900 feet was defined that would be desirable for a townsite and for the operation of Colliery No. 1, and would overlie the underground rights of coal leases Nos. 334 and 335.

The timber on the surface of coal leases Nos. 334 and 335 is the alpine type of spruce and pine. It is of poor quality as regards saw material, because of its rapid taper and persistent branches. It was estimated that on these leases there is enough mine material to supply the mines for twenty years at an output of 50,000 tons of coal per month.

Concerning the land required for agricultural purposes, 340 acres in sections 5, 8 and 17, township 47, range 24, locally known as Greasebone Flats were gone over. The elevation of this flat is 5,400 feet, 80 acres of which at the south end is covered by wind-fall and jack pine reproduction. If the remainder, 260 acres, were broken and seeded to grass, there is no doubt that a good return could be had. The timber on this flat occurs in small groves of spruce, likely amounting to about 12,000 feet, board-measure, of lumber.

As a tie permit had been applied for on a tract west of the Grand Trunk Pacific Railway, under construction to the Mountain Park Coal Co.'s mines, between stations 285 to 338, I went over this, finding that some construction timber has been taken out. The timber is of spruce of the river-bottom and lower-slope type. Immediately west of this flat is a mountain, the upper slopes of which are composed of bare limestone.

On this tract, between the above stations but west of the McLeod river to the base of the mountain, about 45,000 ties could be cut out without detriment to the district, as most of the timber is overmature.

On March 12th, I left Edmonton to go over the Canadian Northern Railway's right of way west of Rocky Mountain House, returning here March 23rd.

Most of the right of way to the Brazeau Mines has been fairly well cleared up. West of Mire Creek Gap the right of way has been cleared to Brazeau River, but this line is to be revised. It is not likely that construction will be carried on here this season.

Some attempt was made to pile the brush where construction timber has been taken out, but on the whole, this is rather unsatisfactory, as there is considerable merchantable timber fit for ties that has been left.

The requirements of the Brazeau Collieries for timber and a townsite have been left off till May, when they will make definite application for what areas they require of timber and for their operations.

Respectfully submitted,

G. H. EDGECOMBE,

Forest Assistant

No. 24.

REPORT OF E. G. McDOUGALL ON PORCUPINE HILLS, ALTA.

DEPARTMENT OF THE INTERIOR,
FORESTRY BRANCH,
OTTAWA, September 3, 1911.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I beg to submit the following report on the work which I have carried on under your instructions in the Porcupine Hills, Alberta, during the past summer.

THE SURVEY.

Objects.—The primary object of the survey was the location of the boundaries of the land in this region suitable for forest reserve purposes; the secondary object, an examination of the land recommended for reservation, to determine the quantity and quality of the timber, the best means of protecting it from fire, and other questions bearing on the administration of the forest reserve. This purpose involved the preparation of topographical and type maps of the reserve area.

Time in Surveying District.—The party, seven all told, left Claresholm on the 26th of May, and returned there the 23rd day of August.

Much of the month of June was spent in getting accustomed to the work. By the end of that month, seventy-six sections of land had been mapped, and nineteen and one-half miles of boundary were located. In July, with much worse weather conditions, one hundred and thirty sections were mapped and forty miles of boundary located. Early in August I received instructions to proceed as soon as possible to Prince Albert in order to make an examination of a tract in that locality. Accordingly, it was necessary to discontinue the mapping and make haste to complete the boundary; on the 22nd of August, the remaining fifty miles of boundary were completed.

Methods of Survey.—I was instructed to include within the reserve, as far as possible, all lands above 4,000 feet in elevation which had not already passed into private hands. The boundary, in fact, was largely determined by the position of the private holdings above this elevation. Homesteads and other patented lands were left out whenever this course seemed at all practicable. Where homesteads had to be included within the reserve, we obtained full information regarding the residence and improvements of each homesteader, and reported thereon.

At Mr. Caverhill's suggestion, boundary stakes were planted at intervals of half a mile; they were cut from spruce, pine or Douglas fir saplings, about three inches in diameter and three feet long; they were peeled, squared and marked 'D.F.R.' on the outer face.

In mapping, it was our practice for two men to go together, following surveyed lines where these could be traced, and sketching the country half a mile on each side of the line. Distances were measured by pacing, and elevations by means of the aneroid. Contours were sketched in at intervals of 500 feet. A complete description of each section visited was written on the forms provided. Small patches of timber were tallied by means of quarter-acre circular plots. When a large stand was located, the whole party would take a day to cruise it by the strip method.

THE PORCUPINE HILLS, NATURAL FEATURES.

Topography.—The Porcupine Hills are an outlying ridge, parallel to the Livingstone range, from which they are separated by a deep synclinal valley, (hereafter referred to as 'the valley'), open at both ends, and drained northwards by Willow Creek and southward by Callum Creek, which joins the North Fork of the Oldman river. The main divide of the Porcupine runs from about section 25, township 13, range 2, west of the 5th meridian, to about the south end of township 9, range 30, west of the 4th meridian. Long spurs run eastward from the main ridge, dividing the coulées of the Willow, Lynden, Trout, Burton, Burke, Muddypound, Kyiskap and

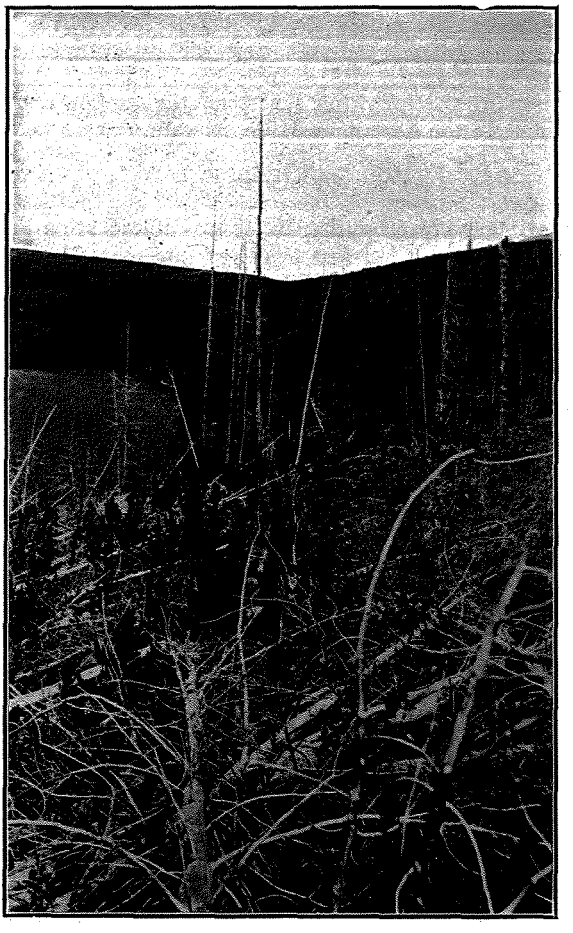


Photo E. G. McDougall, 1911.
A Burn in the Porcupine Hills, Alta, showing Reproduction, which is endangered by Fire.

Beaver Creeks. On the west of the ridge, the streams tributary to Willow and Callum Creeks are smaller; the erosion has consequently been less, and the spurs are shorter.

West of the valley arises a series of three steep and parallel ridges. The middle and highest of the three, sometimes called the Lloyd range, is about as high as the main Porcupine range, and is continuous from Willow creek to the North Fork of the Oldman river; the other two are lower, and broken by gaps. Behind these ridges rises the lofty Livingstone range.

The ridges throughout the region are usually quite steep; the valleys, however, are broad and flat, and the lower slopes gentle.

Rock and soil.—The rock formation is a medium fine-grained cretaceous sandstone, almost destitute of fossils. Towards the foot of the Livingstone range, the formation changes, and indications of coal are sometimes met with. Occasionally, in the Porcupine range, igneous boulders, granites, syenites, &c., are met with, apparently having been transported by glaciers from the neighbourhood of the Churchill river.

The prevailing type of soil in the hills is a light, rather sandy clay. Rock outcrops are not extensive. Gravels are only found in the beds of the larger streams.

Climate.—The climate of the Porcupine Hills is characterized by such extreme variability that the inhabitants sometimes deny its very existence. The summer of 1910 was so dry that many large streams ceased flowing; and that of 1911 was decidedly the reverse. Nevertheless, we were often told that the streams had not yet regained thir normal level, from which it would appear that the ground had dried to a great depth. 'Chinook' winds break up the winter, and snow persists only in the shade of the trees. Snowstorms, however, have been known to occur in every month except July; and severe frosts may be expected any night in the year.

Fires.—The season of greatest fire-danger is in the fall, when the dry grass and high western winds make a dangerous combination. The great fire of 1910, whose ravages are apparent from a glance at the map, took place, however, in the spring before the frost was out of the ground.

There is every reason to believe that, with the assistance of the frequent grass fires, the prairie has been gaining on the forest for a long period; and that, unless the fires can be effectually checked, the day is not far distant when the forest cover will have vanished completely from the Porcupine Hills.

Grass and scrub.—Grass is everywhere abundant, and in some of the coulees is so luxuriant that it may be cut for hay. Unfortunately, it is by no means free from poisonous weeds. In the autumn it cures, and from thenceforth constitutes a menace, which may be greatly reduced by judicious grazing. The settlers state that grass fires are decidedly injurious to the range.

Young growths of aspen poplar, together with willow bush, form dense clumps of brush, widely distributed over the grass-lands. Since they serve the stock for shelter, they are not without value.

Tree growth.—The principal trees of the Porcupine Hills are the following:—

Douglas fir, *Pseudotsuga mucronata,* Sudw.
Engelmann spruce, *Picea Engelmanni,* Engelm.
White spruce, *Picea canadensis,* B.S. & P.
Lodgepole pine, *Pinus Murrayana,* Engelm.
Limber pine, *Pinus flexilis,* James.

In addition, there are aspen (*Populus tremuloides*) (widely distributed, but rarely large enough to be classed as a tree), balsam poplar and cottonwood (*Populus balsamifera* and *Populus acuminata*), both rare and confined to the banks of streams at the lower levels.

The Douglas fir is the chief timber tree. Its thick bark has saved it from the grass fires which destroyed its associates; and it survives in extensive parks, sometimes closely enough spaced to be classed as timber, 2,000 to 5,000 feet per acre. In these positions its form is naturally very poor, low and limby, and it may generally be counted on to be unsound at the butt. Where it grows scattered, it may be kept as a seed-tree, since it is fit for little else.

In the denser stands, both of poles and timber, spruce and lodgepole pine almost equal the Douglas fir in importance. White and Engelmann spruce are intermixed in,

approximately, equal proportions, and are very similar in site requirements and habits of growth. Lodgepole pine attains a diameter of 18 to 24 inches, and a height of 70 to 90 feet.

The limber pine, small and crooked, occurs on all the high rocky ridges, and, like the aspen, is of little use except for fuel and as a slight protection to the soil.

On the whole, a very small proportion of the country enjoys an effective forest cover; much that has been mapped as timber is so open that its influence on soil-moisture and stream-erosion cannot be very great.

Fish and game.—The streams arising in the Porcupine Hills were formerly well stocked with trout, but the dry summer of 1910 reduced their number considerably. Grouse and prairie chicken are plentiful everywhere, but the large mammals were rare; a few deer and bear were seen by members of the party. Tracks of timber wolves were not infrequent in the remoter parts; and coyotes were fairly plentiful. Elk antlers and buffalo skulls were frequently seen, but the range cow has long since replaced these animals.

ECONOMIC CONDITIONS.

Communications.—Trails have been constructed by settlers, and others by sawmill owners with a certain amount of care; but for the most part the hill trails are simply travelled wagon-tracks, meandering about in search of the easiest passage. The ridges divide the country sharply, and only the older settlers know much of local geography 'on the other side of the hill.' One of the hill trails, from Burton's to Playle's, is much used; for the other roads leading out of the valley cross streams which are sometimes impassable. Unfortunately, the grade is too steep to permit the removal of much lumber by this route at present. Improvement of the road would be possible but costly.

Irrigation.—Irrigation ditches have been constructed in many of the valleys, often, apparently, for the purpose of acquiring title to land, but sometimes on the lower levels, for actual use in assisting cultivation. Above the level at which grain can be successfully ripened, there would seem to be little reason for official encouragement of irrigation, which merely diverts water that might be more profitably employed lower down.

There is a marked difference in the flow of streams from wooded and grassy valleys of similar size. The dryness of the grassy valleys may be attributed in part to factors of exposure, depth of soil, etc., and considered as a cause rather than an effect of the absence of forest cover; but such an explanation is not entirely satisfactory, and the facts, if they do not conclusively prove the importance of forest influence on stream flow, at least establish a presumption in its favour so strong as to amount practically to certainty.

Agriculture.—Owing to the frequency of summer frosts in this region, grain cannot be ripened with any certainty at a greater altitude than 4,000; or, at most 4,200 feet. Above this level, where the slopes are not too steep, the settlers raise hay and green feed for the stock, and cultivate the hardier vegetables.

Grazing.—Stock-raising is the chief industry in the immediate vicinity of the Porcupine Hills. Formerly, large ranchers occupied most of the country and some of the choicer parts are still in their possession. More recently, however, the homesteaders have made a place for themselves, in the teeth of the sharpest opposition. It may be generally asserted that, once established, they have quickly become as keen as their predecessors to exclude newcomers and remove neighbours by any means in their power. The local atmosphere of bitterness and jealousy astonished all of us; but the reasons for it are not far to seek. In order to maintain a family in moderate

comfort, a man requires at least one hundred and twenty head of stock, and hence he needs the unrestricted use of about six sections of range. The homesteaders, however, seldom have so many cattle to start with, and cannot lease so much land; hence, they have no assurance of room for future expansion, and see themselves threatened with permanent pauperism. Under the circumstances, it is not altogether surprising that every man's hand is against his neighbour, and that accusations of theft, cattle-poisoning, and malicious incendiarism are heard on all sides.

Most of the smaller owners have located their homesteads in or near the mouth of a coulée in which they run their stock. Those who have taken the precaution of leasing the coulée have had no reason to regret it. Close neighbourhood among these people makes inevitably for trouble.

Lumbering and wood-cutting.—Lumbering operations have contributed largely to the deforestation of the Porcupine Hills. Abandoned mill-sites were seen in most of the coulees. The largest mill, in Beaver Creek valley, long supplied the town of Macleod with lumber; it is now a ruin and the slash is burned over.

A mill on Burton creek is still in operation, and settlers come to it for their lumber from a considerable distance. It may be safely stated that the merchantable timber on the eastern side of the hills is rapidly nearing the point of complete exhaustion. The large stands on the western slope are, as already intimated, practically inaccessible to dwellers on the east; moreover, certain contingencies, such as the construction of a railroad through the valley and the subdivision of the Waldron ranch, might quite possibly create an adequate market for lumber on the west side of the range.

Many farmers and townspeople from the prairie drive to the Porcupine Hills for the purpose of cutting wood for domestic use. They have been taking both green and dry timber, and have paid no dues on either. The supply of fire-killed timber alone should be equal to the demand for the next decade.

Recreation.—On account of their ready accessibility from a productive farming country, their natural beauty and their supply of fish and game, the Porcupine Hills are already a favourite resort of pleasure-seekers. In the future, with the increase of population, their value in this respect will be greatly enhanced, always provided that the forest cover can be maintained and extended. Without it, the hills would lose their attractiveness, and both fish and game would soon disappear.

RECOMMENDATIONS.

Roads and trails.—A complete set of trails, connecting lookout points, following the ridges where possible, and (no slight advantage) enabling the patrol to watch the country with his field-glasses without being seen, is projected by the ranger, who has already constructed several sections. Where the trails thread grassy valleys, they could be first ploughed as fire-guards, after which a diligent patrol would keep them well beaten. On the ridges and in the timber the trails would soon be well-worn, and could be used, in an emergency, as lines from which to back-fire.

The need of a good wagon road crossing the main ridge has already been mentioned. By improving the valley trails and bridging Willow creek or Oldman river, the same end might be gained, perhaps with less expense.

Fire-guards.—Ploughed fire-guards are the most satisfactory, and, for the most part, there is enough open ground to permit of their construction. It will be necessary, in some cases, to run them across privately owned land. A great deal of hill-ploughing and some brush-cutting will be called for, so that the expense and labour will be very considerable, even if only single furrows are used. The ranger should be allowed such assistance as he requires for the construction and maintenance of a system of fire-guards (of which the well-travelled trails should form an integral part) surrounding and intersecting the whole reserve.

Grazing regulations.—From what has been said regarding the grazing situation, it is plain that very close supervision of the range is absolutely necessary. The larger owners have more cattle than the reserve can accommodate, and by the statutes of Alberta they are not bound to fence or restrain them. The smaller owners fear that the extinction of their leases and the removal of their fences would be followed by an invasion of their pastures by trespassing herds. The ranger's only remedy, when he finds trespassing cattle, unless he can detect the herdsmen in the act of bringing them in, is to put them off, though, to be sure, he is under no obligation to put them off on the owner's side of the range.

A three-strand barbed-wire fence, such as the Alberta statutes call for, would cost at least $100 per mile, or, say, $10,000 to enclose the whole reserve. Without such a fence, a single ranger, watching about thirty brands, would find it almost impossible to prevent great damage by trespass, and destructive, even if secret, warfare among the cattle owners.

It would seem that the most practicable way to avoid a Canadian edition of the Montana sheep and cattle wars would be to continue and extend the system of individual leases, which has served that purpose fairly well up to the present time. Two plans have been suggested: (1) to buy out the small owners and lease the grazing, on extensive ranges, to the large ranchers, or (2) to retain the small owners, giving them the exclusive right to the grazing on the coulees where they are located, and grant such rights to large owners only when they are similarly situated. The latter plan would be less expensive, and, if properly worked out, more conducive to the fullest use of the resources of the country. It is well adapted to local topography and customs, and would involve no fencing on the government's part. Each man involved should be strictly limited in the number of cattle he might keep, and, to avoid complication, he should own no range outside of the reserve. His homestead, with the range attached, should be converted into a single leasehold, forfeitable for misconduct; and the leaseholder would be, in effect, an assistant ranger, responsible to the Chief Ranger for the prevention of fire and trespass in his particular range.

Cutting regulations.—As already indicated, very little merchantable timber remains on the east side of the Porcupine Hills. If local scarcity is so great as to make its utilization profitable, the cutting should be carefully supervised, and a sufficient number of seed-trees left to assure propagation. The tops should be downed, but burning, in most cases, would be superfluous and dangerous.

The dense stands on the west slope may be best treated by the selection system, using a diameter limit of about sixteen or eighteen inches for the first cutting, to avoid too great an interruption of the crown cover.

As I have previously implied, the cutting of firewood should be limited to dead material. Building logs may be allowed to adjacent settlers when they may be cut without injury to the forest; but few of the stands are dense enough to fulfil this condition.

Fish and game protection.—An attempt should be made to co-operate with the provincial authorities in enforcing the game laws. Trout and deer should have a close season, and systematic war should be waged on the timber wolves. The coyotes, however, may be tolerated, since they are not very dangerous to cattle or deer, and are probably of service in keeping the rabbits in check. When game has re-established itself, permits to enter the reserve for the purpose of hunting, shooting or fishing in season may well be issued to reputable residents within the fifty mile radius.

Respectfully submitted,

E. G. McDOUGALL,
Forest Assistant.

No. 25.

REPORT OF E. G. McDOUGALL ON LANDS NEAR FORT A LA CORNE, SASKATCHEWAN.

DEPARTMENT OF THE INTERIOR,
FORESTRY BRANCH,
OTTAWA, January 4, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—As instructed by you in your letter of November 6, I have made a short reconnaissance of non-agricultural lands in the vicinity of Fort à la Corne, Sask., with a view to determining the boundaries of the land suitable for forest reserve purposes. Herewith I present a map of the area examined, with the proposed boundary marked in green.

As stated in my report for the month of November, two areas south of the river were found to be unsuitable for agriculture, and are recommended for reservation. The prevailing type of soil is sandy and the timber is jack pine, attaining a size of about twelve inches by fifty or sixty feet, suitable for ties or building logs. The country is by no means covered with timber of this type, however. There are considerable park-like areas, large muskegs fringed with spruce and tamarack, and extensive burns, not all of which are restocking. A fire last year burned over a large tract to the east of the Hudson's Bay Company Reserve. Much of the large jack pine timber has been wind-thrown, both by uprooting and by breaking at the butt. I have not sufficient data for an estimate as to the number of pieces available.

It will be noted that a piece of land in the angle between the main Saskatchewan river and the south branch has been left out of the reserve. The land here is open or scrubby, with aspen on the lower levels, and may be of some use agriculturally. Moreover, one quarter-section near the Forks has been sold, and four others homesteaded. So far as I was able to ascertain, the places are unoccupied at present; but it seemed best to avoid complications by leaving out this block of rather doubtful land.

Two other pieces of land, to the north of the river, have been left out of the reserve there for the same reasons, namely, that it is possibly an agricultural area and that there are existing claims upon some of the land. One piece, in townships 48 and 49, range 20, west of the second meridian, is an elevated scrubby plain, like that just described. Half a section there has been leased by the Church Missionary Society. The other block, in twonship 29, ranges 17 and 18, is said (by hunters who passed through it, and were met just north of it) to be an excellent poplar flat, bounded on the north by marshes and broken poplar land. The northeast quarter of section 31, township 49, range 17, belongs to the Canadian Northern railway.

The examination of the land to the north of the river lasted from November 24 to December 13. Owing to the unusual depth of snow, it was necessary to carry all the horse feed; so two flat sleighs and two assistants were required. For the most part we followed summer trails, making short side-trips, when possible, to reach and determine the boundaries of the agricultural land. Under the circumstances, the location of the boundaries could not be very thorough; but in many cases the types were so much intermixed along their edges that even after a much closer examination a straight and somewhat arbitrary boundary would probably be preferred. Of course, a closer examination is greatly to be desired, both to modify the boundary where necessary and to determine the amount of the timber.

For the rest, the land which was examined on the north side of the river is of the same type as that just described for the south side. The muskegs, indeed, are more extensive, the parks less so; but the bulk of the timber is still jack pine of good size, severely injured by fire and windfall. Spruce trees, singly and in clumps, along the creeks where they attained a diameter of from 24 to 36 inches were met with, but there was no heavy stand of such large-sized spruce timber.

On the north the sand-muskeg type passes over into a loamy poplar type with sloughs replacing the muskegs. On the south a belt of hilly poplar country generally intervenes between the sandy type and the river. The soil in this type is excellent, but the surface is so badly cut by ravines that practically none of the land is available for agriculture.

To the eastward the jackpine belt narrows to a breadth of three to four miles and is said to continue northeast at a distance of two to four miles from the river into township 51, range 13, west of the second meridian. I had not time to follow it out in this direction and would not recommend that this portion of it should be included in the reserve, since it would be difficult to separate from the agricultural land. A similar belt to the south of the river separating the Lost river and Carrot river settlements contains a large proportion of fair agricultural land; there is, moreover, a settlement already established on the north side of the river in range 15. Another settlement in ranges 22 and 23 marks the western limit of the reserve north of the river.

I would recommend, therefore, that a forest reserve should be established in this region, for which I should suggest the name of the La Corne Forest Reserve.

Respectfully submitted,

E. G. McDOUGALL,
Forest Assistant.

No. 26.

REPORT OF E. G. McDOUGALL ON LANDS NEAR PRINCE ALBERT, SASK.

DEPARTMENT OF THE INTERIOR,
FORESTRY BRANCH,
OTTAWA, February 6, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I beg to submit the following report on work which I have carried on under your instructions, in the neighbourhood of Prince Albert, Saskatchewan, during the past fall.

NATURE OF THE WORK.

The object of the survey was the location of the boundaries of the non-agricultural land adjacent to the Nisbet and Pines forest reserves, with a view to the extension of these reserves. In addition, it was necessary to obtain full information regarding the residence and improvements of a large number of homesteaders, who had located upon very poor land adjacent to the Nisbet reserve.

The party, six all told, was rather cumbersome for the rapid examination of an extended boundary. Accordingly, it was divided for a time, two men going up the

river with a canoe, and two going east with a team. The best results were obtained with parties of two men with a conveyance and a light outfit.

TIME IN SURVEYING DISTRICT.

The party, which had been occupied during the summer in southern Alberta, arrived in Prince Albert on August 31, and broke up when the colleges opened; two of the students had to leave on September 9, and the other two stayed on until the 21st of that month, when the cook also left. By that time most of the distant work had been done, and I was able to continue single-handed, working mostly from Prince Albert. The local rangers gave me much assistance, particularly when I visited the Pines reserve.

From November 1 to December 17 I was engaged in the examination of a similar tract of country in the vicinity of Fort à la Corne. This work has been elsewhere reported on, and is only mentioned here because the accompanying descriptions apply to it very closely.

CLIMATE OF THE DISTRICT.

The summer climate of the Prince Albert country is very pleasant, as a rule, although last year there was not enough warmth to mature the crops. On account of the cool summers, heavy soils, especially if wet, are less productive than somewhat sandy soils.

The winter climate is decidedly severe, and the older residents, instead of growing habituated to the cold, frequently become more sensitive to it. Of course, the cold is much more bearable where forest growth gives shelter from the cutting winds.

The muskegs and sloughs with which much of the country is covered are excellent breeding-grounds for mosquitoes, but last year was too cold to coax them out and they were practically absent in September.

TOPOGRAPHY.

The North Saskatchewan river flows between banks of varying height, fringed with a narrow belt of spruce, aspen, balsam poplar and paper birch. Three fair-sized tributaries (the Shell, Little Red and Sucker rivers) enter it from the north; the two former convey many sawlogs from remote limits to the mills at Prince Albert. Though both the main river and the tributaries have a stiff current, the country is level to the eye and very poorly drained, being half covered with lakes, sloughs and muskegs.

SOIL.

A long sandy belt, perhaps a post-glacial lake-shore, commences in the Pines Forest reserve, crosses the North Saskatchewan river, and curves around to the east, passing close to Prince Albert, and 'fraying out' about ten miles farther east. Its width varies from three to six miles and there is an isolated tract of similar character to the north on the Shell river. After a break of about twelve miles, the sand belt reappears, much broader but less sharply defined, on both sides of the united Saskatchewan river. On the south side it soon 'frays out' in a series of isolated ridges and muskegs in a poplar country; while on the north, it continues eastward with varying width and some breaks, for an unascertained distance, leaving the river near Fort à la Corne and returning to it near Birch island, about fifty miles below.

Between the sandy belt and the clay-loam country to the north is a fairly continuous chain of sloughs and muskegs. Isolated muskegs are common in the sand type, and isolated sloughs, passing imperceptibly into lakes, in the other.

The outstanding types of soil, then, are:

1. Sand.
2. Clay loam.
3. Slough.
4. Muskeg.

Of course, there are intermediate grades, especially between 1 and 2.

TREE GROWTH.

The region described is in the transition area between prairie and woodland, and, though the latter predominates, the former also occurs in small areas (as seen on the map of the Pines reserve) on both sand and clay types.

East type of soil has its typical arborescent flora, the jack pine on the sand, the aspen on the clay loam, with white spruce and balm replacing it on wetter sites, and the black spruce and tamarack bordering the muskegs. The paper birch is sometimes met with in gravelly places. The jackpine is here close to its optimum; it grows with great rapidity, and reproduces abundantly on the poorest sites. It does not attain large dimensions, fourteen inches being an exceptional diameter. Moreover, it is seriously afflicted by a parasite which covers it with witch's brooms.

The aspen, on suitable sites, attains a diameter of ten or twelve inches. It is used at present for cordwood, and in future may have a value for pulp.

The white spruce, commonest near streams, attains a maximum diameter of 36 inches. Unfortunately, trees of such size occur only singly or in small groves.

The black spruce and tamarock of the muskegs are stunted where there is too much water, but on the margins attain diameters of ten to fourteen inches. The tamarack is as yet untouched by the saw-fly, and it is to be hoped that some means will be found to save it from this pest, for the wood, though scarce, is the best the country affords for wagon tongues and similar purposes, and for fuel.

The paper birch is also rare, and shares the special uses of the tamarack. It does not attain sawlog size.

OTHER VEGETATION.

Grass on the drier sites is very scanty; but in the poplar country it is luxuriant, and grows mingled with a wild pea-vine. The muskegs provide some wild hay, and the sloughs are full of a long reed, which is also cut for hay by the settlers. Blueberries are abundant in the sand country, and are gathered for the market by Indians and others.

The sphagnum of the muskegs could probably be manufactured into peat fuel, when the cordwood supply has been reduced somewhat.

FIRES.

Fire, the foe of the forest, has been unable in this region to replace it by prairie, or even, apparently, to stay its advance on the grassland, yet it inflicts enormous loss on the encroaching timber. It would seem that the 'climax forest' on the clay soil is a white spruce type, and the same may even be true of the sand ridges, yet vast areas are repeatedly fire-swept before the jack pine and aspen, the 'forlorn hope' of the forest, have passed the thicket stage. The fires are promptly followed by a vigorous young growth of trees, not, as in Southern Alberta, by a park-like formation, gradually changing to prairie.

There is usually just enough grass on the jack pine land to carry fire, but the young thickets and the recent slash are most exposed to it. The latter, indeed, is not much injured, but may carry fire to the former.

The trails in the sand-hills cannot be crossed by ground-fires, if watched; crown-fires, of course, are another matter. Back-firing from a trail or prepared line in an open part of the stand is probably the best method of dealing with them.

On the poplar land, ground-fires are difficult to check, on account of the thick growth of grass and pea-vine. The reeds on the sloughs deprive them of value as lines of resistance; and even the muskegs, if partly dry, may become a shelter rather than a barrier to the enemy.

FISH AND GAME.

The Saskatchewan river once abounded in fish, but their numbers have been greatly reduced of late years. The Shell and Little Red rivers have been spoiled by log-driving. Whitefish and suckers may be had on some of the smaller inland water-courses, but there is nothing in the locality examined to attract either the commercial fisherman or the angler from any distance.

Game, on the other hand, is still abundant. The sloughs swarm with ducks, the timber with grouse; wild geese sometimes halt in the neighbourhood, and rabbits are plentiful throughout the district. Of larger game, moose and jumping deer were seen within a few miles of Prince Albert, and a few elk north of Fort à la Corne. Coyotes approach to the very edge of the town, and engage the dogs in vocal competition. Tracks of bears and timber wolves were seen in the remoter parts.

The moose, deer and elk naturally prefer the fertile poplar country, but as this is now being cleared and settled the animals take refuge in the jackpine sand-hills.

ROADS.

A few good highways, generally keeping close to the old Indian trails, have been constructed, but the majority of the trails are fit for use only in winter. Summer travel, except along the main roads, is decidedly difficult, even on foot. A system of passable trails for patrol purposes is a present necessity, and will greatly increase the usefulness of the rangers.

AGRICULTURE.

The clay-loam soil is the best in the district, and mixed farming is a thriving industry. As already mentioned, the country is hardly adapted for mere grain-growing. The sloughs, when drained, give good hay and grain crops. The cost of draining varies greatly, but steady progress is being made, and every ditch affects a considerable area. In many places, drainage would be a profitable public enterprise.

The sand country is naturally unattractive to the farmer, yet where it approaches the town it is sometimes homesteaded. Excellent potatoes can be grown, and stable manure thrown away in Prince Albert might be used here to advantage; with its use, the cultivation of grain, small fruits, and hardy vegetables might well be possible.

The muskeg type is regarded by the farmers as irreclaimable, even if drained. Bog hay is its only agricultural product.

STOCK-RAISING.

The region is unsuitable for horses; neither the bog hay nor the slough water agrees with them, although cattle thrive on both. Oxen, despite the strong prejudice against them, are replacing horses on many farms. Though painfully slow on the road, they are excellent for the heavy work of breaking and plowing. A few sheep are kept on some of the farms, and seem to do well. The slough country supports domestic ducks as well as wild ones, and chicken farming is the main reliance of the settlers in the sand belt.

HOMESTEADERS.

The eastern block of the proposed extension of the Nisbet reserve is cut off from the main body by a number of scattered homesteaders; some of them had abandoned their entries after cutting off the cordwood, and others had not started to improve, but a few had made substantial improvements and were producing potatoes and poultry.

The northern block of the proposed extension is similarly cut off by homesteaders, who in this case have located along a narrow strip of good clay country between two sand areas. Their farms may be productive but are somewhat isolated from neighbours. Had the lands been vacant they might well have been included in the reserve.

There is also an isolated patentee in the heart of the northern block. His farm, close to the Shell river, is very productive, and it will probably be unnecessary to remove him.

CORDWOOD LICENSES.

A Prince Albert cordwood firm has covered much of the jackpine land with its license, thereby protecting it from homesteaders, and the head of the firm has been active in demanding the reservation of the tract for forest purposes. The license also covers some poplar land, fit for homestead when cleared, and exposed to much danger from fire in the meanwhile. For these reasons, the outlying poplar lands, not included in the forest reserve, should be cut over as soon as they can be made accessible.

When the reserve is established, the license will naturally be allowed to run its course. The market conditions, as well as the natural conditions, favour a tie-and-cordwood management, cutting to about ten inches, and thinning for cordwood in the younger thickets. In future, the demand for saw-timber is bound to increase, and therefore steps should be taken now to plant at least the better sites with desirable species, such as white spruce and, possibly, Scots and red pine. The jack pine may be clear-cut, for the cones on the ground will germinate when the trees are removed.

FIRE PROTECTION.

Trails for patrol purposes should be constructed through all parts of the reserve; a good deal of floating corduroy will be necessary. In the drier parts the trails, if travelled to any extent, would serve in some measure as fire-guards, or at least as lines from which to back-fire. In addition to a diligent patrol, local co-operation in fire-fighting can, and should be secured.

South of the river there will be one ranger at Macdowall and one to the north of the Pines. If the extensions are adopted, two rangers on the north will be necessary, of whom one could be placed at the east end of the present Nisbet reserve, and one a few miles west of the third meridian. If the appropriation will permit the employment of only one ranger, he should be located near the west end of the Waspaton Indian reserve. In addition, the Canadian Northern Railway Company should be required to patrol its lines.

Owing to the close proximity to civilization, telephone lines in the reserves could have town and country connections, and would be highly serviceable. Lookout towers, with telephones, would also be of great value.

Respectfully submitted,

E. G. McDOUGALL,
Forest Assistant.

No. 27.

REPORT OF W. J. VANDUSEN.

TORONTO, November 9, 1911.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I beg to submit the following report, with accompanying maps, on the work which I have carried on during the summer of 1911 on the Porcupine mountains in Manitoba.

According to your instructions I reported to Mr. J. R. Dickson, in Swan River, Man., on May 17 last, and proceeded to the purchasing of an outfit and supplies for the party. I was joined by the other members of the party—Messrs. C. P. McAlister, H. B. Murray and Donald Greig—on May 24, and, having secured a cook and packer, the party was ready to proceed to the field on the 25th, but was prevented from doing so by the weather. It rained on the 25th and 26th, and on the 27th two inches of snow fell. This rain and snow, while delaying us, were exceedingly beneficial, inasmuch as they proved a very effectual stop to the forest fires which had been burning for some time in the region. The following day (Sunday) being fine, we were able to make a start on Monday, and, although the roads and trails were in very bad condition we arrived at Cross lake on the afternoon of May 31.

NATURE OF SEASON.

The first part of the summer (June and July) was very wet. As a result, progress was slow, and the continual wet was hard both on the equipment and on the health and spirits of the party. During August and September we had less rain, more than half of the number of days being without rain. On quite a number of days it was difficult to do much satisfactory work on account of the heavy wind hindering tree-top observation to a considerable extent. According to natives, the season was one of the worst experienced for mosquitoes, it being almost impossible to run a compass or take notes on some days. The mosquito pest lasted from our arrival until about the middle of August. Few of the days were hot and all the nights were cool.

NATURE OF THE WORK.

The work took the form of a reconnaissance survey, with the object always in view of determining a new boundary to the present Porcupine forest reserve which would include all land unsuitable for agriculture. It soon became evident that it was impossible to get a comprehensive knowledge of the area in the time at our disposal by merely running lines on the ground, as the hazel and mountain maple undergrowth made distance observation impossible. We, therefore, relied on observation from tree-tops to a great extent throughout the season.

The work was carried on by two parties, each composed of two men. In running compass lines a party made on an average about four miles a day, having, of course, to return the four miles or more to camp. We took advantage of all wagon and pack trails, and even moose trails helped along the work. In traversing the trails a party could make about four and a half miles a day.

ROUTE FOLLOWED.

Our first working camp was located on Cross lake in section 31, township 38, range 28, west of the first meridian. From there we went to Whitefish lake and thence along the southern boundary of the reserve to Woody river. We then moved to section 7, township 38, range 28. and from there by a series of camps in a northeasterly direction, striking the railway at Birch River Siding. From Birch River Siding to Barrows Junction we had a camp at each station and worked from the railway by means of velocipedes. This proved to be a very rapid method, and Barrows Junction was reached on August 23. At this point we left the railway and moved in a general

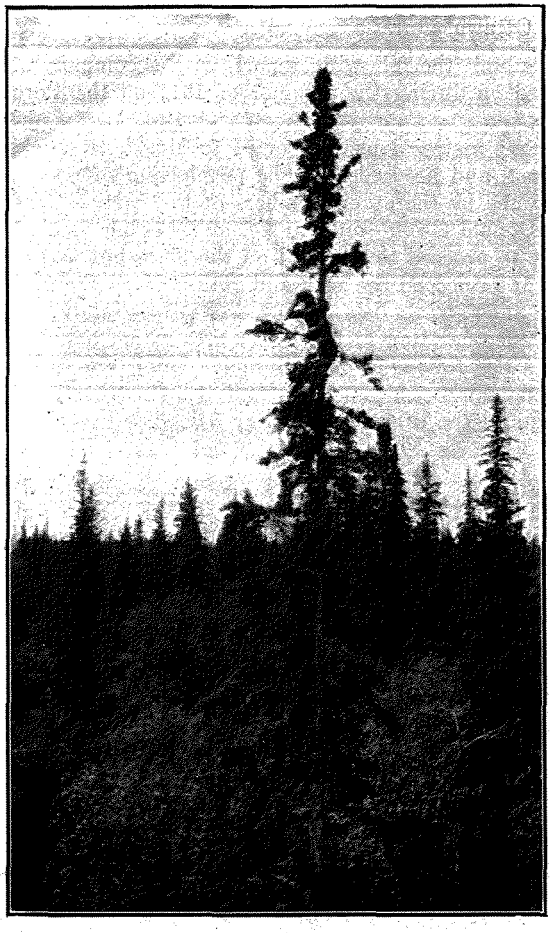


Photo W. J. Vandusen, 1911.
Forester Taking an Observation from Tree-top. Porcupine Mountains, Man.

southwe sterly direction, meeting the northern boundary of the reserve at the northeast corner of township 42, range 31, west of the first meridian.

My three student assistants left for college on September 13. On September 16, the packer, cook and myself left Bowsman to go up the western boundary of the reserve. On reaching the southwest corner of the reserve we found a winter road, instead of a summer road as expected, and as we had provisioned for a rapid trip were

unable to go more than six miles north. From this point, however, I could see for at least ten miles north, and found that the country is all gently rolling. I would recommend that a summer road be cut up this western boundary, and when this is done a closer examination of the area immediately to the west should be made with the view of reserving it if necessary to protect the head-waters of the Swan river.

During the season we had twenty-five main camps and numerous subcamps, and traversed approximately eighty miles of trails.

TOPOGRAPHY.

Most of the rough area known as the Porcupine Mountain is found in the province of Manitoba. The level area to the west rises gently and gradually until within about six miles of the Manitoba boundary, where it breaks into rough hilly country. From here eastward to within two or three miles of the Canadian Northern Railway, for two townships on either side of the eleventh base line, the country is rough and hilly. The falling off of the mountain on the north and south becomes more and more marked on moving eastward. The eastern edge of the mountains is very rough, falling off to the railway quite abruptly. The Canadian Northern Railway from the eleventh base line to Powell Siding skirts along the edge of the rough country, avoiding as much as possible the large muskeg which extends eastward to Swan lake and Dawson bay. On the first plateau the country is for the most part gently rolling, with a large percentage of black spruce muskeg with jackpine and poplar ridges.

Only two lakes of any size were met with during the season, namely, Whitefish lake and Cross lake. Good water was always available in the numerous streams, many of which are fed by springs. Of all the streams only seven deserved the name of river; these were the Woody, Bowsman, Birch, Bell, Steeprock, Rice and Armit rivers.

A number of the smaller streams showed strong indications of the presence of iron. Again, many sulphur and salt springs were met with, which seem to indicate the breaking-down of iron compounds in the hills.

SOIL.

The hills, in the main, are clay, no bed-rock being seen in any of the hills or cut-banks. On the south the subsoil is clay, with usually a good covering of loam and humus, but occasionally boulders are quite numerous. From the correction line north along the proposed boundary the soil becomes very sandy, with gravel in places, until Barrows Junction is reached, where it changes again to clay.

In the muskeg, as a general rule, black muck was found down as far as the water-table, which varied from two inches to two feet below the surface.

TREE GROWTH.

The principal trees found on the Porcupine Mountains are:—

Picea canadensis (Mill.) BSP—White Spruce .
Populus tremuloides Michx.—Aspen (White) Poplar.
Populus balsamifera Linn.—Balsam (Black) Poplar.
Betula alba var. *papyrifera* (Marsh.) Spach.—White Birch.
Picea mariana (Mill.) BSP—Black Spruce.
Pinus Banksiana Lamb.—Jack Pine.
Larix laricina Michx.—Tamarack.

Of these trees white spruce is the only commercially important one at the present time, and that of a commercial size is to be found in the timber berths scattered along the lower slopes. On the uncut limits the white spruce would average between one and a half and two million board feet per square mile. The growth of white spruce in this region is shown by the following table:—

Age.	Diameter at Breast-height.	Height.	Volume.
Years.	Inches.	Feet.	Board Feet. (Doyle Rule.)
10	1·1	6	...
20	2·4	12	...
30	4·0	20	...
40	5·0	28	...
50	7·2	36	16
60	9·1	46	30
70	10·7	53	50
80	12·0	62	60
90	13·0	67	80
100	14·0	71	100
110	14·8	75	130
120	15·7	80	160
130	16·3	82	190
140	17·0	84	220
150	17·7	86	255
160	18·0	..	300
170	18·2	..	333
180	18·4	..	365

This table is based on 26 trees on site I, showing best development therefor.

This species is rarely found in pure stand, invariably being accompanied by poplar or birch in varying quantities. It is the timber tree of the region, very little else being cut by the lumbermen.

There are large quantities of mature poplar, both aspen (white) and balsam (black), in both pure and mixed stands. A large percentage of the aspen is defective, mostly at the heart; the balsam poplar appears to be in a very healthy condition, but the wood of both these poplars warps and checks so badly in the seasoning that as yet they have not been marketable. There is very little demand for fuel-wood in Swan Valley. If possible, some method should be devised for the utilization of this supply of poplar which is ready for the axe.

Black spruce is confined mainly to the muskeg and semi-muskeg, and its growth is very slow.

Tamarack is also largely found in the semi-muskeg. It borders the muskeg in many places, and in all cases appears to be in a very healthy condition, no evidence of its fatal enemy, the larch saw-fly, being noticed. I might also add that both white spruce and tamarack were prolific seed-producers this year.

White birch is found on the south, scattered with the poplar, but on the north there is more birch than poplar. The trees are too crooked for lumber, but would make excellent fuel.

Very little mature jack pine remains, nearly all having been cut for ties.

After going up the first rise of the mountain in most cases one meets young growth of poplar or jack pine about twenty to twenty-five years old. These two species come in first after a fire, but in many places the white spruce is coming in under the poplar, which will eventually be displaced by the more persistent spruce. Above this first rise this fire-muskeg type would constitute from eighty per cent to ninety per cent of the area. I venture to say that there is practically no merchantable timber on the present Porcupine Reserve.

The following percentages of areas will give an idea of the condition of the area proposed as an addition to the present reserve:—

	Percentage.
Spruce timber, with mixture of poplar and birch	7·7
Poplar and birch	7·1
Poles (not in muskeg)	5·0
Burn, restocked	43·3
New burn, without regeneration as yet	11·0
Muskeg, mostly black spruce and tamarack poles	25·9

THE BOUNDARY PROPOSED.

In locating the new boundary I have been guided by three factors:—

1. Topography.
2. Soil.
3. Tree growth.

The boundary proposed, as shown by full yellow line on accompanying maps, is approximately 106 miles in length, adding 428½ square miles to the reserve as at present outlined. This area is of no agricultural use. Lying next to the boundary of the present reserve is a gently rolling area composed of muskeg, with some fifty to sixty per cent sandy, gravelly or stony ridges. These ridges are covered with jack pine and poplar twenty to twenty-five years old. Next to this is an area of rough, rolling country, part of it bearing good timber and part of it fire-swept. The boundary on the north and south skirts the edge of this rough, rolling area, but from this rough area to the proposed boundary on the east there is a very sandy strip from one to two miles wide.

North and south of the present reserve, immediately east of the second meridian, are two areas, 'A' and 'B,' inclosed by a broken yellow line, which I would also recommend to be added to the reserve.

The area on the north ('A') slopes gradually to the northwest and has a loamy clay soil. A considerable portion of the area carries mature poplar, with scattering white spruce. Spruce poles also cover a considerable area and there are found a certain amount of muskeg and jackpine ridges.

The area on the south ('B') slopes gradually to the south and the soil is, in the main, clay loam. Just east of the second meridian a large muskeg extends east about six miles. The ridges are covered with jackpine and poplar about twenty-five years old. The remainder of this area is mostly covered with mature white spruce and poplar.

I do not think there is any likelihood of either of these areas being put to agricultural use in the next fifty years, and, therefore, they should be included in the forest reserve, as, in that condition, they can be better administered for the benefit of the surrounding country.

Again, it will be noticed that the eastern boundary keeps close to the railway, without crossing it, however. East of the railway there is a large area ('C') fit only for growing trees. This area east of the railway, over as far as Lake Winnipegosis, is practically level, the only break being southeast of the south end of Swan lake, where a low range of hills, known as the Kettle Hills, runs northeast and southwest. From interviews with a number of the oldest Indians who have roamed over this section of the country for the last four or five decades, it appears to be mainly muskeg. The numerous streams crossing the railway and flowing east are lost in the muskeg, only the larger rivers retaining any semblance of a course. Around Swan lake, along Shoal river, on the shores of Dawson bay and Pelican bay and on the east shore of Lake Winnipegosis down to Duck bay there is a strip of dry land varying in width from half a mile to three miles. The remainder is muskeg, with about 25 per cent sandy ridges. The ridges are stocked for the most part with twenty-five-year-old jackpine, poplar and spruce. The growth in the muskeg is confined to black spruce and tamarack, which rarely exceeds six inches in diameter. From the mouth of the Woody

river south for some distance past the Swan river there is a considerable area of good hay-land.

Practically the only use to which this area can be put is the growing of trees. A market for its product can be reached by both rail and water, and on account of its peculiar position the fire danger can be reduced to a minimum. I would, therefore, suggest that a boundary be located between Birch river on the railway and Lake Winnipegosis, and that the area north of it, to Dawson bay, Red Deer river and Red Deer lake be put into a forest reserve.

FIRE PROTECTION.

Fire has done great damage to the growth on the Porcupine mountains. About twenty-five years ago immense fires must have raged, which left only a small portion of the timber standing. Over this burnt area jack pine and poplar soon made their appearance, the spruce coming in a little later under the shelter of the poplar. In some cases, being burnt a second and a third time, the soil is robbed of the vegetable covering which took ages to accumulate, and the result is a treeless area. The most recent fire was that of this spring, when approximately 150 square miles were burned over, part of this area being young growth of poplar and jack pine twenty to twenty five years old, and part mature spruce and poplar. This fire was stopped by the heavy rains and snowstorm of May 25 to 29. Only three months after the fire evidences of the spruce wood-borer were noticed in this standing burnt spruce.

There are four danger points to watch in trying to prevent fires, viz., the railway, the sawmill, the settler and the camp-fire; and the greatest of these appears to be the railway. To secure adequate fire protection on the Porcupine Reserve I would recommend that there be two fire-rangers, and that they live either on the reserve or very close to it. Each should become thoroughly acquainted with all the trails and roads in his district and see that they are kept in proper condition, especially during the summer. Trails and roads should be cleared before the freeze-up, for when a trail is cut in midwinter—the easiest route (over muskeg and lake) being, of course, selected—it is usually worse than useless during the summer, the time of fires. Lookout points commanding endangered territory could be very easily located. During the dry season I would recommend a daily patrol, at least, of the railway on velocipedes, and the rangers should have absolute authority as to the time and place of burning replaced ties on the right of way. Then, again, outlying settlers should be visited at least once a year and cautioned as to the proper use of fire and their liability in the case of its spreading from their land.

FISH AND GAME.

In Cross lake we found the jack-fish, and in Whitefish lake, jack-fish and pickerel.

Moose were very plentiful. The sulphur and salt springs, of which there were a considerable number on the slopes, were much visited by them, and in most instances well beaten trails radiated from them like the spokes of a wheel. Then there were the black bear, timber wolf, fox, deer, beaver, otter, lynx and mink. This forest reserve should become one of our best game reserves.

Respectfully submitted,

W. J. VANDUSEN,
Forest Assistant.

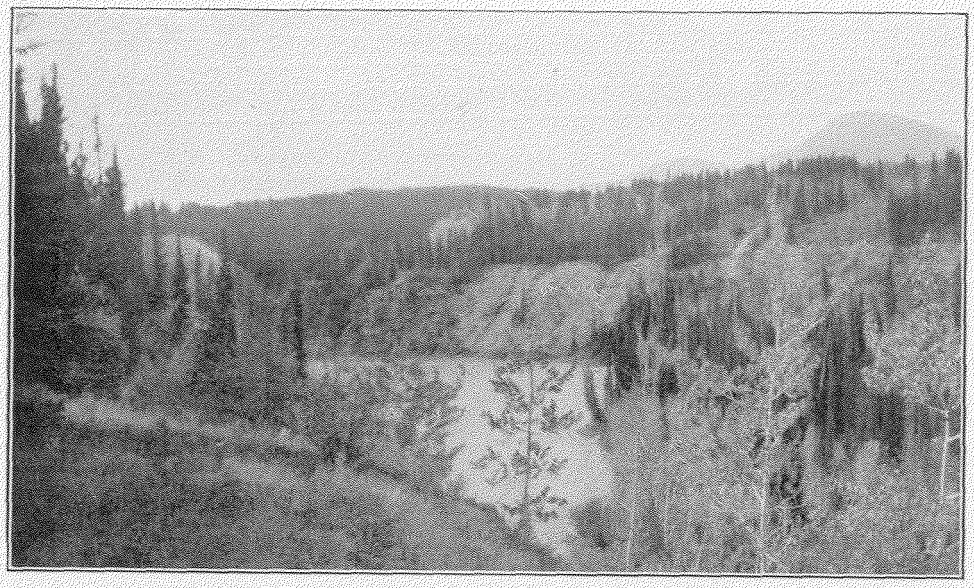


Photo G. H. Edgecombe, 1911.

View in Bighorn River District, above the Falls of the River.

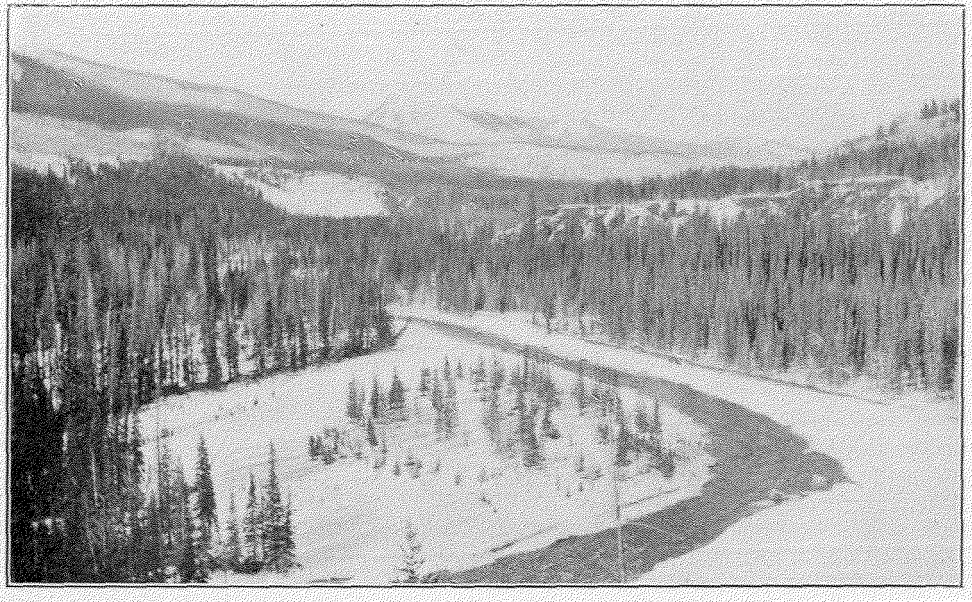


Photo G. H. Edgecombe, 1911.

Athabaska Forest : View in Stony River District immediately north of Jasper Park.

No. 28.

REPORT OF FRANK M. BEARD.

DEPARTMENT OF THE INTERIOR,
FORESTRY BRANCH,
OTTAWA, September 15, 1911.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I have the honour to submit the following report and map to accompany, covering the work done during the season of 1911 by the Hudson Bay Survey party of the Dominion Forestry Branch.

As instructed by you I left Selkirk June 24, 1911, via *S.S. Wolverine,* accompanied by two men, arriving at Warren's Landing on June 26 and at Norway House the same day. As the canoe I brought up with me was not serviceable on the lakes that we would encounter I traded with the Hudson's Bay Company at this post for a larger one. Mr. Blackford, fire ranger at this post, kindly furnished us with two men as guides to Cross lake.

We left Norway House June 27 and travelling by the East Branch of the Nelson river, reached Cross lake July 2. Procuring a guide at this post we left July 3 for Split lake, arriving at this post July 7.

One of the men who came down with us to this post returned to Norway House, complaining of being too ill to travel farther. Here, as instructed, Mr. H. B. Blount was waiting with the supplies, a cook and two canoemen. According to your instructions I interviewed Mr. J. T. Whyte (now deceased), who was stationed at this post as fire-ranger, regarding the timber inspection accomplished by him the previous summer. I was informed that he had inspected the territory from the Manitou Rapids to Buttneau lake, a distance of about seventy miles by railway line, and that his reports and maps had been sent into the Department and accepted.

After some difficulty, we procured three Indian canoemen to assist us to York Factory. As we had planned to come back by the Hayes river it was necessary to take an extra canoe to the bay to insure the Split Lake Indians a return.

The party was made up of the following:—Mr. Wilkins, cook; M. Swanson and McLean, canoemen; Mr. H. B. Blount, four Indians and myself. With three canoes, we left Split lake on July 11, travelling by the Nelson river until we arrived at the mouth of the Buttneau river, going up this river into a small lake. We portaged over into the Kettle river and proceeded up to Kettle lake, as this was the point at which Mr. Whyte left off. We inspected the timber along the proposed route of the Hudson Bay railway to the Bay. Finding the timber of little commercial value, we were able to cover the territory in a much shorter time than we had anticipated. From Kettle lake we went down the Kettle river into the Nelson, and via Nelson river to Hudson Bay, inspecting the timber by running compass lines back to the railway line, where practicable. Where the railway line extended south of the river at its greatest distance and the area intervening was covered with deep muskegs, making it impossible to traverse during the summer months, I interviewed members of the railway survey party who ran the line from the Bay to the Manitou Rapids, thus gathering information as to the timber conditions of this locality thirty miles along the proposed railway line below Angling river.

Arriving at York Factory on July 26, we repaired our canoes and after some difficulty procured a guide to take us through to Norway House. From York Factory we sent one canoe back to Split lake with three Indians.

The party, now made up of seven men, left York Factory July 27, travelling by the Hayes river into the Echimamish and Nelson rivers, respectively, arriving at Norway House August 21. On August 25 we proceeded to Warren's Landing on *S.S. Highlander,* and on the 27th left the Landing on *S.S. Wolverine,* arriving in Selkirk September 1, 1911, a distance of 1,000 miles having been covered by canoe from Norway House to Hudson Bay and return.

OBJECT OF THE SURVEY.

The main object of the survey was to make a reconnaissance of the country adjacent to the proposed route of the Hudson Bay railway between Buttneau lake and Hudson Bay. The reconnaissance was to consist of locating and estimating merchantable timber to be used as ties for the construction of the proposed railway found within a distance of eight to ten miles of the railway line, excepting on rivers where such timber would be available to the line by driving. Where the timber was not merchantable it was inspected simply by noting the species and the forest conditions.

The methods best adapted for fire protection were carefully noted.

METHODS USED.

From points along the river course, at intervals of eight to twelve miles, compass lines were run back to the line of railway when possible and tied on to that line. The water-courses were also used in locating types. From advantageous points, such as heights of land and the tops of trees, field-glasses were used to good advantage in examining and locating the forest types. Trees under eight inches in diameter at breast-height were considered unmerchantable. Territory not commercially timbered, i.e., producing trees under eight inches in diameter at breast-height, was inspected, giving a description of species, type and prevailing conditions.

WEATHER CONDITIONS.

Information gathered from the inhabitants of the country shows that we passed through an unusual season for this district. During the months of July and August, rain fell continuously and high winds from the northeast were constant most of the time. The temperature ranged from 40° to 50° F., thus making a very unsatisfactory climate for the production of merchantable timber. Frost occurred August 28.

GENERAL DESCRIPTION OF THE COUNTRY.

Topography.—The absolute elevation of Split lake is 470 feet above sea-level, giving a drop of 37·6 inches to the running mile between Split lake and Hudson Bay, a distance of 150 miles. The drop between Split lake and the mouth of the Limestone river (a tributary of the Nelson) is 420 feet, or 50·4 inches to the running mile for a distance of 100 miles. This shows that the drop in elevation between Split lake and the Limestone river is very abrupt, and below the Limestone river to Hudson Bay, the fall is very slight, having a drop of 50 feet in 50 miles.

The surface of the total area covered is undulating to nearly level. The territory surrounding Split lake is composed of areas of occasional granite rock outcrop worn down to the general level of the country by the glaciers of the glacial period. Below Split lake the country is practically level, with a slight northern exposure.

Drainage.—The divides between river courses are very low surrounding Split lake, it being not uncommon to find a muskeg situated on the divides. There is a moderate slope down toward the Bay and it occurs in east and west undulations, so that there is no drainage except by the Nelson river down to the Bay. There are some streams running into the sides of the river, but they, like the Nelson, cut deep

with walled trenches, sometimes eighty feet high, as steep as boulder clay will stand, and that means an angle of sixty degrees for this height. After getting on top of these banks one will find the moss very deep and twenty feet back from the edge of the stream a muskeg will be discovered, indicating that the drainage is very poor. The country is covered by muskeg, but there are a few large lakes, a fact which shows that the drainage of the country is comparatively new.

DESCRIPTION OF FOREST COVERED.

Kettle River District.—The railway line comes into this section between Kettle and Buttneau lakes, following the Buttneau river a distance of eight miles, crossing the Kettle river about twelve miles from its mouth and then following this river on the south side in a northeasterly direction.

The territory surrounding Kettle lake and Buttneau lake has been burned off recently, leaving a most desolate-looking country. This continues on the north side of the river to the banks of the Nelson, and extends over nearly all the country between Kettle lake and the mouth of the Kettle river. On the south side of the river near the lake an old burn has ravaged the country, leaving a very poor growth. This converges into a pole-type to the northeast, and towards the mouth of the Kettle river the type changes to an old burn. A low ridge divides the drainage of the Buttneau and Kettle rivers. Along the top of this ridge jack pine predominates. On the slopes tamarack and black spruce are associated. Along the south of the river the slope is very gentle and extends back for several miles. Black spruce predominates, associated with a small per cent of tamarack.

The only merchantable timber in this district was found along the banks of the Kettle river, in small plots located on flats at the turns in the river.

There are 7,000 spruce ties of first and second grade, 6,000 first-grade, and enough timber of the 12-inch and 14-inch diameter-class necessary for the temporary bridge construction on the Kettle river.

This timber is accessible to the railway by the Kettle river. The best method of taking this out is to have it cut by the railway contractor when the road is put through. A small contractor would not take the contract for the following reasons:—

1st, because the timber is too scattered;

2nd, because the base of supplies is too far away, making the cost of transportation too great;

3rd, because the quantity of timber is too small to insure any profit.

Kettle River to Angling River.—This district is drained by a small creek, showing that the slope to the river is very gentle. The timber has been practically all burned off in former years. Some areas are now producing a stunted growth of spruce, running to the diameter of three to four inches. Most of the territory, especially back from the river two or three miles, is covered with muskeg. There are no large lakes in the district and this applies to the whole area to the Bay. A characteristic feature of the black spruce is that it attains its best growth along water-courses and lakes. This, then, is one reason why the forest cover does not reach merchantable size.

Angling River.—This river is well named, being very crooked. Its banks are forty to fifty feet high, consisting of a green clay. Along the flats of the stream caused by the wash of high water the spruce growth reaches the diameter of 8 in. to 12 in. at breast-height, and is estimated at 4,500 ties. The timber growing back from the stream is of a spindly growth.

The cutting of these ties would not be profitable to either a railway contractor or a sub-contractor for the following reasons:—

1st, because supplies could be transported only on ice, making the cost too great, Angling river not being navigable;

2nd, because the stream is not suitable for transport of ties to place of construction;

3rd, because the quantity of timber is too limited.

Angling River to Hudson Bay.—The only merchantable timber found in this district is situated in small scattered plots along the banks of the Nelson river, and is estimated at 1,400 ties. The timber found in this district would be available by booming and floating it down the Nelson river to its mouth, but being so limited in quantity it would hardly pay to handle the proposition.

The railway line runs adjacent to the river in a northeast direction to Hudson Bay and is located from ten to fifteen miles south of the river.

The territory immediately below the Angling river is covered by a dense growth of black spruce running in the diameter class of four to six inches, the large trees being found along the stream. This pole type extends as far as our line traversed, six to eight miles, and continues down the stream for fifteen to twenty miles, running into an old burn. This area has been restocked by a sickly growth of black spruce and tamarack, the tamarack being found in mixture with spruce on the semi-muskeg areas. Farther down towards Hudson Bay this type merges into a pole stand, consisting almost entirely of black spruce everywhere, including the muskeg situations. This type compares favourably with an alpine type such as is found at high altitudes. On high peaks the conditions for tree growth become unfavourable since the extreme winter temperature above the snow cover and frosts nearly every month in the year can be endured only by the hardiest of species. The wet soil of this sub-arctic region, frozen most of the year, or the thin soil of the alpine peaks, produces trees stunted in form, with small diameters. This type continues to the water-line on Beacon Point.

The area along Hudson Bay, being very low, was covered with water during the past summer.

SUMMARY OF TIMBER.

Kettle river	6,000 ties.
Angling river	4,500 "
Nelson river	1,400 "
Total	11,900 "

This shows that ties for this section of the proposed railway will have to be imported.

GENERAL CONDITION OF FOREST.

Forest canopy.—Black spruce predominates, associated with tamarack and semi-muskeg areas. Aspen and jack pine occur in mixture with the spruce on ridges and along water-courses.

Black spruce is primarily a swamp tree, and is a common inhabitant of cold, poorly drained muskegs, a typical tree for this country. It occurs in pure, dense stands producing trees small in diameter and stunted in growth.

Jack pine and aspen occur on very limited areas and in small quantities in this locality. The type disappears entirely 100 miles from Hudson Bay.

Forest cover.—Alder forms the principal undergrowth in spruce types in restricted areas. Black willow is found under spruce on well drained plots along river-courses.

Forest floor.—Labrador tea is distributed over the whole area, growing in dense formation with moss, making an ideal situation for fires in a dry season and for muskegs in a wet season.

Density.—In the spruce and tamarack types the density averages six.

Density deals with the number of trees found on a given area. The greater the number growing on an area, the more intense will be the competition for the chief factors necessary to growth, which are soil and light in this locality.

The dominating forest canopy, as stated before, consists of spruce and is practically all composed of the same age-classes, owing to the repeated fires.

Naturally under these conditions the competition will be very keen, as the demands on light and soil will be the same. The spruce, being lateral- rooted trees, have not only to compete among themselves for the nourishment to sustain life, but they must also compete with the annuals for these factors.

The competition among themselves which is very strong, owing to the density of tree growth combined with the competing annual plants and the limited amount of plant food in a muskeg situation, explains to a great extent the small, spindly growth in this locality.

Density in a stand has the tendency to direct the trees' growth upward towards the light, clearing the boles of side branches and producing long straight trunks, finally crowding the weaker species out and dividing the forest into two classes, the dominant and the dominated. This theory applies very well when the soil conditions are favourable for the maintenance of this increased height-growth.

But the black spruce is a very tolerant species, the boles do not clear themselves readily, and the trees grow slowly, by reason of the adverse soil and weather conditions. Thus we find that after 100 years growth the development of the stand is about equal, as there is no division into dominant and dominated classes, consequently the trees are stunted in height, running to a small diameter, and bushy in form.

Reproduction.—After a fire reproduction takes place very slowly on account of the thickness of the moss and the repeated ground-fires.

There are no pioneer species, such as the poplar and birch, to restock an area after a fire, as do these species in most localities to the south of Hudson Bay. The black spruce does not bear seed abundantly, although it usually bears some seed every year. Years of especially abundant seed-production are at long, irregular intervals, and for this reason the ground is left barren for many years after a fire, as the spruce must establish itself on the denuded areas.

Rate of growth.—The rate of growth is very slow on account of suppression or unfavourable conditions. Spruce will, however, produce a fair-sized tree when conditions of soil, moisture and light are favourable.

I made a stem analysis of black spruce on two different locations. The first analysis was made on a well drained area along the Kettle river, where the soil was porous. Trees 5 in. to 6 in. in diameter and 40 to 50 ft. high were found to be 110 years old.

The second analysis of spruce was taken in a swampy locality where the soil was non-porous. Trees 3 in. to 4 in. in diameter and 20 to 30 ft. high were found to be 100 years old. This shows that under favourable conditions the black spruce will grow to fair dimensions. The rate of growth for the other species was not taken, as they formed a very small percentage of the stand.

Soil.—The subsoil of this area resembles very much the clay found in Ontario.

To get a fair idea of the soil I took borings in three situations. The first taken was on a low ridge situated near the Kettle river. Growing moss was six inches deep, moist; the decomposing moss ran to a depth of eight inches, and this merged into a wet sandy clay.

The second boring was made in a muskeg in the same area, the growing moss in this situation being eight inches deep, wet; the decomposed moss saturated with water averaged ten inches in depth, and this ran into a non-porous clay.

The third boring was made fifty miles from Hudson Bay in a muskeg, being a typical situation for this region. The growing moss averaged ten inches in depth, wet; decomposing moss averaging eleven inches in depth, saturated with water, the subsoil being composed of a non-porous clay.

Ice was discovered in several localities, occurring generally in deep, cold moss situations within a range of fifty miles of Hudson Bay.

To produce a habitat favourable for tree growth, the muskegs would need to be drained of the stagnant water found in such situations and the deep layers of moss should be burned off, making a mineral soil available for the germination of seeds. The area of muskegs covers thousands of square miles, making it a projet of great magnitude to drain such areas.

Climatic Conditions of Forest.—Spruce growth may suffer severe damage, as was shown in the season of 1910-11. Owing to sudden changes in the weather conditions peculiar to this locality, considerable areas of spruce trees were killed in the territory examined. The explanation seems to be that the trouble is due to climatic conditions. A sudden cold spell froze the moss and upon this fell a heavy snow. Following this a warm period started activity in the tops of the trees, but as they could not draw up moisture from the ground to supply the transpiration, the needles dried up and the trees were killed.

FOREST PRODUCTS.

Cordwood.—The forest covers thousands of acres in this locality, in fact the whole country from Hudson Bay to the timber line in the Arctic region is forested, except where the ground has been stripped of vegetation by the periodic fires. The possible supply of cordwood is enormous, but on account of its remoteness from settlement it has little commercial value.

Fence-posts.—A good percentage of the timbered areas should produce durable fence-posts. The trees grow very slowly, and the wood is composed almost entirely of summer growth. There are two separate periods of annual growth, spring and summer. The wood formed in the forepart of the season is light in weight and soft in texture. The outer darker part is termed the summer-wood of the ring. The latter is very hard and firm, and determines the weight and durability of the wood.

Pulpwood.—The black spruce, as stated before, is a very tolerant species, so that it does not clear itself well of side branches, and every branch on the trunk means a knot in the wood. This, combined with the hard wood produced by the greater proportion of summer growth of the spruce, makes undesirable material for pulpwood. The trees growing on the well drained flats along the streams should make good pulpwood, but as this area forms a very small percentage of the stand, the forest cover of the country could not be classed as a pulpwood type.

CONCLUSIONS ON THE TIMBER CONDITIONS.

1. *Why the forest does not produce merchantable timber.*—The climatic conditions are adverse to the production of merchantable timber.
2. The soil and muskeg situations are not adapted to the production of timber.
3. The density of tree growth is too great for the amount of nourishment.
4. The repeated fires will not permit the establishment of a forest cover.

Uses of forest cover.—The forest cover is adapted to the protection of the watershed of the Nelson river.

The forest cover is fitted for the protection of fur-bearing animals and game.

Problem of forestry.—The problem is to drain the area so that black spruce will have favourable conditions to produce merchantable timber.

FIRES.

The conditions found in this district may be described thus:—

It is a region practically uninhabited, the only means of transportation being the water-courses, as there are no trails or roads. The only means of communication is the York boats transporting supplies from Norway House to the outposts of the Hudson's Bay company.

During the summer months the Indians bring their families in from the hunting grounds and gather in bands around the Hudson's Bay company's posts. At these times there are about 350 Indians at Split lake and 300 at York Factory.

The Nelson River route between Split lake and Hudson Bay is used very little, as there was only one other party, besides ours, over the route during the season of 1911. This is accounted for by the great danger to life in shooting the continuous chain of rapids in a river as large and treacherous as the Nelson. This country is travelled over by Indian trappers in the winter, when it is impossible to set fires. We found the north side of the Nelson river burned over to a greater extent than was the south side. The canoe route on this river follows the north shore most of the way, so that it may be assumed that all the fires started along this route at camping places and on portages were caused by the carelessness of man. When the fact is taken into account that this has been going on for scores of years and the fires are left to burn themselves out, it causes little surprise to find an absence of merchantable timber along the banks of this stream.

Another important factor in starting fires, especially on the south side of the river, where there is practically no traffic during the summer months, is the frequency of electric storms, as in several instances we saw trees that had been struck by lightning in former years and had been the cause of several large fires.

The spruce forests are peculiarly liable to danger of fire in dry seasons. The trees are all small, composed of coniferous species and growing in dense stands, making a combination readily subject to fire. The lower half of every tree is easily inflammable, being covered with dry twigs and moss.

The lateral roots of spruce trees form a poor foundation for the support of the tree in deep moss situations. A fire sweeping through a stand of black spruce, if not completely destroying it, burns the moss away from the roots, leaving the trees unsupported, and kills the individuals by scorching the foliage and injuring the cambium, thus making an ideal condition for wind-falls, especially in this district where the uniform topography leaves free access to the sweeping wind-storms from Hudson Bay.

Protection.—Over large areas of muskeg the rate of growth is very slow and the present forest cover has little value commercially, but the forest cover should be protected, when practicable, to preserve the present stand for the protection of game and fur-bearing animals. The watershed of the Nelson river should be protected by keeping the forest cover established.

There are several difficulties in protecting this region under the present conditions:—

1st. As there are no trails or roads, the country back from the streams cannot be patrolled economically.

2nd. The canoe route between Split lake and Hudson Bay is not safe to travel over, especially by an inexperienced canoeman.

3rd. A ranger would be of little use in a huge, wild, uninhabited area of this kind with no assistance in fighting fires.

Fire is an extremely unnecessary evil and can be prevented by the exercise of care and judgment during the season of danger. The best preventive of fire is watchfulness on the part of all who travel in the forest to see that fires do not start.

If the fire-ranger at Split lake will impress this upon all travellers using the Nelson route below Split lake, I believe it will insure as valuable a protection as is possible under the prevailing conditions.

When the railway construction takes place the territory should be divided up into districts and a patrolman should be placed in each district.

Fire notices written in English and Cree were placed by our party on all portages and camping places.

FOREST ENEMIES.

1. Fire is the greatest destructive agent in this country at the present time, as there is no economical means of protection.

2. The high water carrying the ice out in the spring does great damage to the only merchantable timber in the country, which is always found along the well drained banks of the streams.

3. Adverse climatic conditions are detrimental to tree growth. No bug-killed timber was found in this district. This is probably accounted for by the shortness of the season, which does not allow the development of the life stages of insects.

It is interesting to note that the larch saw-fly was discovered at a distance of 200 miles above Hudson Bay on the Hayes river, being well established in this district and doing considerable damage.

CLIMATE AND NATURAL PRODUCTS.

Potatoes, radishes, lettuce and onions were grown at Split lake, but they were of a very poor quality, as sufficient cultivation was lacking to produce a thrifty growth and the weather conditions were adverse to the production of a good crop.

There is little doubt but that under proper cultivation, vegetables may become a profitable product. Although the growing season is short, covering a period of three to four months and a half, the days are long and the sun is very warm, rain being very plentiful—too much so, in fact, during this season for plant growth—but I understand that dry seasons are not uncommon, and, furthermore, the fact that fires have burned large areas of the country would bear out this statement.

The Hudson's Bay company's factor at York Factory told me that he had tried to grow vegetables but the experiment proved to be a failure. As far as I know, no grain has been grown in this locality.

The effect of the large body of water in Hudson Bay on the temperature, summer and winter, of the surrounding country is to make it much less extreme, rendering the summers colder and the winters milder. The climate around the Bay is foggy, giving the sun little chance of being valuable to plant growth. The mean temperature of the summer within 100 miles of the Bay will not be as high as it is farther back from it.

NATURAL RESOURCES.

Economic deposits.—From such observations as could be made, we found traces of copper, iron and mica. The rock formation from Split lake to the Limestone river is granite; below this point to the Bay the formation changes to limestone.

When the railway comes in there is no doubt that the quarrying of granite for building purposes on the plains will be a paying industry.

Water-power.—From Split lake to the limit of the tide, a distance of about 140 miles by the river, there is a drop of 470 feet. The velocity of the water through the rapids is on an average seven miles per hour, the rapids being distributed evenly between Split lake and Limestone river. The bed of the river is a solid granite formation and the banks are from 20 to 80 feet high between these points, making ideal projects for producing power for manufacturing, such as pulp-mills, grist-mills, &c.

Game and fish.—Much of the area inspected is well adapted for the production of large game, such as deer, moose and cariboo, and will undoubtedly become a paradise for the sportsman.

Fur-bearing animals, such as mink, otter, fisher and muskrat, are very plentiful. Sesveral seal were seen along the shores of Hudson Bay, and white whale were seen in great numbers.

The whale-fishing industry may be developed when the railway is built.

Fisheries.—The fish found in the rivers and lakes are sturgeon, trout, pickerel, jack-fish, suckers and whitefish.

SPECIES OF TREES.

1. *Picea mariana* (Black spruce).
1. *Larix laricina* (Tamarack).
3. *Pinus Banksiana* (Jack pine).
4. *Populus tremuloides* (Aspen).
5. *Salix lucida* (Willow).
6. *Alnus tenuifolia* (Alder).

Respectfully submitted,

FRANK M. BEARD,
Forest Assistant.

No. 29.

REPORT OF J. W. CURRY.

DEPARTMENT OF THE INTERIOR,
FORESTRY BRANCH,
OTTAWA,

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—Having received full instructions from you to make an examination of the timber suitable for pulp, on the Gull Rock lake and Trout lake watersheds, the Wenasaga river and other similar watersheds draining into Lac Seul, I beg to submit the following report:—

Leaving Ottawa on Tuesday, June 13, 1911, I travelled to Winnipeg, reaching there on the evening of the 14th, where I met Mr. Moodie, who was to assist in the work. Mr. Moodie and I were in Winnipeg until June 26 hiring men, purchasing supplies and awaiting canoes from Peterborough, Ont. We hired two cooks, but only two canoemen, as we thought it would be more satisfactory to wait until reaching Lac Seul where we could get some Indian canoemen, who would be able to act as guides in the country to be travelled.

Leaving Winnipeg on June 26, with Mr. Moodie, two cooks, and two canoemen, I reached Hudson in the evening. Here I was met by Mr. McLean, Indian Commissioner, who had hired four Indian canoemen for me, two being hired for the summer's work, the other two to help us as far as the Hudson's Bay Company's post on Lac Seul.

From Hudson I sent most of our supplies to Lac Seul post by the Hudson's Bay Company's steam tug, which plies between Lac Seul and Hudson station, on the Grand Trunk Pacific railway. This enabled us to move right in to Lac Seul without making

more than one trip. With the canoes and the remainder of our supplies we started north, over the canoe route, to Lac Seul post, which is about twenty miles from Hudson.

Arriving at the post at ten o'clock, June 30, we made camp, after which we put our supplies in good shape and stored them in the Hudson's Bay Company's warehouse.

From here our work of exploration was to be commenced After obtaining as much information as possible regarding the country to be covered, from the Hudson's Bay Company's employes, we divided that section of the country east of Lac Seul post into two parts and proceeded to work it first.

COUNTRY EAST AND NORTHEAST OF LAC SEUL.

Starting east on Monday, July 3, we travelled together to within a few miles of the mouth of the Root river, which flows into the extreme northeast end of Lac Seul. Mr. Moodie went straight up the Root river to work it and its tributaries. With my party, I started up a small stream called Jackpine river, which flows into Lac Seul from the northwest, about five or six miles below the Root river. This river is eighteen or twenty miles long, and connects a chain of seven small lakes. There are nine rapids on it, with portages ranging from five to twelve chains in length; otherwise about two-thirds of it is a slow, deep and sluggish stream. From Round lake, which is a little over half-way up, to the mouth, it could easily be made driveable.

From the mouth of the river right to the head the timber has all been burned by a fire which swept through about twelve years ago, with the exception of a block of approximately six square miles, or 3,840 acres, which block is situated on the north side of Round lake. The block reaches north for about two miles, where it touches on Island lake (Island lake drains north). A burn of 1910 stretches north, east and west from here, the fire having run over part of the old burn on the upper part of Jackpine river. The timber on the above mentioned block averages 850 cubic feet per acre, making a total of 3,264,000 cubic feet. The stand consists of seventy per cent of jack pine, with average diameter of eight inches, twenty per cent of spruce with average diameter of seven inches, and ten per cent of poplar with average diameter of nine inches.

I had expected to make a portage across from the head of this river to another small stream, called Swan river, but the upper part of Jackpine river was too small for the canoes, so I was obliged to turn back. On the return trip my small canoe was swamped, a suit case containing maps, instruments, &c., being lost.

Swan river flows into Lac Seul about ten miles southwest of Jack pine river. The first twenty miles of it is about parallel to Jackpine river, above which it flows from the north and northeast. Half a mile from the mouth of the river is Spruce lake, about five miles long and from one-half to three-quarters of a mile in width. Part way up the river are two smaller lakes, and about twenty-five miles from the mouth is Swan lake, about eight miles in length and one mile in width. Two miles above Swan lake, again, is Goose lake, which is nearly two miles in length. The river above here comes from the northeast and north. Swan river is easily driveable from above Goose lake, but has its many faults, the upper part being thickly lined on either side with overhanging alders and other small trees; the water, moreover, is very deep close to the banks, which would make it very hard for working along the shores. The rapids also make the river hard to drive, while the lake expansions will make a greater expense than any of the other obstacles, there being practically no current in them. The only way of crossing would be to boom the timber across with sail-boats or other similar means.

On the north bank of Swan river from the mouth to Swan lake, there is a strip of timber averaging three-quarters of a mile in depth. It contains an approximate area of nineteen square miles, or 12,160 acres, on which the timber will average 800 cubic feet per acre, or approximately 9,728,000 cubic feet on the total area. The stand

consists of seventy per cent jack pine, with average diameter of eight inches, fifteen per cent of spruce with average diameter of seven inches, ten per cent of poplar with average diameter of eight inches, and five per cent of white birch with average diameter of six inches. Back of this strip, toward Jackpine river the country is entirely muskeg and scrub until it reaches the burn as seen on Jackpine river.

On the south side of Swan river there is a similar strip of about twenty square miles, or 12,800 acres, containing, approximately, 10,000,000 cubic feet. The stand is the same as on the north side of the river. South of this strip the timber is of poorer quality and will average only about 500 cubic feet per acre. As this area runs nearly to the shores of Lac Seul it will be put in when the timber on the north shore of that lake is estimated.

One mile above Goose lake on the Swan river is a strip of very good timber. It is about four miles in length and half a mile in width, thus having an approximate area of 1,300 acres. The timber runs 750 cubic feet per acre, or 975,000 cubic feet in all. The stand consists of eighty per cent of jack pine with average diameter of eight inches, ten per cent of spruce with average diameter of seven inches and ten per cent of poplar with average diameter of eight inches.

This takes in all the timber in this section, as a fire during the summer of 1910 burned over an immense area. This fire, coming from the west, crossed Swan river just where it flows out of Swan lake, and ran east to Jackpine river and Island's lake. (This lake empties into Swan river above Goose lake). To the north the country is burned as far as could be seen from the top of a high hill on the north side of Swan lake.

On the Root river there is no timber except four small blocks. Two of these are just west of the mouth of the river. One contains about 400 acres and runs 450 cubic feet per acre, making a total of 180,000 cubic feet, whilst the other contains 150 acres, the timber running 300 cubic feet per acre, or a total of 45,000 cubic feet. About sixteen miles above here is another block of about 220 acres running 450 cubic feet per acre, or a total of 99,000 cubic feet. Five miles above this, again, there is another block of about 160 acres on which the timber runs 500 cubic feet, or a total of 80,000 cubic feet.

All the other merchantable timber on this river and the Dog river, which flows into the Root river about six miles from its source, has been burned by fires which swept through the country about ten or twelve years ago and also during the summer of 1910. These fires are the same as those which burned around Swan lake, Jackpine river and far to the north.

For driving, the Root river would be much the same as Swan river, except that there are on it no lake expansions to speak of.

This completes the section of country east of Lac Seul post, except on the north shore of Lac Seul, which will be dealt with later. The total amount of timber found on this trip would be, approximately, 24,371,000 cubic feet.

WENASAGA RIVER BASIN.

As it was impossible to get across the country from here, towards the Wenasaga river, it was necessary for both parties to return to Lac Seul post and proceed west from there. On the afternoon of July 16, I reached Lac Seul post, where I met Mr. Moodie, who had arrived a short time before me.

Upon our arrival at Lac Seul post we abandoned our two small canoes, as they were not large enough for the work such as crossing large lakes in stormy weather, running rapids, &c. To replace them I hired two larger ones from the manager of the Hudson's Bay Company's post at Lac Seul. This made it necessary to engage an extra canoeman for each party, two more Indians being hired.

Our outfit being too large to move to the west end of Lac Seul in one trip by canoe, I hired the Hudson's Bay Company's gasoline launch, which took us to the

head of the English river on Saturday, July 22. I may say there was no time lost while waiting for the launch, as we were able to do some work from the camp at the post, besides repacking all our supplies for moving.

Before starting out from our camp at the head of the English river, it was necessary to establish a base of supplies in the most central place possible. The Hudson's Bay Company's post, Mattawa, which had been moved from the English river to the upper end of Pakwash lake, was decided upon, as all the country north of there could be easily worked from that point. After taking out one month's supplies for each party, we moved the balance to Mattawa post, returning to the end of Lac Seul on July 27.

On the trip starting from here I gave Mr. Moodie the Wenasaga river and its tributaries to work, while I took the Trout Lake watershed.

The Wenasaga river is a good driveable river, but like the rivers travelled before it has its faults. It has a great many rapids and small falls, is very crooked with short bends, the banks are very low and thickly covered with small brush overhanging the water, which would catch and hold the logs. Then again there are many large lake expansions, which have practically no current in them. Thus the timber would have to be boomed across, by means of a launch or sailboats, which would add greatly to the expense of logging.

From the mouth of the river to within one mile of the mouth of Sandy Beach Narrows river, which flows into the Wenasaga river from the east, about five miles above Bluffy lake, there is absolutely no timber of any value. A great portion of this section was burned over probably eight or ten years ago; the remainder was burned during the summer of 1910, nothing now remaining except spruce and jackpine scrub.

From one mile below the mouth of Sandy Beach Narrows river and running up the Wenasaga river for three miles, the timber is good on both sides. There is a block here of about 4,500 acres, on which the timber runs 1,100 cubic feet per acre thus giving an approximate total of 4,950,000 cubic feet. The stand consists of forty per cent of jack pine with average diameter of seven inches, thirty per cent of spruce with average diameter of seven inches and thirty per cent of poplar with average diameter of eight inches. Above here there is nothing on the east side of the river except muskeg and scrub, until Slate lake is reached. On the west side a patch starts about one mile below the Oochi river, and extends to the lower end of Slate lake. It has an area of about 2,000 acres, on which the timber runs 650 cubic feet per acre, giving a total of 1,300,000 cubic feet. The stand consists of fifty per cent of jack pine with average diameter of seven inches, forty per cent of spruce with average diameter of seven inches and ten per cent of poplar with average diameter of nine inches.

On Slate lake a good block of timber is found, especially on the west side. On this side the timber extends the whole length of the lake and has an average depth of one mile. The approximate area is nine square miles, or 5,760 acres. The timber on it will run 1,300 cubic feet per acre, thus giving a total of 7,488,000 cubic feet. The stand consists of fifty-five per cent of poplar with an average diameter of nine inches, thirty per cent of jack pine with average diameter of seven inches, and fifteen per cent of spruce with average diameter of six inches. The poplar here is of good size, tall, straight and free from limbs.

On the east side of Slate lake the timber is more or less in patches, in some places being really good, while in others it is quite poor. This block runs the entire length of the lake, but is not much over half a mile in depth. It has an approximate area of 4,000 acres, on which the timber runs 800 cubic feet per acre, thus giving a total of 3,200,000 cubic feet. The stand consists of seventy-five per cent of poplar with average diameter of seven inches, fifteen per cent of spruce with average diameter of six inches and ten per cent of jack pine with average diameter of eight inches.

At the north end of Slate lake, running northeast towards Papaonga lake there is a block of good timber covering an area of about 2,000 acres. The timber on it runs 800 cubic feet per acre, giving a total of 1,600,000 cubic feet. The stand consisted of

thirty per cent of poplar with average diameter of eight inches, thirty per cent of jack pine with average diameter of eight inches, twenty per cent of spruce with average diameter of seven inches and twenty per cent of white birch with average diameter of six inches.

For five miles up the river from Slate lake there is nothing but low muskeg covered with scrub. From here to Lake Margaret the timber was totally destroyed by a fire during the summer of 1910. This burn reaches east to the east end of Lake Sesikinaga.

On the west side of Lake Margaret there is a block of about 800 acres, on which the timber runs 600 cubic feet, thus giving a total of 480,000 cubic feet. The stand consists of eighty per cent of poplar with average diameter of eight inches, ten per cent of spruce with average diameter of seven inches and ten per cent of jack pine with average diameter of eight inches. On the east side of the lake is a block of 1,000 acres, on which the timber runs 550,000 cubic feet. The stand consists of sixty per cent of poplar with average diameter of eight inches, twenty per cent of jack pine with average diameter of seven inches, ten per cent of spruce with average diameter of seven inches and ten per cent of tamarack with average diameter of eight inches.

At the chutes there is another block of about 300 acres, on which the timber runs 800 cubic feet per acre, making a total of 240,000 cubic feet. The stand consists of forty per cent of poplar with average diameter of eight inches, twenty per cent of spruce with average diameter of seven inches, twenty per cent of jack pine with average diameter of eight inches and twenty per cent of tamarack with average diameter of eight inches.

With the exception of these three patches there is nothing to the head of the Wenasaga river, the country being low and marshy and thickly covered with scrub, jack pine and spruce. Around Lake Sesikinaga is all scrub, back from the lake being all muskeg covered with small spruce and jack pine.

On the Papaonga river there is nothing except a block on the south side of the first lake, which has been dealt with from the north end of Slate lake. Location of these blocks on the map, as marked by Mr. Moodie, is all on south side of Papaonga lake, not touching Slate lake at all.

There is nothing on Sandy Beach Narrows river until Little Sandy Beach Narrows lake is reached. On the south side of the lake there is a patch of about 1,000 acres, on which the timber runs 700 cubic feet per acre. This gives a total of 700,000 cubic feet. The stand consists of eighty per cent of balsam (black) poplar and twenty per cent of spruce. The north side of this lake was burned over in 1910. From here to the head of the river is all old burn and muskeg. Around Sandy Beach Narrows lake the country is very rough and rocky and covered with scrub.

On Loon river, which flows into the upper end of Bluffy lake, there is nothing except one block on the south side of Loon lake, where the river flows in. This block has an area of about 400 acres, on which the timber runs 700 cubic feet per acre, giving a total of 280,000 cubic feet. The stand consists of seventy per cent of jack pine and thirty per cent of poplar, each having an average diameter of seven inches. Above here as far as could be reached by canoe, the country is rocky, rolling and covered with scrub jack pine, none over five inches in diameter. Between Loon lake and Bluffy lake is low and mostly muskeg.

On the upper part of the Oochi river there are two small blocks of very good timber. The first has an area of about 350 acres, the timber running 600 cubic feet per acre, giving a total of 210,000 cubic feet. The stand consists of forty per cent of poplar with average diameter of eight inches, thirty per cent of spruce with average diameter of seven inches and thirty per cent of jack pine with average diameter of eight inches. The other block has an area of about 300 acres, the timber running 600 cubic feet per acre, giving a total of 180,000 cubic feet. The stand consists of sixty per cent of poplar with average diameter of nine inches, thirty per cent of spruce with

average diameter of eight inches and ten per cent of jack pine with average diameter of eight inches.

The Oochi river is driveable from Sucker lake to the mouth, above the lake being very narrow and shallow.

Thus the total amount of timber found on the Wenasaga river would be approximately 21,178,000 cubic feet.

TROUT LAKE AND PAKWASH LAKES.

In working the Trout Lake watershed I went up the Wenasaga river, the Oochi river and then portaged over into Fly lake, which is the source of the chain of lakes, and Woman river, which flow into Trout Lake river. From around the head of Fly lake I started working the timber with the exception of the two blocks on the Oochi river, which I have already mentioned.

For the entire length of Fly lake and to the southwest corner of Clearwater lake the timber is very good. It is in a strip averaging one mile in depth on either side, back of which the entire country is muskeg or small rocky hills covered with scrub. This block has an approximate area of sixteen square miles, or 10,240 acres. The timber averages 700 cubic feet per acre. The stand consists of seventy per cent of spruce with average diameter of seven inches, fifteen per cent of white birch with average diameter of six inches, ten per cent of poplar with average diameter of eight inches and five per cent of jack pine with average diameter of seven inches. There has been considerable tamarack through this section, but it is now all dead, having been killed about two years ago by worms or flies. On parts of this block the timber runs as high as 1,100 cubic feet per acre, while in a good many parts it will not average 500 cubic feet per acre.

On the east side of Clearwater lake there is a block containing about seven square miles, or 4,480 acres, of timber, which will run 600 cubic feet per acre, the total stand amounting to 2,688,000 cubic feet. The stand consists of sixty per cent of spruce with average diameter of seven inches, twenty per cent of poplar with average diameter of eight inches, ten per cent of jack pine with average diameter of eight inches and ten per cent of white birch with average diameter of six inches.

A new burn comes in at the southwest end of Clearwater lake, and extends north on the west side to the upper end of Washagomis lake. The southern boundary extends southwest towards Trout Lake river. From the top of a hill we could see beyond the valley of Woman lake and river, all of which has been burned over. From this north end of Clearwater lake on the east side, and from where the new burn stops on the west side, the country has all been burned over, probably twelve or fifteen years ago, there being nothing on it except scrub jack pine and small white birch. This continues north to where the river turns west. To the north of this chain of lakes and over the divide, the country has all been burned over, there being no timber for miles. The most northern lake of this chain is called Redcock lake.

On the east end of Redcock lake there is a block of very good timber covering an area of about 1,500 acres. The timber runs about 700 cubic feet per acre, thus giving a total of 1,050,000 cubic feet. The stand consists of sixty per cent of spruce with an average diameter of seven inches, fifteen per cent of poplar with average diameter of eight inches, fifteen per cent of white birch with average diameter of six inches, five per cent of jack pine with average diameter of seven inches and five per cent of balsam fir with average diameter of six inches. This is the first balsam fir I have seen since the work started and it is very poor. The large spruce in this section is either dead or has been thrown by the wind.

Turning west at Redcock lake and working towards the head of Woman lake, there is no timber, the country being all muskeg or old and new burn. The timber on both sides of Woman lake and river has all been burned right down to the junction with Trout Lake river. This is the same burn as seen on the west side of Clearwater lake.

A portage of sixteen chains took us from the north end of Woman lake into Narrow lake. The only timber found around this lake is on the north side about five miles along the lake. The quality of the timber is just fair, being small and in patches. This strip is one and one-half miles in depth, thus giving an approximate area of 5,000 acres. The stand runs 550 cubic feet per acre, or a total of 2,750,000 cubic feet. The stand consists of fifty per cent of spruce with average diameter of seven inches, thirty per cent of jack pine with average diameter of seven inches, ten per cent of poplar with average diameter of eight inches and ten per cent of white birch with average diameter of five inches. To the north of this the country is all burned over. On the south side of Narrow lake from Woman lake west to Trout lake has all been burned. The north side, from where the above mentioned block of timber stops, has all been burned. This burn also reaches to the east side of Trout lake, and north for miles.

From the west end of Narrow lake, a portage two and a quarter miles in length nearly due north brought us into a small lake which flows into the east side of Trout lake. This portage, the entire length of which was through burn, had to be cleared out before it could be used. Around the above lake and west to Trout lake is all burn and muskeg.

Around the north side of Trout lake the timber is quite poor. The country is very rocky, with practically no soil. Thus the timber is small except in a few places. It is quite thick, but the larger trees have been thrown by wind. On the east side of the largest bay on this side of the lake there is a patch of about 3,000 acres, the timber running 600 cubic feet per acre, or giving a total of 1,800,000 cubic feet. The stand consists of eighty per cent of spruce with average diameter of six inches, fifteen per cent of jack pine with average diameter of seven inches and five per cent of poplar with average diameter of eight inches. Back of this strip is all muskeg and scrub. At the north end of this bay, a burn of 1910 comes into the lake shore. This burn comes in from the west and leaves a strip of timber as far as the northwest corner of the lake. This strip has an area of about 6,000 acres, on which the timber averages 500 cubic feet per acre, thus giving a total of 3,000,000 cubic feet. The stand is practically the same as on the east side of the bay.

The northern part of Trout lake is thickly studded with islands, the larger ones having been burnt over, the smaller ones being low and covered with scrub.

On the west side of the lake the timber is better than on the north side. There is a block here of approximately 4,200 acres, the timber running 900 cubic feet per acre, thus giving a total of 3,780,000 cubic feet. From the end of this block and on south is another block of about 1,800 acres, the timber running 750 cubic feet, thus giving a total of 1,350,000 cubic feet. The stand consists of eighty per cent of spruce with average diameter of seven inches, ten per cent of jack pine with average diameter of eight inches, ten per cent of poplar with average diameter of eight inches and ten per cent of white birch with average diameter of six inches.

On the point on the south side of the lake and just east of Cat island, the timber runs about 500 cubic feet per acre. Parts of it are poor through having been thrown a great deal by the wind. This block has an approximate area of 3,200 acres, thus giving a total of 1,600,000 cubic feet. The stand consists of eighty per cent of spruce with average diameter of seven inches, ten per cent of jack pine with average diameter of seven inches and ten per cent of poplar with average diameter of eight inches.

The long point on the east side of the lake has some good timber on it. The block has an area of about 5,000 acres, the timber running 800 cubic feet per acre, giving a total of 4,000,000 cubic feet. The stand consists of spruce and jack pine, forty per cent of each with average diameter of seven inches, ten per cent of poplar with average diameter of eight inches and ten per cent of white birch with average diameter of six inches.

On the south side of Trout lake, east of the river, there is a strip which runs down along the river and to the lower end of Otter lake. It contains about 2,000 acres,

and the timber runs 500 feet per acre giving a total of 1,000,000 cubic feet. The stand consists of sixty per cent of spruce with average diameter of six inches, twenty per cent poplar with average diameter of seven inches, fifteen per cent white birch with average diameter of six inches and five per cent of jack pine with average diameter of seven inches.

Outside of these blocks the timber around Trout lake has all been burned over, from one to eight years ago.

Along Trout Lake river the timber has all been burned except two small blocks. The first at the junction of Woman river, contains about 600 acres. The timber runs 650 cubic feet per acre, giving a total of 390,000 cubic feet. Jack pine forms about seventy per cent of the stand with an average diameter of nine inches, spruce ten per cent with average diameter of seven inches, poplar ten per cent with average diameter of eight inches and white birch ten per cent with average diameter of six inches. The other block is on the east side of the river about four or five miles from the mouth. It has an area of about 125 acres, the timber runs 1,000 cubic feet per acre, giving a total of 125,000 cubic feet. Poplar forms eighty per cent of the stand with average diameter of eleven inches, while jack pine makes up the remainder with average diameter of eight inches.

Trout Lake river can be easily made driveable, both from the head of Fly lake and from Trout lake. There are a number of rapids and falls on this river, one sixty feet high, but these would not be so hard to contend with as the lake expansions.

On August 25 I arrived at Mattawa post where I met Mr. Moodie, who had arrived some time before me.

On Upper Pakwash lake there is no merchantable timber at all, the country being very rocky and covered with scrub.

On the west side of Lower Pakwash lake, there is a small block of timber containing an area of approximately 850 acres. The timber runs 700 cubic feet per acre, giving a total of 595,000 cubic feet. The stand consists of seventy-five per cent of poplar running from four to sixteen inches in diameter, fifteen per cent of spruce running from four to eighteen inches in diameter, and ten per cent of jack pine from six to thirteen inches in diameter.

One mile due east of Pakwash lake and east of Mattawa post, there is another block of about 640 acres. The timber runs 750 cubic feet per acre, giving a total of 480,000 cubic feet. The stand consists of sixty-five per cent of poplar four to twenty inches, twenty per cent of jack pine from six to seventeen inches and fifteen per cent of spruce from four inches to seventeen inches.

The total amount of timber located on the Trout Lake watershed and Pakwash lakes would be approximately 31,776,000 cubic feet.

RED LAKE AND GULLROCK LAKE.

From Mattawa we divided the remainder of the territory into two parts, Mr. Moodie taking the Gullrock Lake and Red Lake watersheds, while I took a stream flowing into the southwest corner of Gullrock lake, the Medicine-stone lakes, the Long-legged river and the north bank of the English river. On the completion of these parts, Mr. Moodie worked the north side of Lac Seul from the Wenasaga river east to the Manitou river, and I worked that part between the Manitou river and the Hudson's Bay post at Lac Seul.

Mr. Moodie started on his section on August 28 working north to the divide on the north side of Red lake.

Along Red Lake river from Pakwash lake to Gullrock lake the country is very low and swampy in many places. What timber there is along the river is very scattered and in small patches, the location, quantity and quality of which will be shown on the map.

The country around Gullrock lake has all been burned over except the south end of the lake. There is a block of good timber on this side just west of where the river flows out of the lake. It has an approximate area of 2,500 acres, the timber running 850 cubic feet per acre, or a total of 2,125,000 cubic feet. The stand consists of forty per cent of spruce with average diameter of seven inches, forty per cent of jack pine with average diameter of eight inches and twenty per cent of poplar with average diameter of eight inches. The rest of the south side is very rocky and covered with scrub.

The fires which destroyed the timber around Gullrock lake occurred, some in 1910, and the others probably about twelve years ago.

The timber along the river from Gullrock lake to Red lake is very poor except in small patches. These consist of small poplar which is very scattered and has an average diameter of only five inches.

Around Red lake there are some blocks of very good timber, although the greater part of the country has been burned over. At the southeast end of the lake there is a block containing about 3,000 acres. The timber runs 950 cubic feet per acre, making a total of 2,850,000 cubic feet. The stand consists of eighty per cent of poplar with diameter from four to twenty-one inches, ten per cent of jack pine from four to sixteen inches and ten per cent of spruce from four to eighteen inches.

About two miles north of this block on the east side of the lake is another block of about 1,500 acres. The timber runs 750 cubic feet per acre, giving a total of 1,125,000 cubic feet. The stand consists of fifty per cent of jack pine with diameter from six to seventeen inches, thirty per cent of spruce from six to fourteen inches and twenty per cent of poplar from four to thirteen inches.

North of this again, about two miles, is another block which extends east to the south end of East bay. It has an area of about 3,500 acres, on which the timber runs 1,100 cubic feet per acre, giving a total of 3,850,000 cubic feet. The stand consists of sixty per cent of poplar with average diameter of ten inches, twenty per cent of spruce with average diameter of seven inches and twenty per cent of jack pine with average diameter of eight inches.

On the south side of the narrows near the northeast end of the lake, is a block of 800 acres. The timber runs 550 cubic feet per acre, giving a total of 440,000 cubic feet. The stand consists of eighty per cent of spruce with diameter from four to twenty four inches, ten per cent of jack pine with diameter from four to sixteen inches and ten per cent of tamarack with diameter from seven to eighteen inches. On the north side of the narrows there is another block containing approximately 9,600 acres. The timber on it runs 850 cubic feet per acre, making a total of 8,160,000 cubic feet. The stand consists of fifty per cent of poplar with diameter from four to twenty-six inches, thirty per cent of spruce, diameter from four to twenty-two inches, fifteen per cent of jack pine with diameter from four to twenty inches and five per cent of tamarack from seven to seventeen inches.

Another block between the northeast corner of Red lake and the west side of East bay contains an area of about 1,200 acres. The timber runs 800 cubic feet per acre or a total of 960,000 cubic feet. The stand consists of seventy-five per cent of poplar with diameter from four to twenty two inches, fifteen per cent jack pine with diameter seven to sixteen inches and ten per cent of spruce with diameter from four to nineteen inches.

There is a narrow strip on both sides of the river between Red lake and Little Vermilion lake, which would have an approximate area of 700 acres. The timber runs 700 cubic feet per acre or a total of 490,000 cubic feet. The stand consists of eighty five per cent of poplar with diameter from four to twenty inches, ten per cent of jack pine from six to eleven inches and five per cent of spruce from four to fourteen inches.

At the southeast end of Little Vermilion lake there is a block of about 600 acres. The timber runs 650 cubic feet per acre, giving a total of 390,000 cubic feet. The

stand consists of eighty per cent of poplar with diameter from four to twenty-four inches, fifteen per cent jack pine from six to fourteen inches and five per cent of spruce with diameter from four to seventeen inches.

The country north of here up to the north end of Rat House lake was burned over about twelve years ago, while to the north, east and west from Rat House lake, as far as the divide, the timber was all burned during the summer of 1910.

There are three other small blocks of fair timber around Red lake. One is on the south side of the lake, southwest of Mackenzie island. It has an area of about 700 acres, on which the timber runs 600 cubic feet per acre, giving a total of 420,000 cubic feet. The stand consists of forty five per cent of jack pine with diameter from six to seventeen inches, forty per cent of poplar from four to twenty-one inches and fifteen per cent of spruce from four to eighteen inches. The other two blocks are at the west end of the lake, on the shores of Pipestone bay. One on the northwest corner of the bay has an area of 450 acres. The timber runs 450 cubic feet per acre, giving a total of 202,500 cubic feet. The stand consists of eighty per cent of poplar with diameter from four to sixteen inches, ten per cent of spruce from four to fourteen inches and ten per cent of jack pine from six to twelve inches.

The other block is at the southeast end of Pipestone bay. It has an area of about 320 acres, on which the timber runs 500 cubic feet per acre, thus giving a total of 160,000 cubic feet. The stand consists of ninety-five per cent of poplar with diameter from four to eighteen inches and five per cent of jack pine with diameter from six to fourteen inches.

All the other country around Red lake has been burned over some time or other, there being no merchantable timber on it at all, and from the rocky condition of the country, which has practically no soil, there is very little prospect of there being any timber for years to come, even on the older burns.

On the west side of Keg lake there is a small block of very good timber. It has an area of 400 acres, the timber running 650 cubic feet per acre, thus giving a total of 260,000 cubic feet. The stand consists of ninety-five per cent of poplar with diameter from four to sixteen inches and five per cent of jack pine with diameter from six to twelve inches. On the north side of Keg lake and on the east side of the river is another block of about 320 acres. The timber on it runs 450 cubic feet per acre, giving a total of 144,000 cubic feet. The stand consists of sixty per cent of poplar with diameter from four to fourteen inches, thirty per cent of jack pine, diameters from six to seventeen inches and ten per cent of spruce, diameters from four to eleven inches.

The river between Red lake and Gullrock lake has very little current. It is deep and very crooked, while both sides are very weedy, which would make it hard for driving. From Gullrock lake to Pakwash lake the river has a very good current. There are four rapids on it, only one of which would retard the work of driving it.

On the 29th of August I left Mattawa post and travelled to the southwest corner of Gullrock lake and started up a small river which flows into the lake there. This river has its source near the waters flowing into Medicine-stone lakes. I worked up this river to the head, thence across into the Medicine-stone lakes and then north to Red lake. Through this section there is practically no merchantable timber, nearly all having been burned, some quite recently, the rest from twenty-five to thirty years ago.

About half a mile up the river from Gullrock lake on the south side of Grassy lake, there is a small area of about 125 acres. The timber on it runs 900 cubic feet per acre, giving a total of 112,500 cubic feet. The stand consists of sixty per cent of jack pine with average diameter of eight inches, fifteen per cent of spruce with average diameter of seven inches, fifteen per cent of poplar with average diameter of nine inches and ten per cent of white birch with average diameter of six inches. Back of this and on top of the ridge is scrub jack pine and white birch. On the other side of the

ridge it slopes back into lowland and muskeg. On the north side of Grassy lake, a burn of 1910 has destroyed all the timber. For two miles above this lake, it is all muskeg or rocky hills covered with scrub. Here the burn of 1910 comes into the river again and extends to about half-way up Bug lake. From here to the head of Bug lake on the south side was burned over about eight or ten years ago. The section of country from Bug lake over to Medicine-stone lake is all muskeg, there being no merchantable timber whatever on it. The river from Grassy lake to Bug lake could not be made driveable, for at its best it is hardly large enough for a nineteen-foot canoe.

The country around the Medicine-stone lakes and north to the south side of Red lake was all burned over, I should say between twenty-five and thirty years ago. This whole section is now covered with scrub jack pine, none of it reaching thirty feet in height and six inches in diameter. The burn of 1910 comes in on the east side of that lake, which is situated just south of Red lake.

Medicine-stone lakes are surrounded by quite high rocky hills, and in paddling along the lake the bare rock is plainly seen, the scrub on it being so scattered. The river flowing out of the lake is also far too small for driving.

Finishing this section I came out on to Red lake and thence down Red Lake river to Mattawa post.

The total amount of timber located on the Gullrock Lake and Red Lake watersheds would be approximately 21,689,000 cubic feet.

WEST OF LAC SEUL.

On reaching Mattawa post I found that we had not supplies enough to do us while finishing this section of the country; therefore, it was necessary for me to go in to Lac Seul post for more provisions. Returning from there I went down the English river and worked up Long-legged river to its head. From the mouth of this river up to the middle part of Long-legged lake has been completely burned, a fire going through it about eight or ten years ago, while another in 1910 burned over a large area of it again.

The upper part of Long-legged lake is very much the same as around Medicine-stone lakes, having high rocky hills around it, which are covered with scrub, there being insufficient soil to sustain the timber.

On finishing this river I came back down it and then worked the north side of the English river to the foot of Lac Seul, where there is some very good timber.

From the mouth of Long-legged river to about half way up Barnston lake there is a strip averaging one mile in depth. It has an approximate area of 11,500 acres, on which the timber runs 850 cubic feet per acre, giving a total of 9,775,000 cubic feet. The stand consists of sixty per cent of poplar with average diameter of eight inches, twenty five per cent of jack pine with average diameter of seven inches and fifteen per cent of spruce with average diameter of seven inches.

From here to where the long portage goes across to the lower end of Duck lake, the timber will run 900 cubic feet per acre. There are about 4,200 acres in this area, giving a total of 3,780,000 cubic feet. The stand consists of the same species as in the last section, the quality being practically the same.

On the point where the portage crosses to Duck lake there is a block of about 1,200 acres, on which the timber runs 1,300 cubic feet per acre, giving a total of 1,560,000 cubic feet. The stand consists of sixty per cent of poplar with average diameter of eleven inches, twenty per cent of jack pine with average diameter of nine inches, fifteen per cent of spruce with average diameter of eight inches and five per cent of red pine with average diameter of twelve inches.

From here to the mouth of the river flowing out of Pakwash lake, there is a block of about 3,600 acres, where the timber runs 900 cubic feet per acre, giving a total of 3,240,000 cubic feet. The stand runs the same as farther down the river. In some

places the timber reaches back for nearly two miles from the river, in other places not much over half a mile. Back of this is low wet country covered with scrub.

There is a strip on both sides of the river between Pakwash lake and the English river. The total area would be approximately 7,000 acres, on which the timber runs 650 cubic feet per acre right through, thus giving a total of 4,550,000 cubic feet. The stand consists of seventy per cent of poplar with average diameter of nine inches, fifteen per cent of jack pine with average diameter of eight inches and fifteen per cent of spruce with average diameter of seven inches.

From the head of Duck lake to within one mile of the west end of Lac Seul, the timber is not quite so good as further down the English river. It will run about 650 cubic feet per acre, of which there is approximately 9,000 acres, thus making a total of 5,850,000 cubic feet. The stand consists of seventy-five per cent of poplar with average diameter of seven inches, fifteen per cent of jack pine with average diameter of seven inches, and ten per cent of spruce with average diameter of seven inches. From the end of this timber to the head of the river is either small scrub or burn.

Between the head of the English river and the Wenasaga river, there is a block of about 800 acres. The stand will run 850 cubic feet per acre, making a total of 680,000 cubic feet. The stand consists of fifty per cent of poplar with average diameter of nine inches, and fifty per cent of spruce with average diameter of seven inches.

On the territory covered on this trip the total quantity of timber would be approximately 29,435,000 cubic feet.

NORTH SIDE OF LAC SEUL.

From here I moved east to the mouth of the Manitou river, where I met Mr. Moodie, who was working the north side of Lac Seul from the Wenasaga river east to this point.

Starting from the Wenasaga river and working east along the north side of the lake, Mr. Moodie describes the timber in the following way:—From the mouth of the Wenasaga river there is a strip which runs east for about twelve miles along the lake. It has an average depth of three miles and an approximate area of 25,000 acres. The timber on it runs about 900 cubic feet per acre, giving a total of 22,500,000 cubic feet. The stand consists of fifty per cent of poplar with diameter from four to eighteen inches, twenty-five per cent of spruce with diameter from four to sixteen inches, fifteen per cent of jack pine, with diameter from six to fifteen inches, and ten per cent of white birch with diameter from four to eight inches.

From here east for about four miles or to Big Inlet on the north side of the lake, there is nothing but scrub. Along the northwest side of this inlet there is a strip of timber which will run 800 cubic feet per acre. It has an approximate area of 6,500 acres. The timber on it runs about 800 cubic feet per acre, giving a total of 5,200,000 cubic feet. The stand is the same as on the last area.

Around the east side of Big inlet and along the lake, to the mouth of the Manitou river, there is no timber of any commercial value, the country being rocky and covered with scrub.

On the lower part of the Manitou river there is no timber of any value. On the west side of Manitou lake there is a tract of very good timber. This block crosses the river just below the lake and runs south towards Lac Seul for about six miles. It has an area of about 7,000 acres on which the timber runs 950 cubic feet per acre, thus giving a total of 6,650,000 cubic feet. The stand consists of forty per cent of poplar with diameter from five to sixteen inches, thirty per cent of jack pine with diameter five to fourteen inches and thirty per cent of spruce, with diameter from five to twelve inches.

In the interior of the country between the Wenasaga river and the Manitou river, there is a large area of timber which is of much poorer quality than that near the

lake. This section would cover an area of probably 225 square miles or 144,000 acres, on which the timber should average 600 cubic feet per acre throughout, thus giving a total of 86,400,000 cubic feet. The stand consists of poplar, jack pine, spruce and white birch running from four to sixteen inches in diameter.

This completed Mr. Moodie's territory with the exception of some on the north side of the lake, east of the Hudson's Bay Company's post.

Starting just east of the mouth of the Manitou river, I worked that section east to the Lac Seul post and as far inland as it was possible to reach. I ran lines back at frequent intervals, which ranged from three to eight miles in length. Near Lac Seul post I found an old transit line which ran due north and followed it for nearly nine miles to a large lake, where I had to turn back, as it was impossible to get across.

The timber close to Lac Seul is much better than farther inland, as there is a strip between the Manitou river and Lac Seul, on which the timber is very good. This strip averages about two miles in depth, and will have to be divided into about five blocks on account of the difference in quality of the timber.

The first block east of the mouth of the Manitou river has an approximate area of 4,200 acres on which the timber runs about 1,200 cubic feet per acre, giving a total of 5,040,000 cubic feet. The stand consists of forty per cent of jack pine with average diameter of eight inches, fifteen per cent of poplar with average diameter of nine inches, fifteen per cent of white birch with average diameter of seven inches, and ten per cent of red pine with average diameter of twelve inches.

Next to this block and east is another on which the timber runs 1,050 cubic feet per acre. It has an approximate area of 8,000 acres, with a total of 8,400,000 cubic feet. The stand consists of thirty per cent of jack pine with average diameter of eight inches, twenty five per cent of poplar with average diameter of nine inches, twenty five per cent of white birch with average diameter of seven inches and twenty per cent of spruce with average diameter of eight inches.

The third block along the lake here has an area of about 7,500 acres, on which the timber runs 1,100 cubic feet per acre, thus giving a total of 8,250,000 cubic feet. The stand consists of thirty per cent of jack pine with average diameter of eight inches, thirty per cent of poplar with average diameter of nine inches, twenty per cent of spruce with average diameter of seven inches and twenty per cent of white birch with average diameter of six inches.

The next block has an approximate area of 4,500 acres on which the timber is somewhat better. It will run about 1,300 cubic feet per acre, thus giving a total of 5,850,000 cubic feet. The stand consists of forty per cent of poplar with average diameter of nine inches, thirty per cent of jack pine with average diameter of eight inches twenty per cent of spruce with average diameter of eight inches and ten per cent of white birch with average diameter of six inches.

The fifth and last block along the lake reaches to within about one mile of the Hudson's Bay Company's post, Lac Seul. It is the smallest block of the five and the timber is poorer, having been culled by the Hudson's Bay Company's people and the Indians, for wood, &c. It has an area of about 2,200 acres, on which the timber runs 800 cubic feet per acre, thus giving a total of 1,760,000 cubic feet. The stand consists of thirty per cent of jack pine with average diameter of eight inches, thirty per cent of poplar with average diameter of eight inches, twenty per cent of spruce with average diameter of seven inches, fifteen per cent of white birch with average diameter of six inches and five per cent of red pine with average diameter of ten inches.

Back of the above strips and running north for about sixteen miles, there is a large area, which I could not reach except for short distances on the different sides. North of Lac Seul post I ran through it for over eight miles, while in other places I ran lines from one to four miles back into it. The timber on parts of it is very good, while in other places it seems to get to a certain size and then dies. There is an area east of the Manitou river and reaching north from Lac Seul nearly to Swan river, which would have an area of approximately 250 square miles, or 160,000 acres. On

this area from what I covered I would judge the timber to run about 700 cubic feet per acre all through, thus giving a total of approximately 112,000,000 cubic feet. The stand is made up of jack pine, spruce, poplar and white birch, but it would be hard to give the percentage of each species. The trees run from four to fourteen inches in diameter, the larger ones being badly thrown by the wind. This completed my section of the territory on the north of Lac Seul.

Mr. Moodie worked a section east of Lac Seul post, while I was in Winnipeg getting money to pay off the canoemen. The timber runs along the edge of the lake from about a mile east of the post for nearly twenty miles or about two miles east of Tugtegweick river. It has an average depth of one mile. The total area of the strip would be approximately 13,000 acres, or a little over twenty square miles. The timber runs about 800 cubic feet per acre throughout, giving a total of 10,400,000 cubic feet. The stand consists of about eighty per cent of poplar from four to twelve inches in diameter and twenty per cent of spruce and jack pine from five to fourteen inches in diameter.

The total amount of timber estimated on the north side of Lac Seul from the Wenasaga river east, and for about sixteen miles north from the lake, is approximately 272,450,000 cubic feet.

The figures included herein, together with about 4,000,000 cubic feet of timber shown in small blocks on the map, would give a total for the whole territory covered, of, approximately, 405,000,000 cubic feet. This, it will be noticed, is a very small amount for the size of the territory covered. I may say in the first place that the country does not seem to have ever been really heavily wooded. It is a very rolling country with numerous patches of muskeg running through it, besides a great many rocky hills, none of which rise to any great height. There seems to be very little soil except close to the water, where it seems to be dried out for about one to three miles back, while away inland as a rule it is very swampy. Where a fire has run through, one will invariably find nothing but the naked rock, which goes to show there was never much soil. Thus there is nothing to sustain the tree after it gets to a certain size.

Besides a large amount of the country being muskeg and marsh, an enormous area, especially the northern part, towards the divide, has been burned over at some trip, covering as much ground as possible and getting an idea of the lay of the country, while a very large area was burned over during the summer of 1910. These fires are due mostly to the carelessness of the Indians, who do not seem to realize that by destroying the forest they are taking away their own livelihood, as they depend almost solely on the fur which they catch during the winter months.

They roam around during the summer hunting moose, &c., and leave fires wherever they happen to be, and until the country is opened up and the white people get in, it will be next to impossible to keep them from destroying the timber.

Respectfully submitted,

J. W. CURRY.

No. 30.

REPORT OF GEO. A. MULLOY.

FORT SMITH, ALBERTA, June 20, 1911.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I beg to submit a report of work done by my assistant, L. Boyd, and myself during the past month. I arrived at Fort Smith on June 8, and immediately made

arrangements for a trip to the northern herd of wood bison, called the Salt river herd. I was advised that the country was almost impassable at this time of the year owing to the great quantity of water in the muskegs and hay-meadows. The rivers also cannot be forded in the usual way, but have to be crossed by means of rafts built on the spot. In addition to this the flies are very numerous and worry the pack animals, making them unmanageable at times. However, I decided to make a preliminary trip covering as much ground as possible and getting an idea of the lay of the country as well as learning some of the main trails. I think I cannot do better than to give you a resumé of my diary for the fourteen days we were away from headquarters.

Monday, June 12.—The morning was taken up in the usual delays peculiar to any trip of this kind. We got started, however, at 1.25 p.m. The first stage of our trip will be to the Salt River Indian settlement which is near the mouth of the Salt river. We intend following the trail cut by the mounted police, accompanied by Mr. H. V. Radford, last October. We have two pack horses and an Indian guide, but, fearing to pack the horses too heavily, we are travelling light, taking food for only two weeks.

We travelled eight or nine miles before sundown, *i.e.*, from Fort Smith to the bend in the Slave river opposite Big island. There is a good wagon trail so far, and the land is high and dry. The country through which we have come is very much better than that around Fort Smith. The sandy jackpine ridges begin to run out about two or three miles west, and open poplar ridges and spruce groves make their appearance. The trail for the last two or three miles follows the bank of the Slave river very closely. The valley of the river here is 100 to 150 feet high and a mile or more in width. The timber through which we passed to-day would not do for saw-mill purposes, the spruce of any size, say, fifteen to twenty inches diameter, being so scattered and scarce and the poplar so small that its only use would be for building log houses, fences, corrals, &c. The land, however, is much better than at Fort Smith. The soil would be classed as a light sandy loam, and I think would be suitable for light farming. Oats would do well, other conditions favourable.

Tuesday, June 13.—Last night the flies were very bad, and the horses ran away with the hobbles on. The remainder of the wogan road to the Salt River settlement is very good. The land, however, changes in character a couple of miles from the settlement. Low swampy ground takes the place of poplar ridges. This is covered with a dense growth of scrub, jack pine, willow and alders. We crossed Salt river in a boat carrying the packs and swimming the horses. The river at this point is not salty, as we had supposed. Both the animals and ourselves drank it, and the guide says they use it all year round.

Here, too, is one of the great fishing grounds of this part of the country. The current is moderately swift and the river fifty yards wide. Just here one of our pack-horses showed signs of giving out, but, as we could not get another and the Indian village was deserted, we decided to go on with him.

After dinner we headed due west again. For some distance west of the settlement open glades of parklike hay-meadows are encountered. The grass here is excellent, and the alders are bunched and clumped together, dividing the country into small fields. The footing is rather damp, but the wiry grass holds up the horses as well as the men. This hay-meadow country stretches for about a mile. Then the ground rises. Here a peculiar piece of land is encountered, *i.e.*, a large field of excellent grass surrounded by a dense growth of poplar. It looks like a small farm and some Indian has taken advantage of the opportunity, and dug up a large patch with a spade. He had planted potatoes, but they were not up yet. However, we discovered, when we returned, that they had grown five or six inches in our absence. This piece of open land is an excellent place for the Government Experimental Farm, as it is close to Fort Smith and the soil cannot be excelled. It has a dark, rich mould to a depth of five or six inches with a sandy subsoil. In fact, this character of soil continues for a

distance of four or five miles westward. The forest, however, changes in appearance. For miles on both sides of the trail stretch open poplar uplands. The ground is very level and covered with a dense growth of good grass, but the white trunks of the poplar seem like a forest of white-washed telegraph poles. No underbrush of any account is met with. Sparsely scattered through the poplar are individual spruce trees of very fair size twelve to twenty inches in diameter and very tall. The poplar, although not large, is very uniform, running about fifteen inches. We travelled until dark and camped on a rather marshy place beyond the poplar country.

Wednesday, June 14.—The first part of to-day's journey was through the largest hay-meadows we have yet encountered. They are in the valley formed by Salt mountain on the west and the poplar ridges bordering Salt river on the east. Where the trail intersects them, they are about one mile in width and from Salt mountain they can be seen for fifteen or twenty miles stretching northeasterly. Salt mountain is a low range of hills 100 feet above the surrounding country. They form the western slope of the watersheds of the Little Buffalo river. Although on the lookout for salt deposits, none of any account were seen near the trail. Several small salt streams and sloughs occur, however, in the muskeg bordering the hills. Salt mountain is very rough and rocky, and is covered with a growth of scrub, jack pine, spruce and poplar mixed. No timber of any size. A peculiar thing is here noticed. Depressions appear in the earth varying in size from three feet diameter to the size of a large house. They have three or four flat sides and converge to a sharp peak at the bottom. No inlet or outlet can be found, but no water of any account is found. The country has the appearance of having been covered by hugh blocks of sharp-cornered ice which have melted away and left their shapes in the earth. We travelled until dark again and camped on the eastern slope of the mountain.

Thursday, June 15.—This morning the guide left the main trail and struck across country to a more northern trail which we found out later was the winter trail for dogs coming from the Salt river and which winds up through the hay meadow on the east side of Salt mountain. This, of course, is a good trail in winter, avoiding Salt mountain altogether. We will likely make use of it ourselves. This new trail we marked and blazed well. The country is becoming more and more swampy as we near the Little Buffalo river. Poplar, of course, predominates, but none of any value is seen. I found an old bison horn, the first sign of this animal we have seen. From here to the Little Buffalo river the country becomes more and more swampy. Dense scrub growth of all kinds impeded our passage, and, on account of the great depth of water on the trail, long detours had to be made, necessitating the cutting of a new trail in many places. One of our horses got mired here, and we had to carry his pack for the rest of the distance to the river. The Little Buffalo is a typical muskeg river, with very low or hardly any banks, with a swift current and yellow-coloured water. At this place it is only fifty to seventy-five feet wide, and at this time of the year is too deep to ford. Owing to this fact and also to the condition of the horses we camped here early.

Friday, June 16.—This morning we crossed the river. The guide, with our assistance, made a raft and on this we carried the packs over as well as ourselves. The horses were made to swim over. The least said about to-day's travel the better. It is just a continuation of the kind of country on the east side of the river. This whole country between the Little Buffalo river on the east and the three rivers shown on Mr. Radford's sketch is one big swamp—particularly so just before we come to the first river. There are innumerable small ponds, separated only by narrow necks of grass and matted willow-roots in which the animals sink shoulder-deep and which quakes and gives underfoot most alarmingly. Both the horses got mired and had to be hauled out with ropes. Shortly before Seton creek is reached, however, poplar ridges again make their appearance and on the first of these we made camp late at night.

Saturday, June 17.—A hard day. With an early start and with the guide under the impression that we want to go as far and as fast as possible, we plunge once more into water knee-deep. Although covered with water, the trail here has a firm bottom. Muskeg, however, prevails. We crossed three rivers, evidently those marked on Radford's map. They are not deep and only twenty to thirty feet wide, but the current is very swift and fording them at this time of the year is very difficult. About noon the guide discovered the first buffalo track. Then a day-old track is seen, and we press on with renewed vigour, hoping to see some before the day closes. This certainly is the best day's travelling we have done. Late at night we made camp on a poplar ridge near where the guide says there are many beaver ponds. In fact this animal seems very numerous up here, as we have seen fresh signs everywhere we went, more particularly near the rivers. This may account for much of the wet land here as the beaver are wont to run wing-dams and flood the country adjoining the rivers. I will look into this another time. I may add that, as this is the rainy season, it rained, as usual, all day.

Sunday, June 18.—At last there is a change in the character of the country. Big reaches of jack pine of fair size, fifteen to twenty inches in diameter, and numerous stretches of straight poplar of the same size are encountered everywhere. The spruce also begins to show itself, and although no really good spruce timber country is encountered, wherever it does appear it is very large, thirty inches or more in diameter. Then the buffalo signs begin to appear on every hand. Immense wallows surrounded us. The ground and trail are pitted with them. Fresh tracks are seen in many of the wallows and soft places and many of the tree trunks near the trail are used by the buffalo as scrubbing posts. On these much hair was hanging. This country is certainly a good range for stock of any kind. The buffalo, I imagine, use it as a winter or spring feeding-ground. The grass is luxuriant and there is plenty of shelter in the winter. The timber remains practically the same throughout the day's travel. In one place a huge whirlwind had made a big clearing several acres in extent. Fires, however, have been very rare, as no brulé or windfalls are seen at all. Early in the afternoon the guide lost the worn trail, and, as we were in the good buffalo country and our time limited on account of food, we decided to press on, following a well beaten buffalo trail. This trail had evidently been used very long and also very recently. One could easily see it was made by some wild animal because where the grass was poor it was straight and narrow and where the feeding was better it was very scattered and indistinct. Here we saw the first and only bison seen on the trip. He (an old bull) was standing in a big wallow fighting flies, and, although we used no particular caution in approaching him, he did not seem to notice us. We were able to get within thirty or forty feet of him. We watched him for some time and then he turned his head and saw us. He made off at a surprisingly fast pace considering his size and the lumbering way in which he travelled. He had probably been driven away from the herd by the younger bulls. He was not fat, although rich feed was on every hand.

Monday, June 19.—To-day as our grub was running low, we decided to track buffalo in this locality. The guide had no difficulty in striking the trail of a band going northwest from a small slough near our camp. Very soon we came out of the swamp into open country. Huge hay-meadows appear and patches of typical prairie land, dotted and divided by clumps of alders. These alders grow to the height of ten to fifteen feet and are sometimes as thick as one's wrist. This part of the country, the guide says, is the border of the great northwestern bison range. From this point westwards and northwards around Buffalo lake and river the country is all prairie. Of course, this is Indian information and, as we were not able this trip to penetrate so far, I will not vouch for the truth of it.

All day, although cold and raining constantly, we followed the trail we had struck in the morning. Here were tracks of six grown animals and one calf, but, as they

were travelling with the wind, which was blowing northwest, and consequently scented us a long distance away, we did not come up with them, although we made many long detours endeavouring to head them off. Some of the Indians say that all the bison in this district go further west during the summer months, but Constable W. Johnston, of the R.N.W.M.P., doubts this and several others of the police support him in this opinion. I myself do not see any reason for their migration westward, and, as the wallows were well used and tracks and droppings were all fresh and in addition the feed plentiful, they evidently have their habitat here most of the year. The distance travelled by us to-day was about eight or ten miles northwest. This would bring us very close to the stream called Jarvis creek on Mr. Radford's map. No timber of any account grows in this district and with the exception of a few jackpine and poplar ridges the country is covered by hay-meadows dotted with alders.

This constitutes my diary for the outward journey. and, as our trail on the return journey was practically identical and as we saw no more buffalo, I will omit the remaining six days' notes. It may be of interest to state, however, that we ran out of food and I had to shoot game. This is very plentiful, moose, bear, caribou, beaver, partridges and prairie chickens abounding everywhere. It is cheaper by far to live by the rifle than to depend on salt pork. We made better time on our return journey, although we stopped many places to blaze the trail better and in many places to cut a new one around a slough or especially bad piece of muskeg. We arrived late on Sunday night, June 25.

Respectfully submitted,

GEO. A. MULLOY.

No. 31.

REPORT OF GEORGE A. MULLOY.

FORT SMITH, ALBERTA, July 27, 1911.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa, Ont.

SIR,—I have to report the work done by Mr. Boyd and myself during the last month. On Monday, July 3, we started on a trip to the southern and western wood-bison range. Our intention was first to visit Moose lake and the district adjoining it and then to continue our trip south towards the Peace river. However, we were unable to reach the Peace River district, as our pack-horses ran away and we had to shorten the trip. As my diary is somewhat broken and condensed, I will accompany this report with a sketch of the country traversed.

Moose lake is a large swampy body of water almost directly west of Smith Landing. The distance is about eighty miles. From here to the Cariboo mountains, which can be plainly seen to the southwest, is fifty to sixty miles. The country all around the shores and westward as far as the eye can see is covered with good spruce timber, ranging from twenty to thirty inches in diameter. It is typical spruce country. The ground is covered with sphagnum moss and a thick undergrowth of alders and scrub of all kinds. I studied the country from the top of a high tree on a jackpine ridge southeast of Moose lake, and this fine timber belt appears to continue as far west as the Cariboo mountains. I was indeed surprised at the character of the country as my informants had told me it was a good prairie country inhabited by buffalo. However,

this is not a buffalo range because absolutely no signs were found and the guide told me that they never come here even in winter.

The country out to Salt river from Smith's Landing is all swampy spruce, muskeg predominating. No timber of any kind except one poplar bluff is seen. The river here seven to eight miles west, is only a shallow creek with a stony bottom. The water is very salty and cannot be used for drinking. The west bank of the river rises, however. This rise continues for two miles or so, rocky in places and covered with small jack pine and poplar. Then the salt country is entered. Everywhere the sloughts and creeks are saturated with salt, and in many places where small ponds have dried up the mud is covered with a thick deposit of salt. It permeates everything. Even the leaves of the trees, when chewed up, taste salty. To the south and southeast a great salt plain stretches. Through this we passed on our return. The ground is covered with a very rich growth of grass, which does not seem to be affected by the salt.

Immediately west of the salt country is a rolling poplar-scrub country, which seems to be a favourite spot for buffalo. Deep-worn trails cross the main trail in every direction. Here, towards evening, we encountered a big buffalo bull. He appeared to me to be very much larger than any I had seen before. He was in good condition, and allowed us to come within fifty yards of where he stood in a wallow. Next morning we met one on the trail almost as large as the first. These were all we saw, because the bush at this time of the year is very dense. However, there are many buffalo wandering through here, because fresh tracks were met with at every step. The range here, though, is very narrow, and I think this is only used by the buffalo in their migrations north and south.

Further west, rolling country is encountered, with hay-meadows dotted with alder brush and broken by poplar groves, spruce clusters and scrub generally. Some of it is good timber but badly damaged by fire. Still further west and north, sandy jackpine ridges are the order. These, especially, are much burned over by fire, which has burned up the needles on the ground and scarred and blackened the boles of the trees. It seems to have been a ground fire of two or three years ago. The timber, however, is mostly standing and not dead. This is a moose country, and no one but the Indians come in here, and they only in the winter time and when driven to hunt moose for food.

This jack pine continues right to Moose lake with the exception of two or three miles of light poplar at the eastern arm of the lake. In most places the jack pine is small and scrubby or not fit for anything but two by four scantling. But for ten miles around the spot on the enclosed map, marked 'Hogback ridge' the timber attains a very fair size, fifteen to twenty inches in diameter and straight and tall.

This, I think, describes the country traversed pretty well. I was gone three weeks and was almost driven out by the flies. They had bitten me so badly I was afraid of poisoning. Mr. Boyd and the Indian guide made a rather foolhardy attempt to recover the horses, resulting in their having to walk eighty or more miles without food or fire. I was left at Moose lake with no idea what had happened to them for six and a half days.

Respectfully submitted,

GEORGE A. MULLOY.

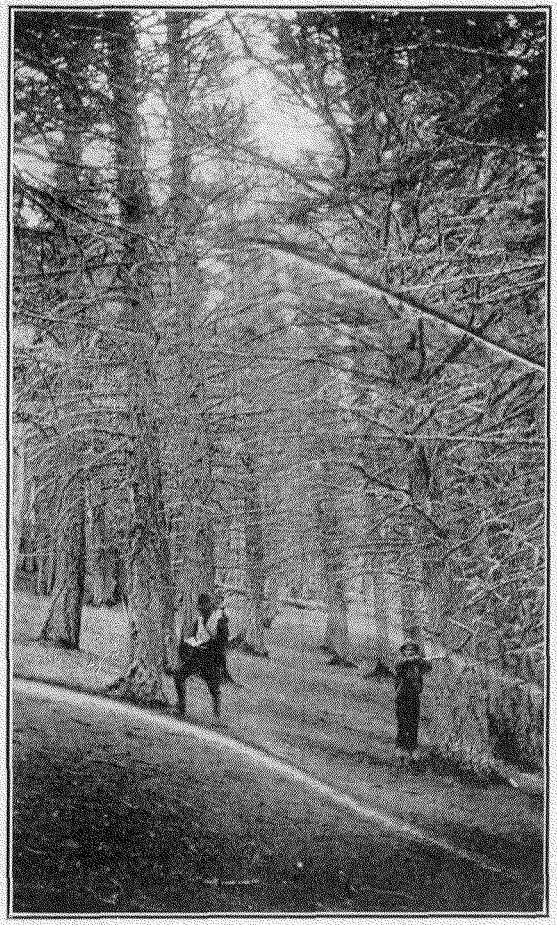


Photo E. G. McDougall, 1911.

Porcupine Hills, Alta.: Forest of Douglas Fir, partly Fire-killed.

Sec. 1, Tp. 15, Rg. 1, west of 5th Meridian.

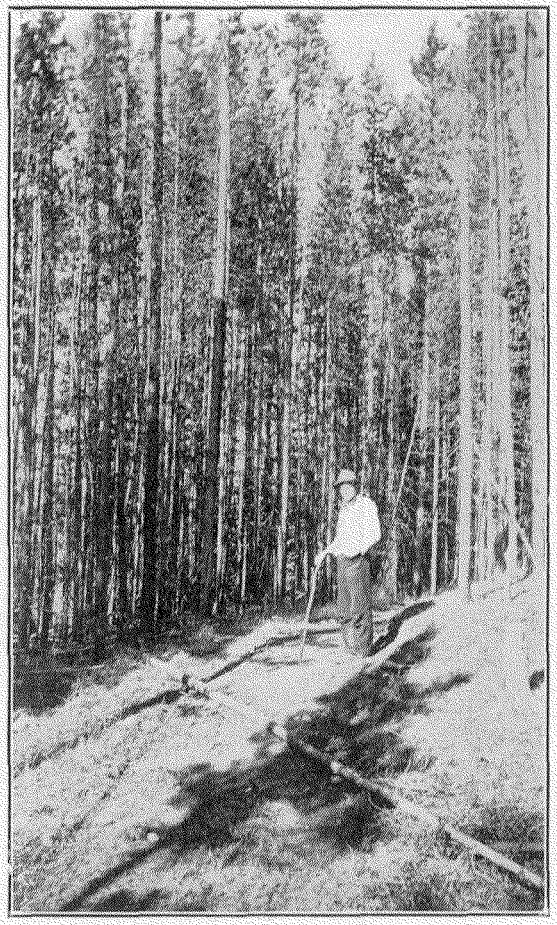


Photo D. Roy Cameron, 1911.

Lesser Slave Lake District: Pure Stand of Lodgepole Pine, South of Lesser Slave Lake.

Tp. 67, Rg. 8, west of 5th Meridian.

No 32.

REPORT OF GEORGE A. MULLOY.

FORT SMITH, ALBERTA, December 28, 1911.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I have to report the work done by the trapper, Peter McCallum, and myself since September last. We have been for three months or more in the northern bison range, and therefore I have not had an opportunity of communicating with you more frequently.

On September 16 last, after putting up a supply of fish for the dogs at Gravel point, we loaded up our skiff with supplies and started down the Slave river. Our intention was to make a small catch of fish at Grand Detour. a big bend in the river some thirty-five miles down stream, so that we would not have to return for dog-feed before the snow came. From this point we were to strike west to the Little Buffalo river and up Bear creek, which enters the Little Buffalo at this point. McCallum knew there was an old shack on Bear creek and our intention was to use this as a store-house and head-camp while in this district. How these plans worked remains to be told.

As was the case with many others who waited too long to lay in their stock of fish for the winter, we were unsuccessful in this second, or supplementary, catch at Grand Detour. The last, or big run of 'connies' never came. Disappointed and left with four dogs to feed until snow came, we decided to push on overland to the Little Buffalo river.

Earlier in the year the crossing of this portage with a boat is much simplified by using several long narrow sloughs which nearly connect these two rivers at this point. But we found the sloughs nearly dried up and the dragging of a heavy boat for miles overland wholly impracticable. So we concluded that our best plan was to hitch the dogs to the sled and drag the sled and as many supplies as possible over dry land, leaving a cache on the bank of the Slave river. This was killing work, as we had to assist the dogs and incidentally hunt feed for them, wading in icy water after musk-rats, shooting chickens and snaring rabbits—any and every means to get enough feed for those dogs.

At last, after much exploring, we find the shack on Bear creek and take possession. Some moose hunters had pulled the whole side of it out for wood, so it was in a pretty bad condition. But we thought it would save time to repair it.

Now commenced one of the most difficult games I ever had a hand in—trying to carry on our work of exploring the country and repairing the shack and at the same time provide meat enough for the dogs. McCallum killed a large moose and I shot a bear. This aided us materially, but the meat disappeared very rapidly and towards the end of our stay we were reduced to snaring rabbits for dog feed. Thus you see, sir, I am not very much in favour of dogs as a means of locomotion. However, the winter has just set in and their usefulness will be put to a good test. But to continue. Of course, we have made many excursions and trips both far and near so that I will be able to give you a good description of the country and a reasonably accurate sketch. The long trips, of course, have been made only since the snow came. The breaking of a trail is slow work and is rather hard work, but, once broken, a trail can be used all

winter, as the dogs have a solid footing and travelling for man with trail-snowshoes is not a very difficult matter. Our main trail is forty to fifty miles long and runs westwards from Bear creek, crossing what appears to me to be the southern end of this northern bison range. We have not been able to come up with any of the herds as yet, as they can travel very fast and far, but, of course, their tracks in the snow told us all we wished to know. Later, however, when the snow on the huge open hay-meadows or prairies becomes solid and we are not forced to wade through snow and grass to our waists, we will be able to travel more quickly and keep a closer watch on any band we encounter. All the tracks we have seen have been made by bison headed to the north or Resolution end of the range, except seven which were travelling in the opposite direction. One of the trails was quite hard and well defined, although covered several inches deep with fresh snow, and McCallum thinks there were forty to fifty in the band.

Now, with reference to the wolves, I would have preferred, of course, to give some visible evidence of the work done and been able to turn over at least a few of these animals' pelts as proof that we were able to catch them, but it will be probably more satisfactory to you to hear that we saw very few tracks in the locality, and these have almost invariably been those of wolves which have later crossed the Slave river on their way to the caribou territory. This has one exception. We did discover that one large wolf had been following a herd of seven bison (those referred to above) but as they did not show any signs of fright or agitation they evidently were not afraid of him.

We have placed baits and traps on all our trails except where they approach or cross any other trail. These have to be visited very often, as a fresh fall of snow might cover up the track of any poisoned animal, and, although we have caught and killed many birds and rabbits, no wolf has come near our trail or traps. This seems rather discouraging, but better results may be hoped for later in the winter, when the wolf, with many others of the meat-loving animals, cannot catch the rabbits which are very numerous and which fall an easy prey to any of the carnivorous tribe.

At the outset of my description of the territory covered in the last three months I wish to correct a statement or impression I seem to have given you in one of my earlier reports. The timber along the Slave river is splendid. My error may be accounted for when I say that the trail we followed in June last approaches the banks at only a few places, and therefore one does not get a favourable impression at first. But since we have navigated the river in a small boat I have had a better chance of inspecting it. The river all the way to Grand Detour is bordered by a heavy belt or fringe of spruce, varying from one mile or more to a few yards in width. The islands especially are very heavily timbered. One big island which is seven to eight miles long and two miles wide at its widest point, and on which the Hudson's Bay Company has a saw-mill at present, is densely covered with large spruce. In many places the trees are three feet in diameter, and standing so thickly that no underbrush will grow. This is a sample of all the islands as far as Grand Detour, and there are many and all very large.

The country lying between the Little Buffalo river and the Slave is practically the same throughout its entire length. We have crossed it in many places and in coming to headquarters this time we followed some Indian trapping trails which wound in and out all over the country, making our trip across country very tedious and long, but allowing us to get a good idea of the country. This strip of country is invariably flat. Long narrow sloughs or hay-meadows are sandwiched in between long narrow strips of timber, both running parallel to the big river. The timber, which is spruce and poplar mixed, decreased in size and quantity as the distance increases from either of the rivers. Down at Grand Detour, however, the sloughs become immense hay-meadows, varying from half a mile to two miles in width and stretching northwest as far as the eye can see. The timber here becomes almost a

negative quantity, with the exception of the belt along the two rivers and a few scattered islands and isolated strips. This immense hay-slough or prairie, as it is falsely called by some people here, is said to run all the way to Resolution, broken only occasionally by clumps of alders and small spruce thickets. This country, I should say, would make excellent grazing or ranch land, as it is covered by a dense growth of long grass.

Bear creek enters the Little Buffalo river some four or five miles south of the portage to Grand Detour. It is a small stream about five yards wide at the mouth, and inclined to be swift, especially so seven or eight miles from the mouth where it passes through some rocky country. Its course is, generally, from the southwest, and its banks are thickly clothed with good-sized spruce. The rocky country some eight miles west on the Bear creek is a continuation of the outcropping at Salt mountain, I am sure, because it presents the same appearance and runs in a southeasterly direction, gradually approaching the Little Buffalo river. In fact this height of land continues on across Bear creek for some distance and forms the footing, or base, of the big flat buffalo range to the north. It is very rocky and precipitous in places, especially at Bear creek, but in other places is covered with an excellent growth of poplar. However, on the south side of Bear creek, immense old brulés are encountered. These, I am pleased to say, are invariably covered with seedlings and small trees.

To the north of Bear creek, as I have mentioned, lies the great buffalo range. It is the same kind of country as we encountered immediately to the east of the Little Buffalo. Covered with long, rank grass and broken only occasionally by islands and strips of small spruce and poplar, it stretches as far as the eye can see. Occasionally sloughs occur, but these are insignificant compared with the immense amount of dry hay-land.

The sketch I am making is not as yet completed and, as I wish to get this off by the next mail, which leaves on January 1, I will enclose it under separate cover.

We are making a long trip into the southern range in a day or so, as we have cause to suspect some fur hunters in that district. I will let you know the outcome of it later.

Respectfully submitted,

GEORGE A. MULLOY.

No. 33.

REPORT OF GEORGE A. MULLOY.

FORT SMITH, ALBERTA, January 11, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—As I intimated in my last report we have had a trip into the country west of Fort Smith and north of Moose lake. This trip was to ascertain whether the suspicions caused by the action of some Fort Smith Indians were groundless or not, and also to continue our work in connection with the wood bison.

Contrary to expectations, we found nothing that would lead us to suppose any buffalo had been killed, although we searched each camping-place and cache. But, although the Indians who were trapping on this trail when questioned by Mr. Bell had said that no buffalo tracks had been seen and that wolves were very thick, we

found just the opposite to be the case. Only one wolf track was seen and that an old one, while the buffalo seem to use this country as a range all year round. Why the Indians made misleading statements is hard to account for.

While our trip lasted only a week, we were able to cover a considerable distance in that time as the trapping trail was hard and firm, although in some places completely drifted in. The trail leads west and south from a point on the trail from Fort Smith to Salt River settlement and holds this general southwestern course until nearly north of Moose lake, where it swings to the northwest. It seems to be an old trail used by trappers for many years, but I should say it was impracticable for summer use; it for miles follows big sloughs and country which is more or less inundated in the summer months.

The first part of the country going westwards is simply a continuation of the Fort Smith type of land, namely, flat, sandy, and covered with a good growth of jack pine, here and there broken by open patches covered with alders. This stretches for four or five miles and then changes to what in this country is called prairie. This is not really prairie, although it is flat and covered with a short fine grass. I would call it rather scrub country, as everywhere waist-high alders and red willows cover the ground. This runs right to the bank of the Salt river, a distance of seven or eight miles.

Crossing Salt river, which is here thirty yards or so wide, we came in view of the Salt Mountain range of hills, some four or five miles away, across a big slough or shallow lake. This latter runs to the north along the foot-hills. The range of hills here is fully as high as at Salt Mountain proper but is not rocky and precipitous. It slopes up gently and is covered thickly with jack pine and an undergrowth of small poplar. The jack pine is of good size, ten inches diameter being the average of the larger trees, but the poplar is of no account at all. Farther on, however, say four or five miles, as the country slopes gradually downwards and westwards, poplar and spruce predominate. Large hay-meadows and sloughs make their appearance, bordered by densely timbered spruce muskegs. Here it is, on this western slope of this range, that the buffalo have their habitat. In fact, I think that we will eventually find that, as this range of hills bisects the country north and south at every point I have visited it, the buffalo use the western slope of it for both winter and summer feeding, probably using it also as a connecting link between the two bands, the northern or Resolution band and the southern or Peace River band.

Westward from here (ten or twelve miles from the Salt river) begins a country which is hard to describe as the cause of its condition is not readily apparent. It is practically flat until the foot-hills of the Caribou mountains are reached, and although very swampy in places it is not a muskeg. Evidences of forest fires can be found if looked for, but the subsequent fallen timber has long ago rotted away. The country is now clothed with a dense growth of small spruce and a forest of dry small poles. It is a great moose country, and this may possibly account for its condition, as moose hunters as a rule are not very careful of their camp-fires. I climbed to the top of a tall, rocky promontory which juts out from the west, just north of Moose lake, and saw that this kind of country stretches south to the big timber surrounding Moose lake, and north as far as the eye could see, following the course of the Little Buffalo, which here winds northward to its source in some small lakes. Of course patches and strips of big timber are scattered here and there, almost invariably spruce, but they are only islands in a sea of small second-growth spruce.

I have not had time to prepare a sketch-map as we are almost continually on the trail or getting ready for the next trip, but hope to be able to do so in the near future.

I might add, in conclusion, that we saw where Indians had followed buffalo tracks in many places, but were unable to ascertain whether a kill had been made or not. This will have to be done in the spring when the snow goes. The wolves,

however, seem neither to be very numerous nor to have any inordinate desire for buffalo meat. We are continuing, however, to pursue them as vigorously as possible.

Respectfully submitted,

GEO. A. MULLOY.

No. 34.

REPORT OF GEORGE A. MULLOY.

FORT SMITH, ALBERTA, March 1, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I have to report work done by the trapper, P. McCallum, and myself since last report in January.

As I intimated in my last letter, we returned to our trapping operations in the Bear creek and Little Buffalo River district. This has been singularly unsuccessful, owing, most probably, to the absence of any wolves in that part of the country. Foxes, however, were very plentiful and why none of them took our bait or got into our traps is a matter which the trapper has been trying to explain to me. Foxes and wolves are about the same, in regard to trapping operations; at least the same methods are employed to catch both, and the natural deduction is that something was wrong with our method of trapping. The fact remains that no wolves were caught or killed, and, as no new buffalo tracks were seen, we decided to quit operations in that locality.

For some time Mr. Bell has wished us to make a trip into that district lying between the Peace river and Slave river near the junction, the object being both to determine whether there were any buffalo there and to get a description of the country. On February 20 we started up the river with a guide and extra team of dogs. Our intention was to follow the pack-trail on the river until we came to the big bend in the river some fifty miles or so south of Smith's Landing. Here, starting from the most westward part of the bend, we could cut a trail through to the Peace river following a southwest course as nearly as possible. This was done by means of the compass and, with everything favourable, should take us to the most eastward point of the big bend on the Peace river, somewhat below Peace Point. In all this we were very successful, landing at the nose of the bend on February 24.

No signs of buffalo, however, were seen at any part of the twenty-five to thirty miles of trail which we were forced to cut through this country. Alexis, the guide, however, tells me that there is quite a band, 50 to 100 of these animals, some miles north of here. This is where Mr. Radford shot his specimen, and the guide has a trapping trail through or near their winter feeding ground.

Of our elusive enemies, the wolves, not a track was seen.

Now, I have been talking over the situation with Mr. Bell, and especially his plan for the localization or rounding up of the buffalo in a certain district, and most heartily concur with his ideas. You will see from my description of the country appended hereto that there would be plenty of feed and shelter for them and their protection would be only a simple matter. As it is, since they are scattered so widely up and down the country, any adequate measures for their protection would necessarily be very expensive.

Trapping or poisoning operations have to be carried on in one part of the country at a time. This would be all right if we could get close to a big band of buffalo and kill any or all of the wolves that came to molest them. But as they are scattered so widely it means that we are neglecting ninety per cent of the animals to do ten per cent of them some doubtful good. Therefore, sir, you can see why Mr. Bell and I have decided that the best interest of the buffalo can be served by making trips of inspection here and there and everywhere through the country.

It is also of great importance to determine a thing the determination of which, to most people up here, seems an impossibility, and which up to the time of writing I have not had much opportunity to determine, *i.e.*, the approximate number of buffalo in each locality. Of course I know that upon this point will hinge the advisability of further expenditure in regard to their protection, and tripping everywhere through the country is the only means of obtaining this information. It can never be obtained by localized trapping operations, as the trapper McCallum expected would be the case.

I will now describe as accurately as I can the country encountered on our Peace River trip.

The timber south of Smith's Landing along the Slave river as far as the big bend is not nearly as good as that in the lower river below Fort Smith, both in regard to individual size and quantity. Each point has its big bluff of spruce. This timber is fair in size, ten to fifteen inches in diameter. Every tree, however, is limbed nearly to the butt owing to their exposed nature. The main bank of the river is clothed with small black poplar of no commercial value. Islands, however, are numerous and these one and all are densely wooded with good spruce.

The bank of the big bend is practically the same, big bluffs of spruce alternating with long stretches of small poplar.

Striking inland from the river in a southwest direction, high lands covered with a mixed growth of poplar and spruce are encountered. The spruce is very good and continues so until the bank of a small river is encountered. This stream is of fair size, thirty yards wide, with high, steep banks. It has numerous names, or rather, there seems to be a discussion which is the right one. However, the Indian told us that it comes out or empties into the big river at Le Butte, a point twelve miles above the northern end of the big bend. From a well informed riverman I also have the information that it is open at the other end through some sloughs into the mouth of the Peace river, and, at high water, the water flows from the Peace river directly through this channel into the Slave river. However at this point, three miles southwest from the Slave, it comes from the south and appears to be very navigable for small craft.

The west bank of this small river is well wooded, with black, or balsam, poplar and spruce, but, as is the case with the timber on every stream in this country, it soon diminishes in size and quantity as the distance inland is increased. Hay-sloughs are next encountered surrounded by dense growths of small spruce, but this soon gives way to scrub prairie. This, in fact, is the character of the country until half-way to the Peace river, small flat openings covered with knee-high scrub and surrounded with thin fringes of small dense spruce. Here and there, to the south or north, rolling land is seen covered with a scattered growth of poplar. The timber is of no commercial value.

For the rest of the distance there is nothing but brulé. An enormous fire has destroyed the whole vegetable growth of the country. This reaches in places to the bank of the Peace river itself. This fire, which occurred some ten years ago, at least, seems to have started from the Peace river side, and to have swept eastward until seems to have started from the Peace River side, and to have swept eastward until back from the Peace is hilly and sandy, and is now covered with a forest of fire-blackened big jackpine poles. On the banks of the Peace, however, the worst damage has been done. The spruce there was of enormous size and extended a mile or so

back from the river. Just where we reached the river there is a very large strip of timber that has been spared. But to the east, north and south the fire has left nothing but an impenetrable brulé.

The soil throughout the central district is a good clay loam, but on the jackpine hills nothing but sand has been left by the fire.

Our next trip will be a joint patrol with the mounted police, and I hope will be more enlightening as far as the buffalo are concerned.

Respectfully submitted,

GEO. A. MULLOY.

No. 35.

LETTER OF A. J. BELL.

OFFICE OF THE DOMINION GOVERNMENT AGENT,
FORT SMITH, ALBERTA, January 16, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I beg to submit for your consideration, the following report on the protection of the wood bison in the neighbourhood of the Great Slave river.

The protection of the bison is rendered difficult owing to the vast area over which the various small herds wander, and the distance from posts where supplies can be secured; these points make the efforts of the appointed herders of little real value, owing to the length of time taken in travelling between the base of supplies and the ever moving herds.

If it were possible to centralize these herds the annual expenditure would be greatly reduced and more effective protection afforded them.

At the junction of the Peace with the Great Slave river there is a district much frequented by bison, both in the summer and the winter months. A line drawn eastwards from Peace Point, upon the Peace river, would intersect the Great Slave river about twenty miles below the junction with the Peace.

If a suitable fence were constructed along this line, a distance approximately twenty five to thirty miles, the bison could gradually be worked from the north into this peninsula where there would be ample range for a very large herd for a number of years.

Should the bison attempt to leave the range in the winter by crossing one of the rivers upon the ice, the herder (whose business it should be to patrol the water front) could follow and turn them back. It is not probable, however, that they would attempt to do this.

There are many old bulls who have been driven out of the herds by younger ones. These animals, being alone, are often killed by wolves. They are useless to the main herds, and, as they are as a rule of immense size, would make valuable trophies for museums or public buildings. They could be killed, skinned, and the bones preserved for articulation, the whole forming a few packages which could easily be shipped to the Department.

I beg to enclose an estimate of cost for the erection of fence and buildings, and for the moving of the northern and central herds to the southern end of the district.

Respectfully submitted,

A. J. BELL,
Agent.

(Memo re Cost of Fence, &c.)

ESTIMATE OF COST NECESSARY FOR THE MOVING SOUTH AND ENCLOSURE OF THE BISON IN FORT SMITH DISTRICT.

Country to be enclosed.—From Peace Point on the Peace river to a point upon the Slave river, about twenty five miles eastward.

Area within proposed enclosure.—125 square miles.

Nature of country.—Numerous level prairies, some jackpine ridges and poplar bluffs, a few hay-sloughs, and a small percentage of muskeg lands. A fringe of good spruce along the river banks.

MOVING THE HERDS SOUTH.

Three parties starting simultaneously from a point about sixty miles west of the number required, about 10,000. Cost of labour necessary for erection of fence, $50 an equal distance east of Buffalo lake, could pick up the trail of the herd which frequents that district, and move south a few miles abreast. They should follow the buffalo trails, which are well defined and followed regularly by these animals in their migrations. These trails follow the high ridges, of which there are but a few in that country.

The time of year chosen for this work should be the middle of April.

Three Indians and three white men (acquainted with the country) should be sufficient for this work. They would need a pack-horse for each party. Wages, $50 per month with rations, the cost (landed) of which would amount to $25 per month.

Cost of pack-horses, $1 per day. The Department has one pack-horse now on hand. Two months' steady work should sweep the country as far as Peace Point.

ERECTION OF FENCE.

This work should be commenced simultaneously from the east and west ends.

Jackpine and tamarack posts can be obtained in the locality, cost 20 cents each; number required, about 10,000. Cost of labour necessary for erection of fence, $50. per mile.

Cost of wire, 7 cents per lb. additional to the cost at Edmonton. It is estimated that five wires would be used.

Preliminary survey and 'blazing' of fence line, $500.

Erection of two shacks within enclosure, at $150 each, $300.

RECAPITULATION OF COST.

Moving the bison south	$1,080 00
Cost of fence posts	2,000 00
Cost of wire, 125 miles	(?)
Erection of fence	1,250 00
Survey and 'blazing' fence line	500 00
Erection of two herders' shacks. (These shacks to be erected at either end of enclosure)	300 00

All of which is respectfully submitted,

A. J. BELL,
Agent.

No. 36.

REPORT ON A SHIPMENT OF REINDEER.

DEPARTMENT OF THE INTERIOR,
FORESTRY BRANCH,
OTTAWA, October 25, 1911.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I have the honour to submit herewith a report in connection with a shipment of reindeer from St. Anthony, Newfoundland, to Fort Smith, Alberta, the details of which were carried out almost entirely under my personal supervision.

In order to convey a correct understanding of the reasons for undertaking to establish a herd of domesticated reindeer in the sub arctic regions of Canada it will be necessary to recite, briefly, the circumstances which led up to it.

The earliest recorded attempt to domesticate reindeer on this continent is that of the United States government which, about 1892, imported a herd of Siberian deer to Alaska for that purpose. Several small herds have since been imported and, as the result of careful and intelligent handling, there are now some 15,000 domesticated reindeer in Alaska. The deer are used for practically all the purposes for which domestic cattle may be used and are, in addition, very useful for transportation purposes. The problem of transportation is, aside from the severity of the weather, the most serious with which dwellers in the Arctic regions have to deal. The cost of grain and hay, neither of which is grown in any considerable quantity, precludes the use of horses or cattle for transportation purposes and, prior to the introduction of reindeer, dogs were used almost entirely. While Eskimo or husky dogs made excellent beasts of burden, their usefulness is seriously impaired by the necessity of hauling with them sufficient fish, or other food, for their own subsistence. This seriously limits the sphere of a dog's usefulness, as on long trips dogs can haul little, if any, load beyond their own food supply. Reindeer, on the other hand, while quite as hardy as the best train dogs and able to haul somewhat larger loads, find their own subsistence in the moss which covers practically all of the sub arctic region. No matter how cold the weather, or how deep the snow, the deer can paw their way down to the moss and thus keep themselves in good condition on the longest and roughest trips. Another point in favour of deer is that, should misfortune overtake a party of Arctic travellers and it become necessary to kill the transport animals for food, the flesh of the deer is palatable and nourishing, while only dire necessity would impel anyone to use dogs for food.

It seems to have been the idea of the United States government that the establishment of large herds of domesticated reindeer in Alaska would be a long step in the direction of solving the transportation problem of that district and, in addition, would to a considerable extent provide a food supply for the natives who otherwise would from time to time become charges upon the public treasury.

This experiment by the United States government was followed with great interest by many Canadians who were interested in the development of our northern territories, and particularly by Dr. W. T. Grenfell, who, in connection with his medical missionary work on the Labrador coast, found himself confronted by practically the same conditions that obtained in Alaska, viz.: severe climate, absence of means of winter transportation other than dogs, and scarcity of food supply for natives and fishermen during periods of unusually severe weather.

At Dr. Grenfell's request the Dominion government in 1907 purchased a herd of some 300 Norwegian reindeer. These were handed over to Dr. Grenfell to be used by him in connection with his work. It was originally intended that the herd should be established on the Canadian Labrador coast, but Dr. Grenfell finally decided that his mission station at St. Anthony, on the northeast coast of Newfoundland, was a more suitable place for the experiment. There is an abundance of reindeer moss at, or near, St. Anthony, the climate is in all respects suitable and, should occasion require it, the deer can readily be shipped from there to any desired point on the Labrador coast as conveniently as from the point first selected.

Dr. Grenfell's experiment has proved successful from the start and, from the small beginning above referred to, he now has over 1,200 deer. A considerable number of stags and barren does have been killed for food, and there have been the usual unavoidable losses by death and accident. He reported in May, 1911, that the meat is excellent and the skins valuable and that, in his opinion, reindeer will in the future be as valuable in Labrador as in Alaska and will afford an export industry of meat from a district where it is never probable that wheat, corn or other cereals can be profitably produced.

During the summer of 1910, His Excellency the Governor General, Earl Grey, visited Dr. Grenfell's mission station on his return journey from Hudson Bay. His Excellency was greatly interested in the reindeer experiment, and, having just seen a considerable part of sub arctic Canada, was impressed with the desirability of further extending the experiment by the establishment of herds in portions of the Northwest Territories. His Excellency subsequently discussed the question with Hon. Mr. Oliver, then Minister of the Interior, and some correspondence ensued between Mr. Oliver and Dr. Grenfell which resulted in Dr. Grenfell agreeing to supply a limited number of deer from his herd at what the animals had actually cost him.

At this stage the correspondence was handed to you with instructions from Hon. Mr. Oliver to report upon the feasibility of locating a suitable reindeer range in the vicinity of Fort Smith, on the Slave river at the extreme northern boundary of Alberta. You submitted a partial report on 22nd May, 1911, but, with the information then available, were not able to make any definite recommendation. Subsequently, however, you called upon Dr. Grenfell, at Toronto, and discussed the whole question thoroughly with the result that, on 9th June, Dr. Grenfell in a letter addressed to you, submitted a detailed proposal covering the whole question and agreeing to supply deer, moss sufficient for the journey, and experienced herders to take charge of the deer throughout the trip and to remain with them for a sufficient time to permit of others being trained to succeed them. This offer was accepted, and on 21st June, 1911, authority was given to complete the purchase and to arrange for the shipment.

At about this time you were called away from Ottawa on business and the further arrangements were entrusted to me. The first step was to ratify the provisional arrangement with Dr. Grenfell and, accordingly, on 26th June he was informed that the Department would accept his offer to supply fifty reindeer at the rate of $51.30 each. Dr. Grenfell was further informed that three trained deer dogs would be required and a supply of deer moss sufficient for a journey of thirty days; also that the Department would require two herders and one apprentice. The salary suggested for the herders was not exceeding $500 a year each and not exceeding $30 per month for the apprentice. An arrangement was made with the Department of Marine and Fisheries to have one of the government steamers call at St. Anthony and transport the deer to Quebec, from which point they would be taken by rail to a point on the Canadian Northern railway about sixty miles north of Edmonton. Arrangements for transportation beyond Edmonton were entrusted to Mr. J. W. McLaggan, Chief Fire Ranger for that district, who was instructed to have scows built and crews engaged to take the deer from Athabaska Landing to Fort Smith. I was authorized to go to

Montreal and Quebec to arrange necessary details in connection with the shipment by ship and rail and to go to St. Anthony to receive the deer and to accompany them at least as far as Edmonton or Athabaska Landing.

I went to Montreal and Quebec between August 18 and 22, arranged all necessary details, and again left on the 5th September for North Sydney, Nova Scotia, to meet the ship, it having been arranged that she would call at that port for coal after loading the deer at St. Anthony. Owing to pressure of work and to the infrequent trips made by the only steamer calling regularly at St. Anthony I was unable to reach that point in time to superintend the loading of the deer.

It had been arranged with the Department of Marine and Fisheries that the G. SS. *Montmagny* would call at St. Anthony for the deer between 25th August and 10th September, but, as the ship was then delivering lighthouse supplies in the Gulf of St. Lawrence, it was impossible to fix a definite date much in advance. The *Montmagny* reached St. Anthony on the evening of the 6th September, loaded the deer on the 7th, and sailed for North Sydney on the 8th. She was delayed by fog and bad weather and did not arrive at North Sydney until the night of the 12th. I went on board on the morning of the 13th, and we sailed at 9 p.m., on the same date.

I found the deer—six stags, four oxen and forty does—all apparently in good condition. They were in comfortable, roomy pens, six in all, in the forward part of the boat, 'tween decks directly under the main fore hatch. The air was fairly cool and the ventilation, with the hatch open, was excellent. Nathaniel Gear, the chief ranger, informed me that there had been little difficulty in loading the deer and that none had been injured so far as he could ascertain. Mr. and Mrs. Gear had been given cabin accommodation, while the other herders were treated as deck passengers and messed with the crew. I found that four, instead of three, herders had been sent by Dr. Grenfell, but Gear explained that the fourth man, Wroughton Vickers, was returning to his home near Toronto and had been sent with the deer to assist in caring for them on board ship and in transferring them to the cars at Quebec. Dr. Grenfell seems to have assumed that the Department, in return for Vickers' services, would be willing to pay for his meals on the ship and his railway fare from Quebec to Montreal. I may add, in order to clear this matter up, that Vickers made himself generally useful during the trip and I paid for his meals and railway fare; he left us at Montreal.

I had not been furnished with an invoice of the goods supplied by Dr. Grenfell, that having been sent direct to Ottawa, but I examined as carefully as possible all the articles that could be seen and satisfied myself from the statements of the chief herder that everything had been supplied in accordance with the agreement. I have since verified this by reference to the invoice. The moss for the deer was packed in bags and stored in such manner as to make it difficult to count the number of bags or to estimate the weight; experience proved, however, that sufficient had been supplied to last for at least one month.

Upon leaving North Sydney I was informed by the ship's officers that, instead of proceeding directly to Quebec, the vessel was under orders to stop at Cheticamp, a village on the north coast of Cape Breton island, to take on board and convey to Montreal a cargo of powdered gypsum. So far as any of us knew at that time the only objection that could be made to this was the delay, but subsequent experience proved pretty conclusively that the dust from the gypsum was injurious to the deer. We reached Cheticamp at 8 a.m. on September 14 and immediately commenced taking on cargo, which was continued without interruption until 2 p.m. of the 15th. The vessel lay with her starboard side to the wharf and the bulk of the cargo was taken on through the fore hatch. Owing to the gypsum dust it became necessary to close the ports on the starboard side and to hang tarpaulins in front of the three deer pens on that side of the vessel, but in spite of all precautions the air became very hot and the dust in those pens was stifling. Some of the deer were noticed licking up the dust which had

settled on their pens and watering troughs. During the night of the 14th-15th one doe died and on the following day (15th) two more were found to be sick. The death roll shows the following:—

September	15.	—1 doe died.
"	16.	—2 does died.
"	17.	—1 doe died.
"	18.	—2 does died.
"	22.	—1 doe died.
"	25.	—1 stag died.
"	29.	—1 doe died.
Total....		9

The first seven deaths were from the three pens on the starboard side of the vessel, where the air was closest and the dust most stifling. The symptoms were practically the same in each case, very laboured abdominal breathing and, as death approached, a painful gasping for breath and violent muscular spasms. From close observation of all these cases and from opinions given by veterinary surgeons who had seen the animals, or to whom the symptoms had been described by me, I am confident that at least seven, and probably eight, of the nine deaths were due directly to inhalation of gypsum dust. Since my return to Ottawa I have discussed this matter with Dr. J. G. Rutherford, Veterinary Director General, who confirms my opinion. Dr. Rutherford describes the disease as 'traumatic pneumonia,' due to irritation from inhaling gypsum dust. It is very much to be regretted that the success of this experimental shipment should have been jeopardized and, as the result shows, seriously impaired, by avoidable causes. As soon as the loading of gypsum was finished the ports and hatch were opened and the pens thoroughly cleaned. Small watering troughs were built and placed in each pen and kept constantly supplied with fresh water. One of the herders was kept constantly on duty so that special attention might be given to any animal showing signs of disease. The officers of the ship were very considerate and did everything in their power to assist in caring for the deer.

We left Cheticamp at 2 p.m. of the 15th September and, after an uneventful passage, reached Quebec at 9 a.m. of the 18th. Arrangements had previously been made with the Canadian Pacific Railway Company for transportation of the herders, deer and baggage from Quebec to Edmonton, but I found instructions awaiting me cancelling this arrangement in part. Under the new arrangement shipment was to be made via the Canadian Pacific to Port Arthur and via the Canadian Northern from Port Arthur to the end of the steel on the uncompleted line from Edmonton to Athabaska Landing. I at once got into communication with the officers of the railway companies and arranged to have cars placed on the tracks at the dock in time to unload the deer at high tide—about 2 o'clock p.m. I was informed that, if the loading was completed in time, shipment would be made by the regular train at 7 p.m.

My time was very fully occupied during the morning in passing the shipment through Customs, securing a certificate from Dr. Couture, a veterinary inspector in the employ of the Department of Agriculture, and in purchasing provisions and other supplies required for the long journey by rail. These details occupied considerable time and entailed a good deal of running about, but they were finally arranged and I got back to the ship shortly before two o'clock in the afternoon.

TRANSFER FROM SHIP TO CARS.

Owing to the necessity for unloading the deer during high tide when the deck of the vessel was approximately level with the dock, it was impossible to unload directly into the cars and, moreover, it was impracticable to bring the cars very close

to the ship. There was a vacant warehouse on the dock just opposite the ship and, through the courtesy of the harbour officials, it was arranged to turn the deer into this until all were off the ship and then to load into the cars from the opposite side of the warehouse. The does and stags were taken from their pens and placed in a large cage which was then hoisted by the donkey engine to the dock, from four to six deer being carried at each load. From the spot where the cages were landed on the dock to the door of the warehouse was about thirty feet and ropes were stretched so as to form a lane from the cage to the door. The ship's crew and spectators were used to form a line outside the ropes so that the deer were readily induced to trot into the warehouse. Mr. Gear and the other herders placed the deer in the cage and released them from it and their work was both hard and unpleasant, as the animals were greatly excited and in some cases fought viciously. The ox deer could not be hoisted in the cage on account of the size of their horns. (I neglected to say that the stags had been dehorned at St. Anthony in order to facilitate handling and to prevent their injuring one another. The horns of the does are much smaller and do not seriously interfere with handling.) Each ox deer was hoisted singly in slings and then led into the warehouse. The oxen are broken to drive and handle and we had no trouble with them at any stage.

It took about two hours to land all the deer from the ship and during this time the ship's carpenter and others were employed in building partitions in the stock cars, using the lumber that had been used in the pens on the ship. The idea of partitions in the cars was to permit the doors to be opened without any risk of the animals escaping; a further advantage was that it permitted of the use of the space between the doors for storing moss and bedding.

Our real troubles began when we attempted to load the deer into the cars. A passenger gangway, with sides about thirty inches high was run from the door of the warehouse to the first car and we first led a stag up this inclined way. He went about half-way up and then suddenly jumped the railing and landed on the dock among the spectators, causing a rapid scattering. Several breaks of this sort were made, but, by climbing along the outside of the gangway and keeping the deers' heads down, we were generally able to prevent any getting away. One stag, however, put up a vicious fight, using both horns and hoofs, and was finally carried on board fighting all the way. One of the herders was somewhat injured in the fracas, but fortunately his injury proved not to be serious. The does were easier to manage but all had to be led into the cars. It was not considered safe to drive them, as they might have injured themselves by jumping over the gangway railing and possibly might have escaped altogether.

The loading of the deer was completed about six o'clock and then a very busy hour was spent in loading the moss and baggage. All was completed, however, about seven o'clock and the cars were moved away to the freight yard where the train was being made up.

The tourist car in which the herders were to travel had been placed on a siding near the dock and as the provisions and other supplies purchased by me during the morning were delivered they were placed on board and the car kept locked. The last of these supplies was delivered about six o'clock and I then placed Mrs. Gear, the wife of the chief herder, in charge of the car, while Mr. Gear and the other herders remained with the deer cars. I then drove to the railway station where I completed arrangements for the shipment, made out and signed a bill of lading and procured tickets covering the transportation of myself and the herders. We left Quebec at 7.30 p.m. very tired but thankful that there had been no serious accident or delay and that in spite of the many things to be done and the short time to do them in we had been able to accomplish all that we had set out to do, without delaying the shipment in any way.

I feel that I should not close this part of my report without expressing my appreciation of the kindness of the officers and crew of the G. SS. *Montmagny,* who not only assisted in unloading the vessel, which was probably their duty, but who also very materially assisted us in handling the deer from the dock to the cars and in preparing the pens in the cars. Without their voluntary assistance we would hardly have been able to get loaded and away within one day.

I am also greatly indebted to Mr. G. J. O'Dowd, freight agent of the Canadian Pacific railway at Quebec, who personally supervised the placing of the cars at the most convenient points and who remained on the dock constantly from shortly after noon until the last car was loaded.

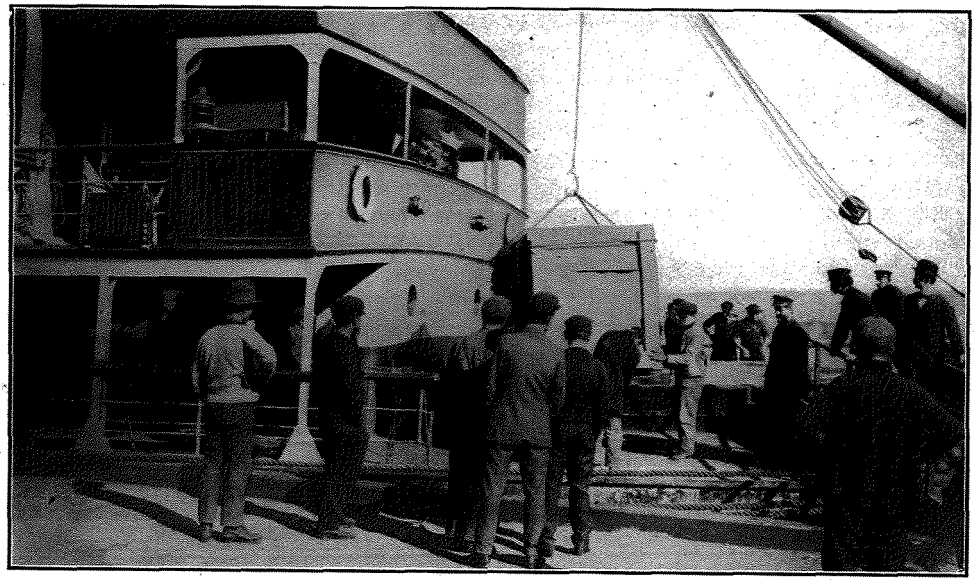


Photo E. F. Drake, 1911.
Landing Reindeer from Canadian Government Steamer 'Montmagny' at Quebec.

JOURNEY FROM QUEBEC TO EDMONTON.

We arrived at Mile End, Montreal, at 4.30 a.m., of the 20th September, and here learned that we would not pass through Ottawa as had been previously arranged. I accordingly wired you, suggesting that you meet us at Smith's Falls, which you did in the afternoon. Two deer which had been sick the previous day had died during the night. We watered and fed the deer during the stop at Mile End, and, later, while stopping at Outremont, the herders went into the stock cars and remained there practically all day employed in putting up partitions, arranging water troughs, &c., so as to make the deer as comfortable as possible. The cars supplied us were the most modern form of stock cars, but the facilities for watering and feeding, while no doubt admirable for cattle or horses, were entirely unsuitable for deer. Owing to the height of the troughs and hay-racks it was impossible for the deer to reach up to them and we therefore utilized the small watering troughs built by the ship's carpenter. These troughs were fastened to the floor and were kept filled from water-barrels which had been purchased at Quebec and placed in each car. Moss was fed by being placed in a ridge along one side of the car; doubtless some was wasted by being trampled upon, but the deer seemed to get most of it.

Our equipment consisted of one tourist car, three stock cars for the deer and one stock car for feed, baggage and dogs. We left Quebec with forty-six deer, divided among the three cars as follows:—

Car No. 1—6 stags, 4 oxen, 1 doe	=	11
Car No. 2— 16 does	=	16
Car No. 3— 19 does	=	19
Total..		46

In the baggage car we had most of the personal baggage of the herders, a supply of moss sufficient to last some three weeks, a supply of hay for bedding, and three Lapland deer dogs.

You joined us at Smith's Falls and accompanied us as far as Chalk river and personally saw that the conditions were as satisfactory as it was possible to make them.

At North Bay, on the 20th September, it became necessary to purchase an additional supply of hay for bedding in order to keep the cars clean, as a good deal of water splashed out from the barrels and troughs and made the floors sloppy. On this day I discovered that one of the stags had an abscess in his throat and other symptoms of illness similar to the does that had died previously. All the other deer were well at this time except one doe that had been sick ever since we left Quebec. I may add that both of these animals finally died, the doe on the 22nd and the stag on the 26th September.

We arrived at Port Arthur about noon of the 22nd September, where we were transferred to the Canadian Northern Railway. The deer had been billed through to a point north of Edmonton, so I had no difficulty about them, but, as our own tickets ran out at Port Arthur, I procured five second-class tickets over the Canadian Northern Railyway from Port Arthur to Edmondton, giving a receipt therefor and requesting the agent to submit the account to the Department for payment. It had previously been arranged that the shipment should be taken to the end of the steel on the Athabaska Landing extension north of Edmonton, but the agent preferred to issue tickets only as far as Edmonton. These tickets were subsequently altered, I understand, to cover transportation as far as Morinville—some twenty two miles beyond Edmonton, the farthest point to which the line is open for traffic,—and the account since submitted covers transportation to that point. We had expected to be required to transfer at Port Arthur from the Canadian Pacific Railway tourist car in which we had so far travelled to a Canadian Northern Railway car, but nothing was said about it and we proceeded in the same car as far as Winnipeg.

You had arranged by correspondence with Dr. Rutherford for a veterinary surgeon to examine the deer at Port Arthur and a careful examination was made by Dr. D. B. Fraser. At the time of Dr. Fraser's inspection I was engaged with the station agent in arranging for our further transportation and so failed to see him, greatly to my regret. Subsequently, however, I saw his assistant, Dr. Parkhurst, and went very fully into the circumstances surrounding the illness and death of the six deer that had died up to that time. We were supplied with medicine for the sick stag and given instructions as to treatment, but I think Dr. Fraser realized that the animal was not likely to recover.

We left Port Arthur at 3.45 p.m. on the 22nd September, by a special freight train and reached Winnipeg at 2 o'clock a.m. on Sunday, the 24th. The journey was uneventful except that the sick doe died on the night of the 22nd and the condition of the stag did not improve under treatment. One unfortunate mishap was the loss of one of the deer dogs. All the dogs were tied in the stock car used for baggage and were given sufficient rope to permit them to move about and have access to the water-barrel. The slats of the car were so close together that there was no possibility of a dog's squeezing through between them, except in the space where the iron watering trough was attached. As we were not using these troughs we had carefully turned them so as to completely block up this aperture, but some curious person must have

turned one of the troughs so as better to see the dogs and left it open with the result that this dog squeezed through and hung suspended until his rope broke and dropped him beside the track. As the train was rounding a curve one of the herders noticed the dog suspended from the side of the car and clambered over the cars to secure it before it choked. Unfortunately the rope broke before the herder could reach the car. We left word with the agent at the next station to send the dog on to Edmonton by express if he could secure it, but there is little prospect of recovering it. This occurred near Hume, a station about forty miles west of Port Arthur.

Upon our arrival at Winnipeg at two o'clock on Sunday morning we had to transfer all of our personal effects, provisions, &c., into a Canadian Northern car which had been prepared for us. We were delayed some little time here owing to the necessity for taking on fresh water, coal and gas in our own car and water in the stock cars, but finally left at 6.15 a.m.

The journey from Winnipeg to Edmonton was uneventful; we made good time and there were no further signs of sickness among the deer. On the afternoon of the 25th Mr. J. W. McLaggan met us at Paynton and returned with us to Edmonton. Mr. McLaggan had been instructed to arrange all details in connection with the transportation and care of the deer beyond Edmonton and had joined us at this point in order to further discuss matters with me before our arrival at Edmonton. I found that Mr. McLaggan had arranged with the Canadian Northern Railway Company to take our cars straight through from Edmonton to the end of the steel—some sixty miles—and that he had a corral built at that point and a camp established with some of his men in charge, so that the deer could be promptly unloaded and taken from there to Athabaska Landing where scows were waiting to take them to their final destination. The only difficulty about these arrangements was that no provision had been made for a sufficient delay at Edmonton to permit of the purchase of the supplies which would be required by the herders and which must be taken with them to Fort Smith. It had originally been my intention to purchase these supplies myself upon arrival at Edmonton, but my experience at Quebec had very forcibly illustrated the undesirability of one man's attempting to do too many things in a limited time. I had suggested to you at Smith's Falls that it would be a good idea to forward a list of the required supplies to Mr. McLaggan so that he could have all the purchases made and the goods ready to be shipped with us. You had sent such instructions to Mr. McLaggan on the 20th September, together with a list of the required supplies, but these instructions failed to reach him until after our arrival at Edmonton and arrangements had then been made for sending us on at once; in fact an engine and crew were waiting to take us on at once, so that it was practically out of the question to make any further delay at Edmonton. The only alternative was to make the purchases at Athabaska Landing and this course was finally decided upon.

The cost of the supplies at Athabaska Landing was considerably higher than at Edmonton and it subsequently proved impossible to procure some articles at any price, but against this must be considered the cost to the Department of freighting the supplies by wagon from the end of the steel to the landing, a distance of some fifty miles over a very rough road, and the difficulty of securing a sufficient number of wagons for this purpose in the short time at our disposal. Taking all the circumstances into consideration the increased first cost of the supplies is of comparatively little importance. I regret, however, that the herders themselves had to pay the higher prices for the articles of clothing, etc., which they had to purchase for their long stay in the North. This was particularly hard on the chief herder, Gear, who, being married, had to make more extensive purchases than the others.

I saw the Hon. Mr. Oliver at Edmonton and reported to him regarding the shipment up to that point; he had previously given personal instructions to Mr. McLaggan regarding the arrangements beyond Edmonton. Mr. Oliver saw the deer and the herders and gave instructions to rush the shipment through as fast as possible and to procure and take with us a supply of closely-woven fencing wire for making a corral

at Fort Smith to protect the deer from dogs. He also authorized me to have the head of one of the does that had died mounted by a taxidermist at Edmonton and shipped to Ottawa. All these arrangements were carried out and we left Edmonton at noon on the 26th September. The journey by rail up to this point had covered 2,425 miles, and the elapsed time was seven and one-half days, a remarkably good run when it is remembered that the running time of passenger trains between the same points is about four days. Every possible consideration was shown us by the officials of both railways.

EDMONTON TO END OF STEEL.

Leaving Edmonton at noon on the 26th September, we had an uneventful run to Morinville, some twenty-two miles north. This is the farthest point to which the road

Photo E. F. Drake, 1911.

Reindeer in Corral at End of Railway.

is open for traffic. At Morinville we were joined by Mr. A. A. Wocks, who has charge of the construction of the line beyond that point, and he accompanied us to the end of the steel. About four miles north of Morinville our baggage car ran off the track and the front truck was torn off; this delayed us about two hours. The road-bed was in pretty bad shape and we ran quite slowly, not caring to risk any more derailments. About dark we stopped at one of Mr. Wocks' construction camps where we had supper and watered and fed the deer. The stag which had been sick for several days died here and the carcass was left with Mr. Wocks. This head was useless, as the horns had been removed before leaving St. Anthony. Resuming the journey about eight o'clock we ran very slowly all night, averaging about three miles an hour, and reached the end of the steel about daybreak. Six puppies were born during the day, so that now, in spite of the loss of one dog, we have eight, although the new arrivals will be more ornamental than useful for some time.

BY WAGON TO ATHABASKA LANDING.

We found awaiting us at this point Mr. J. A. Dunn and Messrs. Leslie, Graham, and Hayward, all of whom are fire-rangers in the employ of the Department and who had been sent to build a corral and make other arrangements for our further journey. Mr. Dunne has been in charge of the fire-ranging in Jasper Park, while the others are the captain, engineer and cook, respectively, of fire patrol steamer No. 1, which the Department operates on the Athabaska river.

The builders of the corral evidently overestimated the size of the reindeer, as they had built a pole structure capable of containing moose or elk, but quite unsafe for reindeer. Considerable work was required to get the corral into shape to safely hold the deer, but this was accomplished in about an hour and the deer were then unloaded direct from the cars to the corral, which was on a bank a few feet above the level of the track.

Mr. McLaggan left by team at 9.30 a.m. for Athabaska Landing to arrange for suitable pens to be built in the scows and to try to get the crews together so that there would be no delay when the deer arrived. He took Mrs. Gear with him, at my suggestion, as we had no suitable accommodation for her in the camp and she could make the journey more comfortably with him than with us.

Mr. Dunn left camp about ten o'clock to engage teams to be on hand at daybreak of the following day and to purchase a load of green oats to be fed to the deer in order to save the small supply of moss remaining on hand. We had not previously fed anything but moss, but had found that the deer would eat green poplar and willow twigs and leaves and had resolved to experiment with green oats. I may add that the experiment proved entirely successful, as the deer seemed to relish the oats and we could not see that any ill effects resulted from the change of diet. We procured a further supply at Athabaska Landing for use on the trip down river. We spent the day in arranging our baggage in suitable shape for loading in wagons and in making halters to lead the ox deer. Mr. Dunn returned towards evening, having been successful in engaging ten teams.

Shortly after daylight on the morning of 28th September the first team arrived and we at once commenced to build crates inside the wagon boxes, to prevent the deer from jumping out and to keep them from being knocked about too much on the rough journey. The crates were merely slatted extensions making the wagon boxes about five and one-half feet high, enclosed by slats on top and divided into two compartments, fore and aft. From two to three deer, according to size, were placed in each compartment, so that each wagon accommodated from four to six deer. There were forty-two deer at this time, but four were oxen, broken to drive, and these we intended to lead, so that accommodation had to be provided in the wagons for thirty eight; this required eight wagons. It had been suggested that the ox deer be led in front and the others driven after them, but, as the road for the entire distance runs through a bush country and as the deer were excited and strange to the country, it was considered safer to haul them than to risk delay and probably loss by their straying off into the woods.

A good deal of trouble was experienced in getting the deer loaded. All possible arrangements had been made to facilitate matters and a chute had been built so that the wagons could be backed directly up to the corral, but in spite of this it was found necessary to rope each deer and lead, or partly carry it into the wagon. There was so much trouble about the loading, the deer became so much excited and the loading took up so much time that we decided not to unload again until we could do so directly into the scow at the Landing on the evening of the following day. We concluded that, while the close confinement in the wagons was apt to prove injurious, it would be less so than the excitement and handling incident to unloading and loading again from an open corral where the conditions for handling the deer were even less favourable than at the original point of loading.

About eleven o'clock a.m. we finally got started with eight loads of deer and two loads of baggage, leaving one load of lumber, moss, &c., to follow by a team to be engaged later. After travelling about seven miles we unhooked for dinner at Stony Creek, and here I was fortunate enough to be able to hire a team to bring on the supplies we had left behind. We left Stony Creek at about 2 p.m. and reached Lewis' stopping place about 7 o'clock, having made about twenty-two miles. Mr. McLaggan met us about five o'clock, having completed the arrangements respecting the scows and crews. The roads were very rough and the deer had been pretty badly shaken up, but most of them were found to be in good condition and quite ready to feed when the usual supply of moss was put into their cages. One doe was found to be in bad shape, probably due to having been knocked down in the pen and trampled upon by the others. In order to relieve the overcrowding in some of the cages and to prevent similar injury to other deer Mr. McLaggan hired an additional team and we transferred three of the does to it, giving the sick one the rear pen to itself. Two of these deer recovered within a day or two, but the one that had been trampled died on the 29th September.

The following morning (29th) we started at 6.30 o'clock. Mr. McLaggan and I went ahead with a light team and reached the Landing about noon—distance about twenty-five miles. We spent the afternoon in completing the arrangements for our further journey and in purchasing supplies. Mr. McLaggan looked after the scows and crews and I made most of the purchases. The order for provisions was divided between the Hudson's Bay Company and Revillon Bros., while most of the hardware was purchased from Mr. F. R. Falconer. We were able to procure almost everything required, but unfortunately could not obtain any butter and only a small supply of potatoes and onions. Provisions for one year were purchased and a pretty complete outfit of hardware and camp equipment, so that upon arrival at Fort Smith the party should be able to maintain itself comfortably until the supplies can be replenished next year.

The deer arrived about five o'clock in the afternoon, apparently none the worse of their rough trip in close confinement, and were immediately loaded on the scows. The scows are about fifty feet long by ten feet wide and a space of about twelve feet in the middle of each had been converted into a deer pen by means of 2 in. x 4 in. uprights and 1 in. x 3 in. boards, making a pen about six feet high. Sliding bars had been left on the side of each pen and the wagons were backed into the water to the side of the scows and the deer unloaded without any trouble; in fact the handling at this point was much easier than at any point throughout the trip.

BY RIVER FROM ATHABASKA LANDING.

On the following day (30th) the supplies purchased on the preceding day were delivered and loaded and by mid-afternoon all was in readiness to start, except that the load of moss, &c., which had been left behind at the railway had not arrived. There had been a heavy rain during the night and the roads, which at the best are bad enough, must have made the hauling slow and heavy. However, the delayed load arrived about six o'clock and was promptly transferred to the scows. Some further delay ensued, owing to the difficulty experienced by the captain and pilot in rounding up the boatmen. The four scows finally got away about seven o'clock and shortly after eight Mr. McLaggan and I followed in the steamer. We overtook the scows within about half an hour and took them in tow, continuing until about nine o'clock when we tied up for the night at a point about seven miles from the Landing.

We were very fortunate in getting away from Athabaska Landing with so little delay, as even firms such as the Hudson's Bay Company usually find it difficult to control their crews and two or three days often elapse before they can be got together and started on such trips. Moreover, had we not got away on Saturday night we would have been compelled to wait until Monday, as we would not have been permitted to start on Sunday.

The arrangements respecting the shipment had so far been carried out without mishap, but at this point the first serious difficulty occurred. The contract for taking the scows down the river from Athabaska Landing to Fort Smith had been made with Captain Shot, an experienced and reliable river pilot. The agreement provided that Captain Shot was to be paid a fixed sum per scow and in return for that he was to furnish a pilot and crews and arrange for their subsistence and to personally take charge of and accompany the party. At the last moment Captain Shot informed us that, owing to the sudden and severe illness of his wife, he would not be able to go. There is no reason to doubt Captain Shot's good faith, as he has the reputation of being one of the most reliable rivermen in the north. Captain Shot placed the scows and crews in charge of Philip Atkinson who had already been engaged by him as pilot, and he also sent one of his own sons to assist and to pilot the steamer back up river. The arrangement worked very well as far as I accompanied the party and Philip Atkinson has the reputation of being quite as competent a river pilot as Captain Shot, but some difficulties arose later over the terms of engagement of the crew.

On the following morning (1st October) we re-arranged some of the loads and trimmed the scows so as to make towing easier. Just as we were about ready to start we met Mr. F. J. P. Crean, an engineer in the employ of the Department, who was returning to civilization after some eighteen months of northern travel. Mr. Crean and his party, which included Mrs. Crean, were travelling by one of Mr. Jas. Cornwall's steamers, which stopped for a few minutes to permit us to exchange greetings and the latest news. We again started down stream about 8.30 o'clock and made good progress until about eleven, when we stuck hard and fast on a mud bar. After trying unsuccessfully for an hour or more to extricate ourselves from this unpleasant situation, without other result than to get more firmly imbedded in the mud, we finally cut the scows loose and, one by one, poled them off the bar and sent them adrift with a crew of two men each. About two o'clock we managed to work the steamer free and again started down river, picking up the scows as we passed them. We tied up for the night at Calling river, having made, in all, some forty-eight miles.

The next morning we got away about seven o'clock and ran steadily all day arriving about dark at Bentley's trading post, about a mile above Pelican rapids. There is a flowing well of natural gas near the river bank at this point which has been burning more or less steadily for some twelve or fourteen years. I understand that the gas was discovered and tapped by some men who were boring for petroleum several years ago, and that efforts have since been made to stop the flow, but without success. At present the gas is escaping from a pipe some two inches in diameter a couple of feet above the ground and the flame shoots into the air some thirty or more feet. It is quite spectactular, especially at night, and is evidently a favourite camping place for river men and others.

We were advised by Mr. Bentley that it would not be safe for us to take our steamer further down the river, as the water was low and still falling and we would find it difficult, if not impossible, to come back against the current. Whether or not Mr. Bentley overestimated the difficulties of the return journey I don't know, but after thoroughly discussing the whole situation Mr. McLaggan and I concluded that it would serve no useful purpose to take the steamer further. Up to that point we had been able to tow the four scows at the rate of about seven miles per hour, but from Pelican rapids onward the current becomes swifter, although there are intervals of slack water, and the scows should be able to make fair time by the use of sweeps. In any case we could only go as far as Grand Rapids, some sixty miles farther down, and the time saved would not, in our opinion, have justified the risk of having to leave the steamer so far down river for the winter. We decided, therefore, to turn back with the steamer and to send the scows on in charge of Mr. J. A. Dunn, with Philip Atkinson as pilot.

The morning of the 3rd October was spent in again rearranging the loads of the scows so as to facilitate rowing and steering and about noon the four scows started

on the last stage of their journey. A tent had been put up for Mr. and Mrs. Gear on the stern of the leading scow and a cooking stove set up in it. Mr. Dunn and the two herders, McNeill and Broomfield, also found sleeping accommodation on this scow and it was arranged that Mrs. Gear would cook for the party. Philip Atkinson took personal charge of this scow.

The difficulty over the engagement of the crews, to which reference has previously been made, first came up here. Atkinson reported that Capt. Shot had only engaged the men to go as far as McMurray, some one hundred and forty miles below Pelican rapids. For the further journey of some two hundred and fifty miles from Fort McMurray to Fort Smith Capt. Shot had agreed to take down some packages of freight for Colin Fraser, a down-river trader, and in exchange for this service Mr. Fraser was to have towed the scows on from McMurray with his steamer. Through some oversight or misunderstanding the freight for Mr. Fraser was not taken on at Athabaska Landing and, consequently, there is no reason to suppose that Mr. Fraser would be willing to carry out his part of the bargain. Mr. McLaggan had previously procured for Mr. Dunn a letter of credit on the Hudson's Bay Company for five hundred dollars, to provide for any emergencies that might arise and he now authorized Mr. Dunne to engage new crews at McMurray, should it become necessary, or to arrange with Colin Fraser, or any other steamboat owner, to tow the scows on from that point. Any payments made by Mr. Dunn for such service were to be reported at once to Mr. McLaggan in order that the amount might be deducted from the contract price to be paid to Captain Shot. This was the only arrangement that could be made under the circumstances and I can only express the hope that it worked out satisfactorily. It was our intention to take this matter up with Captain Shot on our return to Athabaska Landing, but he was not in the village when we got back.

At 12.30 p.m., Mr. McLaggan and I started on the return journey on the fire-patrol steamer and reached Athabaska Landing at 9 p.m. on the 5th October. The actual running time on the return journey was thirty hours and the distance one hundred and twenty miles, which is not bad time for a small steamer against a strong current. On the trip up river we met Mr. Goodspeed and Mr. Tibbetts, engineers of the Public Works Department, going down in a canoe with two Indian paddlers to inspect the channel improvement work at Grand Rapids.

I was, fortunately, able to secure passage in the semi-weekly stage which left Athabaska Landing on the following day (6th October) and reached Edmonton on the evening of the 7th. Mr. McLaggan was delayed in the Landing paying some accounts and did not leave until later in the day, arriving at Edmonton on the 8th. I left Edmonton on the night of the 9th and, after spending one day in Calgary, reached Ottawa on the morning of the 14th October.

GENERAL.

I believe I am right in assuming that this shipment of fifty deer was intended merely as an experiment with a view to determining two things: first, if the deer would stand such a long, hard trip at this season and, second, if suitable feeding ground could be found for them in the vicinity of Fort Smith and if the deer could be protected from dogs and Indians. While we have not yet received reports of the final stage of the journey we have sufficient information to justify the statement that these reindeer have proved themselves excellent travellers and, barring such an accident as shipwreck in the rapids, there is every reason to suppose that at least forty of them will safely reach their destination. Had it not been for disease due to the gypsum the loss would have been trifling, probably not more than two or three, and this in spite of the fact that the shipment was made at a peculiarly unsuitable season. The rutting season generally begins between the tenth and twentieth of September and during its continuance the deer are more difficult to handle than at any other time. I do not know a great deal about the habits of reindeer but assume that the season,

in this instance, will merely be postponed until the deer reach their destination, about the middle of October, and that it will not be lost for the year. It will be unfortunate if no fawns are born in the spring of 1912.

Autumn is the only season when reindeer can safely be shipped over this route. In winter the drawback is that the northern rivers are frozen and the deer could not well be taken beyond Athabaska Landing; in early spring the does are heavy with fawn and later are suckling their fawns, while in summer the great heat would probably prove disastrous.

With regard to feeding grounds I made careful inquiries from men familiar with the north country and am informed that there is an abundance of deer moss within reasonable distance of Fort Smith, or Smith Landing, particularly the latter, and that it is plentiful over practically all of the north. We found quite a good deal of moss near our camp at the end of the railway and picked several sacksful there for the deer; we also noticed it at many points along the road to Athabaska Landing and along the river, so that there seems to be absolutely no doubt of a plentiful food supply.

The question of protection from dogs and Indians will depend very largely upon the good judgment and watchfulness of the herders and cannot be determined until further reports are received next year. In my opinion the deer camp should be established at least fifteen to twenty miles from any settlement and if this is done and reasonable care shown there is no reason why the experiment should not succeed.

In the event of the experiment proving reasonably successful I would strongly recommend purchasing about two hundred more deer, chiefly young does, and shipping them in early next fall. The number already purchased is not enough to justify the expense of keeping them and it will be many years before, from such a small beginning, a herd of reasonable size can be raised, but with a start of some two hundred does and about forty stags a rapid increase could be confidently expected, while the cost of management would remain about the same, as three herders could look after three or four hundred deer as easily as after forty. There is also the question of apprentices to be considered. It is understood that the herders now with the deer will train others to succeed themselves and that these apprentices, to be selected from Indians in the vicinity, will be housed, fed and clothed at the expense of the government during their time of apprenticeship. It would hardly pay to do this unless the herd were much larger and it is doubtful if a very small herd would sufficiently interest the natives to make them willing to take up the work. There is no doubt that by next September the Canadian Northern railway will be in operation to Athabaska Landing and that the whole trip from Newfoundland to Fort Smith can be covered within a month and probably with a very small percentage of loss.

As an alternative I would suggest attempting to capture and domesticate young barren-ground caribou which migrate southward to the vicinity of Fort Smith every winter. There is little difference between the species, except in the size and formation of the horns; if there is any difference in size the caribou are slightly larger.

PUBLIC INTEREST IN REINDEER.

All along the route from Quebec to Athabaska Landing great numbers of people came to the stations and looked at the deer and a good deal of interest seemed to be taken in the experiment, judging from the questions asked. The ear markings were the subject of a great deal of comment. All the deer were marked by a cropped ear, so as to permit of ready identification at a distance, but in addition to this each deer had an aluminum button, or disc, in the unmarked ear. These discs are marked with the year of birth and may also bear such addditional markings as will distinguish different families, or species, if required. Mr. Holt, of Quebec, was greatly interested in these discs and was of the opinion that he might advantageously use them to dis-

were safely brought across arriving at about two o'clock on the morning of October 27. his estate at Montmorency Falls. I may add that Mr. Holt very kindly offered the

use of a pasture at Montmorency Falls, so as to give the deer a chance to recuperate after their confinement on board ship, but, while I greatly appreciated his kind offer, I was unable to accept it owing to the necessity of getting through to our destination before the Athabaska river froze up.

HERDERS.

The herders were selected by Dr. Grenfell and their contracts for service were prepared and executed under his direction. Mr. Nathaniel Gear, the chief herder, is thirty-three years of age and was born at Groswater Bay, on the Labrador coast. He has lived at Cape Eliek, about 200 miles north of his birthplace, for the past fifteen years up to October, 1908, since which date he has been with Dr. Grenfell's deer herd at St. Anthony, Newfoundland. He learned the management of reindeer from the Laplanders who accompanied the original shipment of deer to St. Anthony and remained with them for two years after their arrival. For two years prior to his engagement by the government Gear was in charge of the herd. According to Gear's statement the herd purchased for Dr. Grenfell comprised 250 does and 50 stags and oxen and reached St. Anthony in December, 1907. Mr. Gear is married, but has no children. His wife accompanied him to Fort Smith, where she will cook for all the herders in return for free rations to be furnished by the government. Mrs. Gear is also a native of the Labrador coast.

William McNeill, the second herder, is twenty years of age and was born at Island Bay, on the northern part of the Labrador coast. He served a two years' apprenticeship with Dr. Grenfell's herd.

John Broomfield, the apprentice herder, was born at Groswater Bay and is twenty years of age. He served an apprenticeship of one year with Dr. Grenfell's herd.

All the herders are robust and apparently in perfect health and are thoroughly familiar with the handling of deer. They should be able to readily adapt themselves to the new conditions of life in northern Canada, as they have from childhood been accustomed to the hardships and vicissitudes of the life of hunter and fisherman on the inhospitable Labrador coast.

PHOTOGRAPHS.

I regret that I was unable to take good photographs of many of the most interesting incidents of the trip. It usually happened that there were so many other and more important things to be done at such times that I was compelled to forego the pleasure of using the camera. The pictures which accompany this report will, however, give a fairly good idea of the deer and of the conditions under which their long trip was made.

Appended hereto are a statement of the expense so far incurred in connection with this shipment, and a schedule of the supplies purchased and sent to Fort Smith.

Respectfully submitted,

E. F. DRAKE.

APPENDIX TO REPORT ON REINDEER SHIPMENT.

DEPARTMENT OF THE INTERIOR, FORESTRY BRANCH.
OTTAWA, March 31, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I beg to submit the following additional report respecting the reindeer experiment. This information has been obtained from letters and reports submitted by Mr. J. A. Dunn and Nathaniel Gear, and takes up the account of the journey from the point where my report of October 25, 1911, left off.

The party reached Grand Rapids, on the Athabaska river, about four o'clock in the afternoon of October 4, having run the sixty miles from Pelican rapids in about twenty-eight hours, including the time lost by tying up at night. The stage of water was very low and it was found necessary to transfer most of the freight and to reload below the rapids. The deer were not unloaded and all the scows went through safely.

Good progress was made until the morning of October 16, some 260 miles having been covered in this time. On this morning, however, a heavy head wind was encountered and the scows were blown into an eddy and it was found impossible to proceed. Strong winds, with snow and rain, continued until the 20th, the supply of moss ran short, the scows leaked badly from scraping over the rocks in the rapids, and six deer died.

On the 20th, the weather conditions improved and the party again got under way, making twenty miles during the day. They were also fortunate in being able to pick sixty sacks of moss for the deer. The following day they made a run of fifty miles, but on the 22nd and 23rd, head winds were again encountered and but ten miles were covered.

Lake Chipewyan was reached on the evening of the 25th, and, after waiting until nine o'clock at night for the wind to die out, an attempt was made to row two scows across to the Hudson's Bay Company's post on the north shore. The pilots proved incompetent and the scows were tied up to a root until morning. In the morning it was necessary to break ice for about half a mile before getting into open water, after which sail was hoisted and the remaining distance was covered in good time. The crews then returned to the mouth of the river for the remaining scows, which were safely brought across, arriving at about two o'clock on the morning of October 27,

Here the party were met by a steamer which had been sent up from Fort Smith to tow the scows down the Slave river to that point, a distance of some eighty miles. They left Fort Chipewyan at 4 p.m., on the 28th, and made about nine miles, when they ran on a sand-bar where they remained all night. The following forenoon was spent in getting the steamer off the bar and in the afternoon ice was encountered, so that only about seven miles were covered during the day.

On October 30 the river was frozen nearly across and there was so much ice in the rapids that the captain of the steamer refused to go any farther. The deer and freight were unloaded, the scows were drawn up on the bank and a permanent camp was established for the winter at a point some seventy miles south of Fort Smith and about twelve miles from Fort Chipewyan. There is an abundance of moss for feed and the camp is sufficiently removed from any settlement to insure safety from dogs.

Mr. Dunn remained with the herders until a comfortable cabin had been built and the men and stores safely housed, after which he returned to Edmonton, the greater part of the journey being accomplished on snowshoes with a dog team.

The deaths occuring during this stage of the journey were as follows:

October	18th	2 does
"	19th	3 "
"	20th	1 doe
"	30th	1 "
"	31st	1 "
November		1 ox deer
	Total	9

There are now thirty-two deer remaining out of the original fifty, viz.: 24 does, 5 stags and 3 oxen, and the latest reports show that they have wintered well and are in much better condition than when they left St. Anthony.

The difficulties encountered between Grand Rapids and Fort Chipewyan were due, chiefly, to the fact that the scows were under-manned. When travelling in slack water or against head winds, there were not enough men to handle the scows, in spite of the fact that Mr. Dunn and the three herders worked at the sweeps. This delayed the party and there was further delay due to lack of energy on the part of the crews, but this last is always to be reckoned with when dealing with halfbreed boatmen. The stock of moss and green oats taken from Athabaska Landing would have been sufficient to last for the whole journey if it had been accomplished in reasonable time. The death of the eight deer in the latter part of October was directly due to this delay and the consequent shortage of feed.

Reports received from the Departmental Agent at Fort Smith indicate that suitable grazing ground and abundance of reindeer moss may be found within about fifteen miles of that point and the deer will be transferred there as soon as spring opens—probably about the end of May. From present indications there will be no fawns born this spring, owing, no doubt, to the close confinement and long journey during the rutting season last fall. This is greatly to be regretted, but could not be avoided.

Respectfully submitted,

E. F. DRAKE

IRRIGATION

26113—12

Photo R. J. Burley, 1911.

Irrigated Barley on Enright & Strong Project.
Tp. 6, Rg. 23, west of 3rd Meridian.

No. 38.

REPORT ON IRRIGATION.

DEPARTMENT OF THE INTERIOR,
IRRIGATION OFFICE,
CALGARY, April 20, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry and Irrigation,
Ottawa.

SIR,—I have the honour to submit herewith my annual report of the work done under my charge during the year 1911 on Irrigation and Canadian Irrigation Surveys.

I have the honour to be, sir,
Your obedient servant,

F. H. PETERS,
Commissioner of Irrigation and Chief Engineer.

REPORT ON IRRIGATION AND IRRIGATION SURVEYS,

BY

F. H. Peters, A.M. Can. and Am. Soc. C.E., D.L.S., A.L.S., Commissioner of Irrigation.

It may be said with certainty that the general public does not realize the great importance or the large scope of the work which is being carried on by the irrigation office at Calgary. In an endeavour to correct this, attention is drawn to the fact that during the season 1912-13 twenty-two civil engineers will be employed on the staff, and, to mark the significance of these figures, it should be noted that this is the largest engineering staff connected with any one office of the Dominion Government except the office of the Public Works Department at Ottawa. Another significant fact is that the irrigation office carries on its property returns 45 horses and the necessary equipment of wagons, &c., all of which are used during the summer in carrying on the field-work.

The irrigation office may well be said to be the guardian of the water resources of the provinces of Alberta and Saskatchewan, and this naturally carries with it great responsibilities. Much of the work done by this office must necessarily be for the benefit of future generations, and this, unfortunately, does not tend to make the work popular with the people of to-day. This is especially true of the work of stream measurement that is being carried on, and, because there is plenty of water for everybody to-day, even the most interested parties, who are themselves licensed by the government to use water, do not appreciate the work and do not realize that a perfect system of stream measurement means a perfect safeguard to their water-rights in the future, and that every dollar spent to-day in prosecuting this work means many dollars saved in the future in the prevention of litigation that must arise if the load that is placed on every stream is not carefully guarded to-day. Our neighbours to the south have learned this lesson by costly and bitter experience, and we may, if we will, profit by their experience and avoid the mistakes which they made during the earlier days of irrigation development.

The work has been carried on as efficiently as possible, and with due regard to economy, but a considerable increase in the appropriation is necessary if the work of administration of water resources is to be carried on in a manner commensurate with its importance.

GENERAL INFORMATION REGARDING IRRIGATION IN ALBERTA AND SASKATCHEWAN.

The irrigation office has jurisdiction over all water-grants made in the provinces of Alberta and Saskatchewan (except grants for water-power purposes, which are handled by a separate branch) and it can be easily understood that the patrolling of this vast area requires a large staff and a sound organization.

The remarks here following relate almost entirely to the work of irrigation inspections. The work done by this office naturally divides itself into two separate branches: irrigation inspections, together with reservoir site surveys, &c., and the stream measurement work. The two are closely associated and must go hand in hand, but are submitted separately in order to keep down the bulk of each volume, and also because the report of progress of stream measurements is nearly all composed of tables of gauge-heights and discharges and is more fittingly published in a separate report for convenience of reference; a brief, general report on stream measurements is, however, appended hereto.

The two provinces cover an area of 504,190 square miles and extend for 540 miles east and west and 420 miles north and south.

The province of Alberta includes an area of 253,540 square miles, made up of 251,180 square miles of land and 2,360 square miles of water. The province of Saskatchewan includes an area of 250,650 square miles made up of 242,332 square miles of land and 8,318 square miles of water.

In order to give an idea of the extent to which irrigation is now being carried on in the western provinces the following brief summary is given.

The total amount of water granted by the Dominion Government in the two provinces is 23,865 cubic feet per second. Of this total amount 23,536 c.f.s. have been granted for purposes of irrigation, leaving 329 cubic feet per second divided up between the other three classifications; that is, domestic, industrial and other purposes.

In Alberta the total amount of water granted for irrigation purposes is 23,114 c.f.s., or enough to irrigate 3,467,100 acres of land, according to the authorized duty of water which is 2·023 acre-feet per acre.

Of this quantity four large companies have 22,500 c.f.s., leaving 614 c.f.s. divided up among 320 individual users; excluding from these 24 applicants who each have an average grant of about eight c.f.s., we get figures for the average individual water user, viz.: 414 c.f.s. divided up between 296 individual users, which gives each one 1·40 cubic feet per second, or enough to irrigate 210 acres of land.

Of the four large companies mentioned above, the following facts may be stated. The Canadian Pacific Railway Irrigation Company has been granted from Bow river, near Calgary, 3,000 c.f.s. at low-water stages, 13,000 c.f.s. at high-water stages, and 15,000 c.f.s. at flood stages. It has approximately one million acres of irrigable land, and already has issued over 1,500 agreements to furnish water to settlers within this tract.

The Alberta Railway and Irrigation Company has been granted from Belly river 500 c.f.s. at all stages of flow, from Milk river 500 c.f.s. at low-water and 1,500 c.f.s. at high-water and flood stages, and from St. Mary river 500 c.f.s. at low-water and 2,000 c.f.s. at high-water and flood stages. It should be noted, however, that the total amount of the grants from Milk river and St. Mary river have been somewhat modified under the terms of the International Waterways Treaty recently made between

Canada and the United States. This company has already issued water agreements to over 800 water-users.

The Southern Alberta Land Company has been granted from Bow river 2,000 c.f.s. at high-water and flood stages, and from the South Saskatchewan river 1,000 cubic feet per second at all stages. This company has developed a very large reservoir for the storage of flood waters, in order to utilize its high-water and flood license from Bow river. The works are not yet completed and therefore the company has not as yet entered into any agreement to supply water to actual users. The company controls about 400,000 acres, about half of which is irrigable.

The Alberta Land Company, operating as a subsidiary company to the last named company, and diverting water through its works, has a grant of 500 c.f.s. from the Bow river at high-water and flood stages. The works of this company are not yet completed.

In the province of Saskatchewan irrigation has not been undertaken to nearly the same extent as in the province of Alberta, and it has no large irrigation companies. There has been granted to date in Saskatchewan, for irrigation purposes, 423 cubic feet of water per second, and this quantity is divided among 241 individual users. This gives each one an average of 1·75 cubic feet per second, or enough to irrigate 262 acres.

In an endeavour to give some idea of the irrigation work that is now being carried on, the map published with this report has been prepared to show the position of the intake of each of the smaller schemes and also the territory covered by the large schemes. This map covers practically all the territory where irrigation is carried on, and by referring to it and to the above mentioned figures, it will be possible, with a few minutes' study, to get a fair idea of the size of the territory to be covered and of the area of land which is being irrigated.

PROCEDURE FOR GRANTING WATER LICENSES.

The work required in connection with irrigation inspections will not be well understood by those unfamiliar with the work, and, to outline in a few words what this work comprises, the following brief summary is given.

Licenses are granted by the Dominion Government, under the administration of the Minister of the Interior, for the use of water, under the following classification:—

1. Domestic uses.
2. Industrial uses.
3. Irrigation purposes.
4. Other purposes.

Industrial grants are given for the purposes implied by the name, but do not include the sale or barter of water. Where the sale or barter of water is concerned, the grants are classified as for 'other' purposes.

The procedure followed in granting water-rights is, briefly, as follows:

Any applicant for a water-right must first submit a memorial setting forth the purposes for which the water is required, and, accompanying this, must be general and detail plans showing where, and how, and for what purpose, he intends to use the water and what works he intends to construct or install. The next step is an inspection of the scheme by one of the government engineers, who reports upon the feasibility of the scheme, the question of water-supply and the character of the works to be constructed. The proposed scheme is then advertised in a local paper for six weeks, in order to give the local public notice of what is proposed and what water-supply and lands will be affected. Any protests which may be made against the proposed scheme are carefully investigated. Authorization is then issued for the construction of the necessary works, and a limit of time is placed within which the construction must be

completed. The Department's engineers inspect all schemes periodically during construction, and, finally, after the works have been satisfactorily completed and inspected, the water license is granted.

DIFFICULTIES IN CARRYING ON THE WORK.

In case any person should be interested enough to consider the size of the staff employed to do the work required, and to make a study of the cost of the work, it is only fair to the organization to detail here some of the difficulties met with in carrying on the work. These may be generally stated as the great area to be covered, the difficulties of transportation, and the great variety of the inspections to be made. For instance, in the Maple Creek district, where a great many new schemes are being constructed at present, an inspection party starts out from Maple Creek and, perhaps after a twenty-mile move, has to make a complete survey of a new scheme, including in many cases a right-of-way survey over lands not owned by the applicant for water-right. As soon as this is finished the party will probably have to make a day's, or half a day's, move to a scheme which requires only an eye inspection by the officer in charge, and so the work goes on. A minute's consideration of this briefly sketched programme will bring forth clearly the two great factors of apparent waste; that is to say, a great deal of time is taken up in travelling about from place to place and, on account of the great variety of the inspections required, it is not possible to always keep all the men usefully employed. The party must be large enough to efficiently survey and inspect the larger schemes and is, therefore, at times unnecessarily large for some of the work required. This difficulty cannot be avoided, as, unless each party takes all the schemes that are in the same neighbourhood as they come, the waste of time in travelling would be out of all proportion to the work accomplished.

Again, take the case of the engineer for special inspections. This officer inspects the many schemes that are scattered all over the two provinces and these are so widely separated that he has to travel by train from place to place. He may have to travel half a day by train and then waste half a day in the hotel waiting to get an early morning start in order to make a long day's drive to some scheme thirty or forty miles from the railroad. Upon arriving at his destination he probably finds that he requires the assistance of a man or two to make a chained traverse of a scheme, and he may have to spend half a day getting these men from a neighbouring ranch or farm and then when he does get the men they, being unaccustomed to the work, naturally make very clumsy and slow assistants. To complete the inspection there still remains the long drive back to the railway and possibly another half day wasted in the hotel waiting to catch a train on to the next point. All of these factors combine to increase the cost of inspection work, but this is unavoidable under present conditions. The engineer assigned to this class of work must be a man of wide experience, as within a brief period he may have to inspect an irrigation scheme, a railway water-tank scheme, or a town water-supply scheme; his services are very often required as an arbitrator between the interests of some town wanting a water-supply and a number of persons who fear that their domestic rights from a certain stream are being encroached upon.

The difficulties met with by the office end of the organization at Calgary are those of directing the work which is being carried on at such distances and, in many cases, in localities where the mail facilities are very poor; and again those of studying the never-ending questions of the adequacy of the water-supply from a given source, which, in many cases, owing to the lack of records of stream-flow, present problems that are well nigh impossible of definite solution.

Another great difficulty that is met with by the office staff is that the Commissioner, or his assistant, must examine and approve the design of the works and lay-out of every scheme that is submitted. In almost every case the question arises where to draw the line between insisting on permanent, and therefore expensive, works and

those of a temporary nature which are within the limit of the applicant's means at present. In the first case the necessary expense of the works may be unduly burdensome upon the applicant, while in the second case it is usually found that if temporary works are once allowed it is almost impossible to get the irrigator to improve the works at a later date when he is able to afford the expense. Another separate study for each case is the class of material, particularly for dams, that is within the means of the applicant in any particular locality.

DIVISION OF WORK INTO DISTRICTS.

The work of inspection is divided into two districts within which the bulk of the work lies, viz.: the Maple Creek district and the Calgary district; the other schemes, which are widely scattered, are inspected by so-called special inspectors.

The Maple Creek district is under the especial charge of a division engineer, who has under his control two assistant engineers, each with a field-party working under his direction. The Calgary district is patrolled by one district engineer with a small party. Separate reports are appended from these two officers, as well as from the special-inspections engineers, and, as these officers take up in detail the various points in connection with their districts and work, and also describe the limits of the several districts, no further mention of them need here be made.

DETERMINATION OF THE LOW, HIGH AND FLOOD DISCHARGE OF STREAMS.

In order that the following may be intelligible it is necessary to explain the procedure in granting water-rights against any stream or other source of supply. The procedure is to consider that every stream has three separate stages of flow; that is to say, low-water stage, high-water stage and flood stage, and each water-license is issued against a specified stage of the stream flow.

This procedure will be made clear by the following illustration. Suppose a creek has a low-water, high-water and flood discharge between the limits, respectively, of 0 to 10, 10 to 30, and 30 to 50 cubic feet per second. The first licenses against the stream will be issued for 'all stages' of flow until the total of 10 c.f.s. is reached. The next licenses will be issued for 'high-water and flood' stages until these, together with the 'all stages' licenses, reach the total of 30 c.f.s. After this any licenses that may be issued will be for 'flood' stages, until the total of all the licenses reaches the maximum of 50 c.f.s., after which all applications for water-licenses against the stream will be refused.

Now, in order that, under average conditions, there may always be enough water in the stream to fulfil the obligations of all the licenses issued, it is clear that the records of this office must show definitely the quantity of water in the stream, under such average conditions, at the three stages above mentioned. It is also clear that it is a most difficult matter to determine accurately the flow of the stream at the three respective stages; in fact, these figures can only be determined with even a fair degree of accuracy after a long series of stream measurements has been carried on on each stream. It is at this point that the work of stream measurements is indivisible from the work of irrigation inspections.

At the present time the quantities for all the streams, shown against the stages of low, high and flood discharge, are most inaccurate, as they indeed must be, because at the time when they were computed several years ago practically no continued series of stream measurements had been made.

During the present winter the matter of determining these quantities with some degree of accuracy is being actively taken up. The Department now has fairly complete records of stream-flow on several streams from the year 1908 to the year 1911,

inclusive, and on most of the important streams used for irrigation purposes the records of stream measurement date back to 1909. The procedure being adopted is as follows: A separate sheet is being prepared for each stream and on this is being plotted as a profile the mean monthly discharges for all the years during which records have been obtained. The profile for each year is plotted with a different coloured ink, so that the different years can be readily distinguished. After a careful study of each sheet two horinzontal lines are drawn across the profiles showing the three stages of flow as arbitrarily determined from the study. The horizontal lines are drawn only in pencil, so that at some future time, when more records of stream-flow are available, they may be shifted if necessary to more accurate positions as shown by the increased length of the period over which the stream measurements have been gained.

This arbitrary determination of the stage of the streams is a most important matter, as, if these determinations are in error, the streams will either be over-recorded or under-recorded. In the first case, the existing rights of the first license will be jeopardized, and, in the second case, applications will be refused when sufficient water is really available and might be put to beneficial use for irrigation or other purposes.

OFFICE WORK.

A great deal of office-work is required to keep the hydrographic records up to date and in proper shape. To understand this, it should be realized that about 130 cards of gauge-height observations are received at this office each week from the various gauge-height observers. These cards all have to be checked over and the information taken from them and noted on the proper office-forms for purposes of record. A good deal of correspondence springs from this source in writing to the observers to get records submitted which have been overlooked, or in order to get satisfactory explanation of gauge-heights that cannot, perhaps, be deciphered in the office. Again, all the hydrographers are required to send in their note books of stream measurements as they are filled up, and these, also, have to be checked and then filed away so that the information may be readily available for the hydrographers when they return to the office in winter for the purpose of working out the records from their summer's field-notes.

The office staff, generally, has throughout the past season been overworked, owing to the fact that the staff employed was not large enough to handle the work properly. This is a most undesirable state of affairs as it does not lead to, or allow of, the best work being done. When everything has to be rushed through in a hurry, as has been the case, mistakes and slips are bound to occur, no matter how great effort is made to avoid them.

The following list gives a summary of the correspondence, plans, documents, &c., that were handled in the office during the fiscal year ending March 31, 1912.

Letters received	6,939
Letters sent	10,660
Applications for water-rights recorded	67
Plans with applications for water-rights (in duplicate)	67
Right-of-way easements recorded (in triplicate)	32
Transfers of applications recorded (in triplicate)	25
Right-of-way plans recorded (in quadruplicate)	32
Water agreements filed (in quadruplicate)	181
Notices of cancellation of water agreements (in triplicate)	77
Notiees of transfer of water agreements (in triplicate)	20
Applications to cross road-allowances recorded	41
Applications for free right-of-way over Crown Lands recorded.	36
Notices for publication prepared	67

Plans prepared	466
Blue-prints made	1,161
Certificates issued under Section 20 of the Irrigation Act	62
Certificates issued under Section 33 of the Irrigation Act	39
Number of licenses recorded (in triplicate)	51
Reports received and dealt with	492
Weekly reports received from Engineers	670
Reports of discharge measurements (Form H. 4) received	1,490
Weekly reports of gauge heights (Form H. 2) received	4,200
Descriptions of regular gauging stations (Form H. 1) received	130
Reports of changes at River Stations	57

DIFFICULTIES AND DEFECTS IN THE SYSTEM OF IRRIGATION FARMING.

It may not be out of place here to draw attention to some of the troubles and faults that are experienced in connection with the average irrigation schemes of to-day.

Without wishing to cast any reflection on the science of dry farming, it may truthfully be said that irrigation farming is certainly a scientific work, and a general fault that is found is that the average irrigation farmer does not understand the proper methods of applying the water to his land. With the fixed idea in his mind that the thing to do is to put water over his land he proceeds forthwith to do this, without any thought of consulting the requirements of any special crop, and very often without any study of the natural features of the ground that lend themselves to the spreading of the water over the land. He thus very often works against nature instead of with her, gives himself much extra, and very often wasted, work, and then, when the harvest season comes, says to himself, 'I have irrigated my land; why have I not raised a bumper crop?'

This procedure being carried on for several years naturally tends to depreciate in the farmer's mind the benefits that are reaped from the proper irrigation of field crops, and hence it is found that in many districts, and, almost, it may be said generally, the great benefit that might be reaped from a properly conducted irrigation of field crops is not realized or understood.

Another serious drawback to irrigation in many sections of the west, and one which is not the farmer's fault, is the very changeable seasons that are experienced in the matter of rainfall. In many of the southern parts of the United States where irrigation flourishes, the climatic conditions are practically a constant. The farmer can rely upon almost a fixed number of hours of dry weather with an abundance of sunshine, and he can thus determine in advance when he will have to apply water and how much he will have to apply. This is not the case in Alberta and Saskatchewan. As a citation of a good example of this, the season of 1910 was so dry that many fields of grain were withered before they could mature; on the other hand the season of 1911 was so wet that the period of growth was prolonged and much of the grain was frostbitten before it could mature, and the country in general suffered from a late harvest. The irrigation farmer has, therefore, to watch the weather with the greatest care and, although he may not need them, has always to keep his ditches ready for instant use. Unfortunately, however, it has been found that during the wet seasons the irrigator allows his ditches to fall into a state of more or less disrepair and leaves them this way during the next season, and perhaps the next, until some day his crops are in urgent need of water, when his ditches are found to be in such a bad state of repair he cannot run the water through them on his land and therefore suffers a crop failure as the result.

Another point which is deserving of comment is what may be termed the 'grain irrigation illusion.' The irrigation by a farmer of a comparatively small field of grain certainly has its place in a proper system of rotation, but the farmer should be warned that the irrigation of a large grain crop is certainly not the easiest, the most practical or the most remunerative way in which he can apply the water to which he is entitled. Owing to the fact that there is usually a period of only about fourteen days (possibly twenty-one days) in which water can be applied to a grain crop, it is necessary to apply the water very rapidly, which is difficult. Practically it would seem, also, that only some system of flood irrigation is possible for this crop and this requires a very even piece of ground in order that the water may be spread easily and evenly. One great inherent drawback to the matter generally is that the farmer, in leaning toward the irrigation of large areas of grain, is leaning toward a magnified form of soil robbing, which must be the result of the continuous raising of irrigated grain crops on any piece of land.

The tendency of farmers to specialize in grain irrigation is a most serious menace to any large irrigation company, because the fact of all the water-users growing a crop which requires a large amount of water within a very short period would make it absolutely impracticable and uneconomical for the company to construct its main ditches with a capacity sufficient to supply the great demand for water within so short a period. For this reason a practice of diversified farming is absolutely essential among farmers whose water-supply is furnished by any large irrigation company.

What is termed by the irrigation office the 'Calgary district' (that is, the district lying, generally speaking, between the Canadian Pacific railway, from Calgary to Macleod and the foothills of the Rocky mountains) comprises most of the oldest small irrigated schemes, and many of these have fallen into a very bad state as regard the condition of the works. This is probably due to the fact that this district has recently experienced a series of wet years and this has led the irrigators to feel that they no longer require their irrigation ditches.

Many of the older water-users well remember the dry years of the past, when their very existence depended upon their irrigation schemes, but a general feeling now seems to exist, for some reason which nobody can explain, that drouth need no longer be feared in this district. No man can predict the weather conditions of the future, but every evidence that can be produced would tend to show that the weather conditions rotate in a definite cycle of years and that dry years will probably come again. For this reason every holder of a water-right to-day should look forward for his own protection to the time when his irrigation ditch may again become a necessity, and should keep his ditch in sufficiently good repair to allow him to retain his water-right.

CANCELLATION OF LICENSES FOR NON-USE OF WATER.

Under the provisions of the Irrigation Act this department should not permit any person to retain a water-right unless his works are in such condition as to allow him to put the water which he has been granted to a beneficial use, and hence when the owner allows his works to become ruinous and refuses, or neglects, to repair them, the department has no course open to it other than to cancel the water-right. In this respect the department realizes that the water-user may not require to use his ditches every year, and in judging the condition of the works has laid down what is considered to be a very fair and just rule upon which to base the judgment whether or not the works are in a sufficiently good condition of upkeep; that is to say, any licensee shall be held to have abandoned or ceased to use water whenever at any time he allows his whole works, or any part thereof, to fall into a state of such bad repair that he cannot, with the help that he usually employs on his establishment, put his works in a sufficiently good state of repair within one week's time to allow him to divert the proper quantity of water through them and apply it beneficially on his land.

Photo R. J. Burley, 1911.

Blue-joint Hay Growing on an Old Barren Gumbo Flat after One Year's Irrigation.

It can readily be seen that the department must insist on this policy, as otherwise it would permit of persons gaining water-rights and holding them indefinitely without putting the water to any beneficial use, to the detriment of other persons who would make beneficial use of the water were it available for them.

FUTURE WORK OF THE IRRIGATION OFFICE.

An attempt has been made in the foregoing pages to deal with the work of the irrigation office in a general way only. For a detailed description of the progress of the work in the several districts reference should be made to the reports appended hereto which have been submitted by the district engineers. Several special features concerning the work have been taken up and are included in this report under separate headings.

As regards the future work of the irrigation office some comment may be not inappropriate in this report, as the commissioner, being in close touch with the practical end of the work, is probably in a better position to realize the necessities of the future than any other person.

DEPARTMENTAL CONTROL OF NATURAL RESOURCES.

The first point to be taken up is perhaps the most important one, and it is indeed most urgent, for it concerns the policy which the government is pursuing in investigating and controlling its natural resources. The matter may be tersely put by quoting the subject of an address by George H. Maxwell, director of the Pittsburg Flood Commission before the Nineteenth National Irrigation Congresss held at Chicago in December last, the subject of which was:—

> 'One and indivisible: forestry, irrigation, drainage, navigation. The rivers are the greatest asset of the nation *when regulated for all beneficial uses.*'

The last six italicized words are the ones to be studied. '*The rivers to be regulated for all beneficial uses.*' For the Canadian west the indivisibles might better be stated as: 'Forestry, Irrigation, Drainage and Power Production.' The point which it is desired to bring out clearly is that, as the rivers must be regulated for *all* beneficial purposes in order to develop their maximum potentiality, so should the regulation of all the beneficial purposes be carried out by one department, so that in studying any scheme of conservation every beneficial use may be given due consideration. Forestry, irrigation and drainage are at present in one branch of this department, under the Director of Forestry, but the investigation and regulation of power production is a separate branch. It is most important that this work should be included in the work of the irrigation office, or at least placed under the direction of the same head, the Director of Forestry. The water-power branch has its head-quarters at Ottawa, far removed from the scene of its work, and it has no organization in the west with which to carry out the necessary investigation. The irrigation office, on the other hand, has its head-quarters at Calgary, and has a well organized establishment and a staff of engineers familiar with western conditions. In concluding this topic the case of the Bow river is most illustrative. The government anticipates reservoiring the waters of this river and in doing so it must consider the claims of irrigation and also of power production. The claims of these two industries are antagonistic, in that irrigation requires the stored waters for use in the summer and power production requires the stored waters for use in the winter. The two demands have to be adjusted and balanced, and it would be waste of space to further explain that this question can far better be studied and adjusted within the confines of one branch of the department than by two separate branches, neither of them responsible to the other.

The people in the United States, as exemplified by Mr. Maxwell's paper, have after long years of bitter experience come to the conclusion that these matters are indivisible; cannot we save all the inevitable blunders and heart-burnings of the future by profiting by their experiences and having this matter adjusted at once?

DETERMINATION OF THE PROPER DUTY OF WATER.

There exists to-day an urgent necessity for investigations to be carried on by the government to determine the best methods for the practical application of water to field crops. In this regard the most important investigations necessary are those to determine the proper duty of water. The case is most concisely stated as follows: The government has arbitrarily determined and set forth the legal duty of water and, therefore, as a duty to the public and particularly to that portion of the public which this regulation concerns, it should have data to prove that the regulations in this matter are correct and proper. At present, data on this subject are woefully lacking. At the time that the duty of water was determined irrigation was in its infancy in western Canada, and the officials of that day could not do otherwise than base their judgment on conditions existing in other countries, but, as none of these countries have climatic and soil conditions exactly similar to those in Canada, it is necessary to carry on investigations in the sections of the country where the water is actually to be used. In addition to this indisputable fact, the great majority of investigations made in the United States (where the conditions are the most nearly parallel to our own) have been made on small patches of ground, and therefore have not been made under conditions exactly similar to the case of the practical irrigation farmer.

To properly determine the actual duty of water experiments should be made on large fields with the water applied in exactly the same manner as the farmer would apply it in practical irrigation; that is to say, let the farmers do the irrigating themselves on selected fields under the supervision of government engineers, and let the engineers collect and compile all the relevant data. This procedure should be supplementary to investigations made on any experimental farm, as the latter are looked upon with some suspicion by the farmers as being too technical and because the experimental farm always has, and employs, facilities in the way of farm machinery, &c., which many farmers cannot afford.

CLASSIFICATION OF LANDS FOR IRRIGATION.

Another matter to which attention should be called, and one which is in much the same line of thought as the preceding paragraphs, is the seeming necessity of making the duty of water elastic in order to suit the classification of the land to be served.

This statement, although made in a very few words, is one that opens up a very large field for argument and investigation, and will require a short explanation, to make the idea clear. The proper duty of water is a quantity, or perhaps more properly a ratio, signifying the relation between the water and the land, and defining the quantity of the former required to produce the maximum of plant growth on the latter. It can be readily understood that for any given locality this quantity must be governed by a number of different factors, of which the primaries are the seasons' climatic conditions, the kind of crop and the kind of soil. The first of these is a variable and can be placed only between the limits between which the climatic conditions are found to vary for the given locality, and the second is almost as variable because any ordinary soil will produce a great variety of crops, but the third—the kind of soil—does not change and can be classified within certain limits as regards the amount of water which it will require. It is impossible, within the limits of this report, to go into the question fully, but attention may be drawn to one clear-cut case

where a classification would be very beneficial. There are certain gumbo clay lands, generally lying along small creek-bottoms, which are highly benefited, in fact changed from a non-productive soil to a good hay-producing soil, by the application of from four to eight inches of water. In fact, this class of soil, on account of its density, will not take up a greater amount of water than this. These lands occur most frequently in sections where the water-supply is very limited, and where very often the supply is not sufficient to put the legal duty of water on them. Therefore, these lands, under the present regulations, must be left absolutely unproductive, and no irrigation rights can be granted because the rule is hard and fast that unless the applicant can show that the water-supply is adequate to serve the land with the legal duty he cannot get a license to divert the water for irrigation purposes. A great benefit would result from a classification which would allow of the use on these lands of a smaller quantity of water than the present legal duty. The one very grave drawback to any system of classification would be the opening given to prospective purchasers of land under the irrigation system to attempt to obtain an improper classification. This, however, would not apply to applicants who already own the land upon which the water is to be applied.

To show that these statements are not without precedent, the following extract is quoted from a report by Mr. Don H. Bark, Engineer in Charge of Irrigation Investigations in Idaho, U.S.A.:—

> 'The texture of the soil as regards porosity has more to do with the amount of water used than any other one thing. It has been found that adobe soils may be irrigated with the total application of but two or three acre-inches, while in some instances, from one to two acre-feet are required to spread over and thoroughly irrigate an acre of very gravelly soil.'

PROVINCIAL CONTROL OF NATURAL WATER RESOURCES.

In view of the possibility that the Dominion Government may turn over to the provincial governments the administration of their own natural resources, it may be permissible to record here a warning of the great troubles and difficulties that will be met with if the provinces of Alberta and Saskatchewan attempt each to control its own water resources. In dealing with rivers or any question of water conservation it is impossible to draw imaginary lines for administrative purposes. In the United States, which must always be our great object-lesson in these matters which concern the administration of the great natural resources of our virgin territory, it has been found that the greatest obstacle to all the comprehensive schemes of water conservation has been the fact of the separate control by each state of its own waters, and at this late date, after trying every other plan, the consensus of opinion is that the only way in which these matters can be efficiently handled is by the co-operation of the several states. Each province can, if such a policy be adopted, control its own mines, or timber, or lands, but the rivers can be administered, for the development of the maximum of good, only by the Dominion government, which recognizes no boundaries within all its great territory.

NECESSITY FOR INCREASING AND DEVELOPING THE WORK.

The last, but not the least, important point to which attention is here drawn is the great necessity of increasing and developing the work of the irrigation office. The greatest difficulty of to-day is the lack of information which should have been gained in the past, and if the scope of the work of to-day is not very soon greatly increased it will not be possible to keep abreast of the times in supplying that information regarding our great natural water resources which will every day in the future be demanded more strongly by the rapid settlement that is going on at the present day. That this work is not demanded by the public at large is no criterion of its worth,

because the general public does not realize the importance of that work. That body of men who are in the best position to understand the necessities of the case, viz.: the Western Canada Irrigation Association, show a keen appreciation of the need of the work by the resolutions that they have passed at their annual meetings for the past two years. The resolutions which refer particularly to the work of the irrigation office are the following, which were passed at the convention of 1911:—

No. 3. Whereas a knowledge of the practical duty of water for various crops has a most important bearing on irrigation development, and whereas information upon this important question available in any of the provinces of Alberta, Saskatchewan and British Columbia is vague and incomplete,

Therefore, be it resolved that the attention of the governments interested should be directed to this important matter, and that they should be urged to carry out a thorough system of investigation to determine the duty of water in the different provinces and for the different crops, so that such duty may then be determined with approximate exactness.

No. 4. Whereas an accurate knowledge of the location and quantity of water supply available is the basis of irrigation development, and

Whereas the matter of topographical and hydrographical surveys to determine the location and quantity of such water-supply and the proper methods of conserving it must be undertaken by the government administering the law relating to the use of such water;

Therefore, be it resolved that this convention urges strongly upon the Dominion Government the importance of making the necessary appropriation and providing the necessary staff to continue in an intelligent and systematic manner the work of gauging all streams of water-supply and location of all sites suitable for reservoirs for the storage of water, initiated a number of years ago.

No. 6. Whereas the conservation of water for irrigation purposes by companies and individuals, as at present carried out, does not admit of the whole available area in each district being brought under cultivation; and whereas the conservation of water by the government would be the means of developing such areas to the fullest extent, and assuring absolute permanency of supply and materially increasing the security to bondholders,

Be it resolved that the governments in which such districts exist be urgently requested to give the matter their serious consideration, and to put such system into operation at the earliest possible date.

APPRECIATION OF THE WORK OF THE STAFF OF THE IRRIGATION OFFICE.

In concluding this part of the report the Commissioner wishes to express his thanks and appreciation to every member of the staff for their hearty and conscientious co-operation, which alone has made it possible to carry on the successful season's work during the year 1911.

Respectfully submitted,

F. H. PETERS,
Commissioner of Irrigation and Chief Engineer.

No. 39.

REPORT OF THE MAPLE CREEK DISTRICT, BY R. J. BURLEY, B.A.Sc., DIVISION ENGINEER.

DEPARTMENT OF THE INTERIOR, IRRIGATION OFFICE.
CALGARY, ALBERTA, April 1, 1912.

F. H. PETERS, Esq.,
Commissioner of Irrigation,
Calgary, Alta.

SIR,—I have the honour to submit herewith my annual report of the season's operations in the Maple Creek district.

For the purposes of the work of irrigation inspection, the district was divided into two parts, roughly along the western boundary of range 26, west of the 3rd meridian, Mr. F. T. Fletcher taking the eastern section, extending to range 16, west of the 3rd meridian, and from the international boundary to the north boundary of township 14, while Mr. W. A. Fletcher took the western portion, extending to range 9, west of the 4th meridian, and from the international boundary to township 15.

The levelling party, under Mr. W. H. Greene, started from the old government bench mark No. 118 in the town of Maple Creek, established by Mr. Gibbons in 1896, one leveller running westward along the north boundary of township 11 and the other along the north boundary of township 10 until the fourth meridian was reached near the village of Walsh. From this point careful levels were run along the fourth meridian by one leveller and checked by the other, the allowable difference in checks being 0.02 feet by the square root of the distance in miles. This work was done with great care in order to establish a base line of precise levels from which other level lines can be developed in the future with a minimum probability of error.

PARTIES.

The parties consisted of an engineer in charge, an assistant, two rodmen, one teamster and a cook, except in the case of the western inspection party, where Mr. W. A. Fletcher had no assistant and only one rodman. The inspection party in the eastern district was equipped with four tents, one wagon, two democrats and eight horses, together with the necessary cooking utensils, tools, &c., while the one in the western district had three tents, one wagon, one democrat and four horses. The level party had four tents, one wagon, two democrats and six horses, together with the other necessary equipment for six men.

After the parties had been properly outfitted at Maple Creek they separated, and the inspection parties moved as outlined in the reports of Messrs. F. T. and W. A. Fletcher, with the idea of making a circuit of their respective districts in such a way as to be in the vicinity of Maple Creek in the fall when the weather became too severe for further work.

In carrying out the inspection work next season I would recommend that the party in the western district be increased in size to correspond with the one in the eastern district in order to meet the increase in the number of schemes and to properly handle the traverse work which is now being done. In the past this work has been carried on more or less spasmodically, owing to the importance of the inspection

work and to the limited size of the parties in this district, so that there are a large number of schemes sufficiently advanced to permit of traverses being made. In a great many cases it will also be necessary to define accurately the ditch right of way and the irrigable area before the license is issued upon the completion of the scheme.

GENERAL CONDITION OF IRRIGATION WORKS.

In watching and considering the progress of small private irrigation schemes for several years, one fact that has been very noticeable is the apparently decreasing rate of progress per year made on a great number of the schemes. In some cases this arises from pure carelessness or inability on the part of the applicant to do the work, but in the greater number of instances it is doubtful if this explanation will apply, more especially where the applicant has used water on some portion of his land and is favourably impressed with the benefits derived therefrom. In the case of the great majority of such ditch-owners in this district it is necessary to make the irrigation scheme pay its own way; that is to say, the owner usually endeavours to complete the intake and the carrying part of the system as soon as possible, in order to get the water on a portion of the irrigable land so that the produce from this part may help to pay the expenses of the remaining work. From this it can be seen that the scheme will, at first, be very imperfect and the results from it proportionally poor. Naturally, the next effort is in the direction of the best results for the least outlay and an effort is made to improve conditions upon the land already watered, so that the tendency is to neglect the main ditches and works and to concentrate the working force upon the land first covered until it has been put in good condition, when another section of the scheme is taken up. As the proper handling of even a comparatively small irrigated tract takes a great deal of time and attention, the second section does not progress so fast as the first, with the result that, in schemes involving several sections, or even quarter sections, the rate of progress on the last portions of the main works appears to be very slow, although in reality more work may actually be put into the scheme per year than was the case at first.

This brings up a somewhat difficult problem for the inspector to decide in making his recommendation for extensions of time for the completion of the works, for there is no doubt that the irrigator who is actually using the water is doing more to develop the country than one who merely finishes the main canal and works so as to pass inspection. As has always been the case in a new country, the development of irrigation is only perfected by experiment and actual use, and the owners can only learn to handle the water intelligently by these means, even where they have had experience in a different part of the world and under different conditions.

From this argument it can be seen that it is very probable that the applicant who is apparently making slow progress will have his scheme in first-class working order long before the man who has rushed his main works, laid out, possibly, without even a preliminary survey, but has made no study of the conditions under which he will have to apply water. In this latter case it frequently happens that the main works are constructed with little regard to the requirements of the land under them, so that the lateral systems are much more extensive and require much more work than the main system, with the result that the applicant is likely to become discouraged before any benefits are actually attained. As soon as the incentive of gaining the water license, or patent for the land purchased, is removed, he will very often allow the scheme to fall into disrepair; on the other hand, the man who completes his scheme in sections and actually irrigates during the time he is working at it obtains such results that he is satisfied to put more time and expense into the works.

As will be noted from the reports of the inspectors, there were some fourteen schemes that passed inspection and were recommended for license last season and,

while this may seem a small number compared to the number of applications on file, generally speaking the progress made was very good, despite the most unfavourable season, if it be judged from the standpoint of the preceding paragraphs. The most noticeable improvement in a great many schemes has been in the adoption of better methods in the application of water and more elaborate distributary systems. The result of this method of working is that, when a scheme is completed, the owner is in a position to get the best results obtainable out of it, owing to the benefit derived from the experimental work done during construction.

On the other hand there are some applicants (comparatively few, fortunately), who appear to do as little as possible each year and who expect to be allowed to continue in this manner indefinitely. The only course open to the department in such cases is to give the irrigator fair notice, and, in the event of the works not being completed, to cancel the authorization.

IMPROVEMENT OF CONDITIONS.

In considering the improvement and development of irrigation in this district, it would appear advisable for the department to endeavour to direct it along the following lines, viz.:—

(1) Improved Distributary Systems, Revised Grades, &c.

This is probably the first improvement that will occur to the individual owner, as in making it he is acting independently and is getting results in the quickest time, with the least expenditure; also, as the result of personal experience, he sees the defects in the original system and will take a greater interest in rectifying them and in getting the best possible results from his own efforts.

(2) Reservoirs.

In a district where the stream-flow is intermittent, one of the first things to engage a practical irrigator's interest, after he has his own scheme in good working order, is some method of holding up water at flood periods for use during low-water or dry periods. This is a matter which will usually demand co-operation between two or more applicants and, from that fact alone, the development of this phase of the irrigation problem is likely to be delayed for some time. In a few cases it is possible for one owner to provide reservoirs for his own sole use, but in the great majority of cases either the expense is too great or the main ditches are at too low an elevation to fill a reservoir for use on the lands under them. In the latter case it would be necessary to arrange an exchange system, whereby a prior applicant lower down the stream would give up his priority and draw his supply from the reservoir.

In the case of large reservoirs it would usually be necessary for all applicants, who hold lands capable of being irrigated, to combine in order to build the necessary structures and then to apportion the water fairly among them.

(3) Mutual Arrangements for the Division of Water and Construction of Works.

It will be found that when crop rotation is introduced on the lands irrigated the applicants growing different crops will require water at different times and the ideal arrangement is to supply these schemes from reservoirs, charging up the water supplied to them as it is taken, until the total appropriation for each system is exhausted. In cases where no reservoir is available a great improvement can also be effected by one applicant handling the whole available flow until he has thoroughly watered his crop and then turning the stream over to the next man. It also frequently happens that a number of water-users can combine and put in a system which would be out of the question for one or two men, so that in this way a large amount of land could be reclaimed that would otherwise be left in an arid condi-

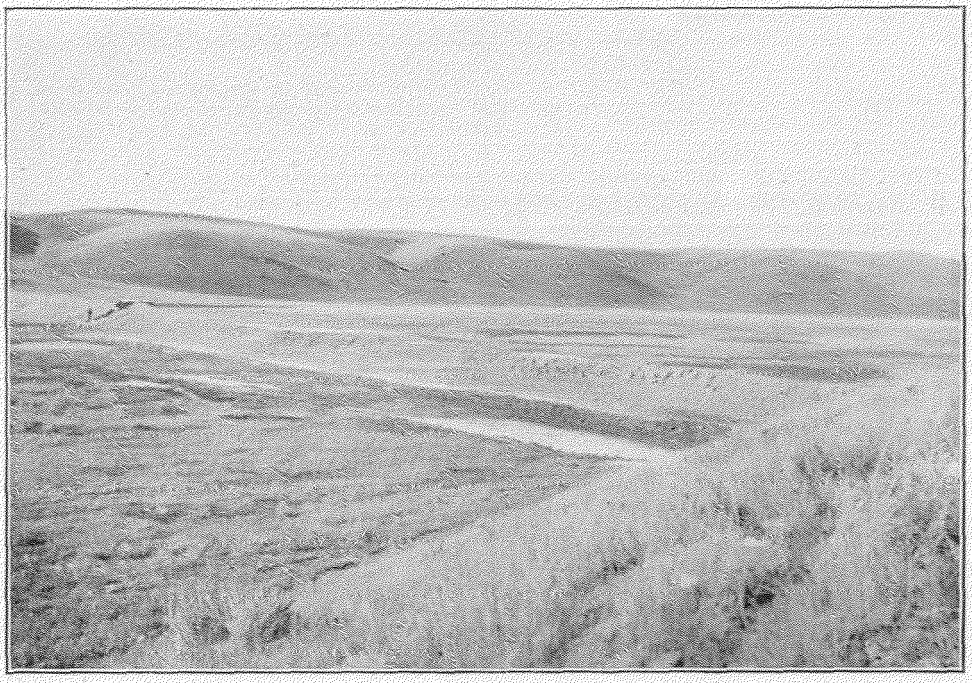


Photo F. T. Fletcher, 1911.

Typical Prairie Reservoir under Construction, N. C. Nelson.
Tp. 5, Rg. 24, W. 3rd M.

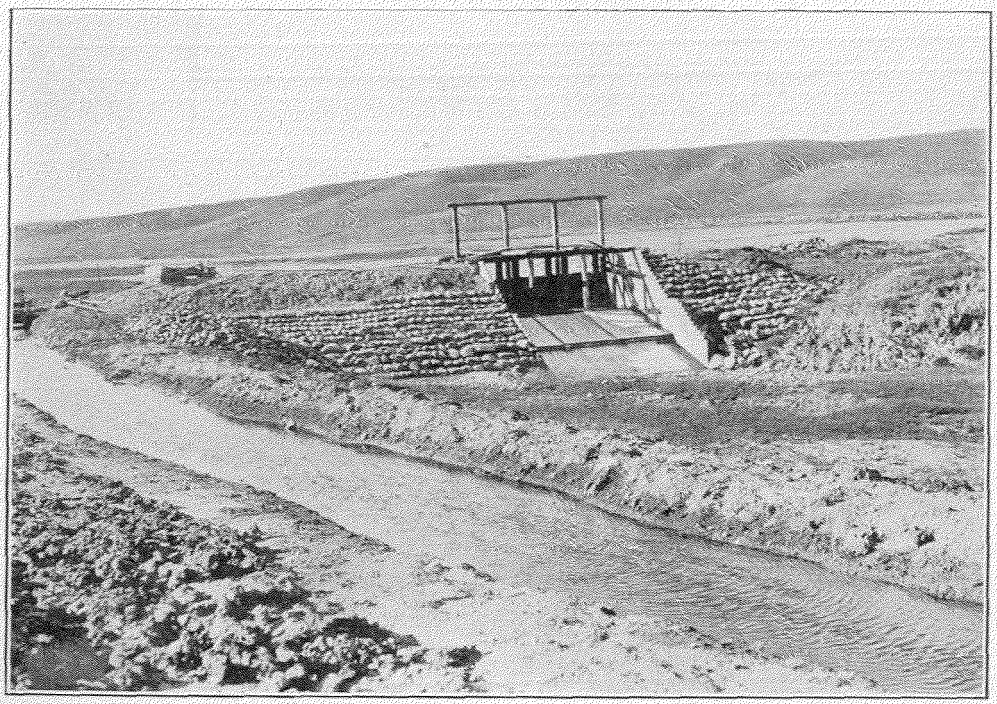


Photo R. J. Burley, 1911.

Wastegate. MacKinnon Brothers' Scheme.
Tp. 5, Rg. 1, W. 4th M.

tion. In many cases, too, the works of one applicant are at a sufficient elevation so that the water from his ditches can be run over the land of another whose works and intake are too low to water it.

As the above arrangements depend wholly upon mutual agreement, it will be seen that this will be one of the last developments to take place in the irrigated districts, but they must be made before the use of water will reach its full efficiency and, as has been the case in older irrigated districts, the consideration of the greatest benefit to all concerned will in time, no doubt, bring about some such state of affairs.

(4) Replacing Temporary Structures with Permanent Ones.

This will probably be the last development to be taken up by the irrigators generally, and such work will not be undertaken until irrigation has made the land of sufficient value to warrant a very considerable expenditure per acre to put the works in a permanently efficient state. A further point in this connection is that of the owner's ability, financially, to erect such structures, and it may be said that the greater number of them must be satisfied with works of a more or less temporary and inefficient nature until such time as they can afford to replace them with good structures.

The points taken up here are merely an expression of opinion regarding the general trend of irrigation development in this country and it is clearly recognized that a good many years must elapse before the improvements outlined will be widely adopted. No doubt there may be many legal complications which it will be the duty of this department to adjust, as far as possible, but, owing to the excellent nature of our Irrigation Act, the field in which such complications can arise is very much restricted in comparison with the older districts in the United States, for example, where the laws were devised to cover difficulties as they arose and where the older appropriators were, only too often, a law unto themselves.

It can be seen that, if the development follows along the course outlined, none of the schemes will be at their greatest efficiency for some years, and this is undoubtedly true so far as the Maple Creek district is concerned. It remains for the department to encourage improvements and, if at all possible, to direct the attention of all the irrigators to improved methods; to encourage co-operation and to commence some campaign of education regarding the best methods to use and the results obtainable from irrigation. This knowledge is bound to come in time, but, unless assistance is given, the process is an exceedingly slow one.

RESERVOIRS.

When natural hay ceases to be the main object of irrigation, the necessity for reservoiring will become very forcibly impressed upon the irrigators in this district, as, while flood-water irrigation is quite suitable for hay lands and is of great assistance in growing grain when it is available at a suitable time, this method of applying water will not be of any great value where intensive farming is practised, nor where alfalfa is grown. As but very few of the schemes have water available at all times, reservoiring is the only solution.

The possibilities for improvement by this means are well illustrated by the success of irrigation in the Cache la Poudre valley, in Colorado, where, at the present time, there are over 200,000 acres in highly improved farms being irrigated from a comparatively small stream with a minimum mean monthly flow of about 70 cubic feet per second and a maximum of about 2,000 cubic feet per second. (Figures taken from Bulletin No. 33, of the State Agricultural College of Colorado.)

Judging from the rapid development following the installation of reservoir systems there during the early '90's it is only to be expected that irrigation will gain greatly in importance when once such systems are started in this country.

As things stand at present the larger part of the run-off is lost each year, and, as a result, a great many of the schemes have to be satisfied with a scanty water-supply, or with one irrigation often available only at a poor season of the year, so that, naturally, the best results are not obtained.

Other points in connection with reservoiring such as the necessity of surveys being made and the construction of large basins by the government, have been taken up in previous reports and need not be dwelt upon here, but, if any dependence is to be placed upon the experience of irrigators in older irrigated districts, it would appear that this is one of the most, if not the most, important question to be dealt with under our Act, and the sooner it is seriously taken up the sooner we may expect the best results from irrigation.

GAUGES IN DITCHES AND STREAMS.

This work was commenced last season and was found somewhat difficult to carry out properly and at the same time to satisfy the ditch-owner as to the correct location for the rod. From the standpoint of obtaining good results for use in this office, it was necessary to place the rod above all laterals and also in such a position that the opening and closing of head-gates or diversion gates would not materially affect the accuracy of the readings. From the standpoint of convenience to the ditch-owner, it was necessary to place the rod as close as possible to his place of residence as, otherwise, it is very doubtful whether the readings could be relied upon. The result of such conflicting conditions was, necessarily, a compromise, and in some instances it is doubtful whether the best cross-sections were obtained. However, under the existing circumstances, the engineer followed what was, in his judgment, the best course. No doubt, as this work is carried on and the irrigators become more familiar with the objects of it, we shall be able to get better results from cross-sections and more reliable readings from the owners.

In all, some twenty-four stations were installed last season and descriptions were forwarded to this office. They were placed on the ditches in use, taking water from the streams upon which there will be the greatest likelihood of dispute in the future, with a view to getting records before any trouble arises in order that the department may be in a position to decide fairly between applicants, should occasion arise. This work will be carried on during the coming season with the same end in view, and it is hoped that stations will be established on all completed ditches by the end of the year.

In addition to the ditch gauge-rods, it will become necessary in the near future to establish gauge-rods on the streams sear the point of intake of each ditch, marked in such a way as to show at what stage the applicant is entitled to take water. This matter has been discussed in previous reports, but it is mentioned here in view of the difficulties continually arising between applicants and in view of the protests made by riparian owners, particularly along Battle creek.

INSPECTING ENGINEERS' REPORTS.

In the report of Mr. F. T. Fletcher, it will be noted that a start was made last season at placing permanent reference points, or bench-marks, at or near the intake of some of the ditches. This work was undertaken with the idea of eventually obtaining profiles of all the ditches, referred to the bench marks, and finally connecting up these to a general contour survey of the country. Such marks are also very necessary in the establishment of gauging stations, and will be connected up with the regular station bench marks as they are put in, while, in the meantime, they give the

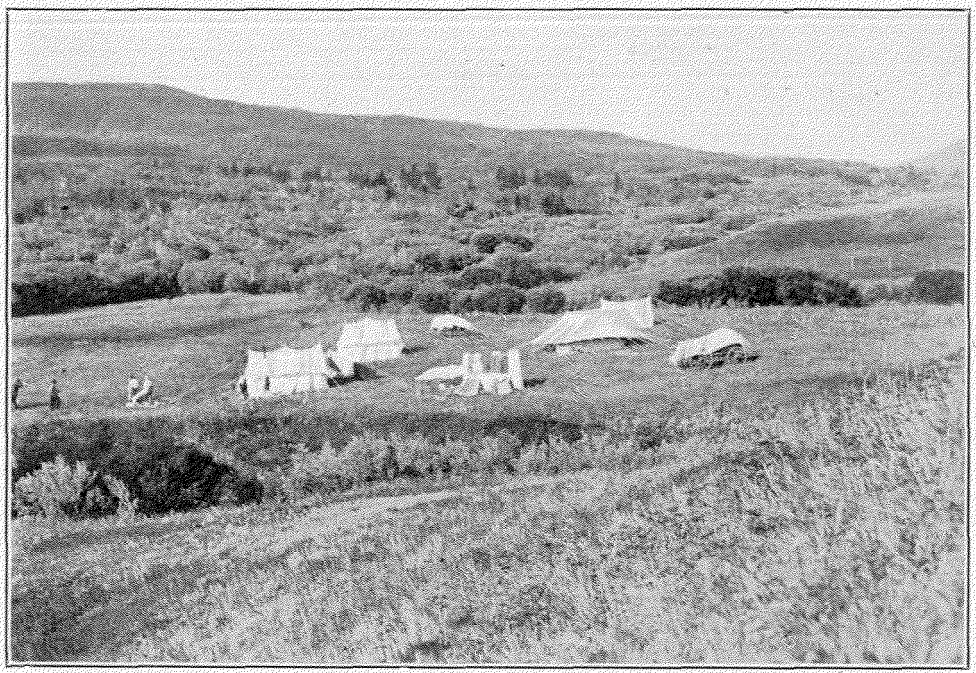


Photo R. J. Burley.

Irrigation Inspecting Engineers' Camp in the Cypress Hills.

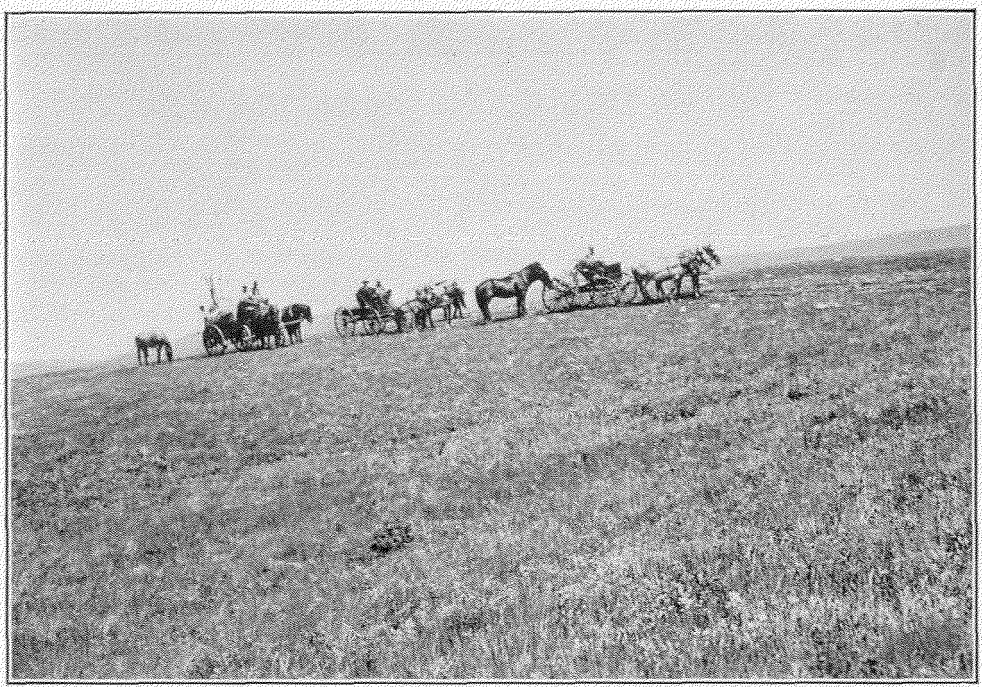


Photo R. J. Burley.

Irrigation Inspecting Engineer Moving Camp.

inspector a check upon what work has been done in the way of lowering, or raising, the ditch grade-line, dam, head-gates, &c., from year to year. It is proposed to carry on this work in a similar manner during the coming season.

The work of traversing the schemes was somewhat more extensive last season than in previous years, 181½ miles of traverse line being run. The majority of the larger schemes are now traversed, especially in the eastern district, and it is hoped that a large number of the smaller schemes will be done this year. In the majority of cases schemes are not now passed until careful traverses have been made, correcting all errors in the original plans, so that the licenses can be issued for the correct acreage only.

The following summary shows, in tabulated form, the main details of the season's work, in addition to that shown on the reports of Messrs. F. T. and W. A. Fletcher:—

Number of inspections	44
Number of reports submitted	72
Number of days of rain or snow, exclusive of Sundays, April 29 to November 25	58
Number of miles driven	3,049

Respectfully submitted,

RALPH J. BURLEY,
Division Engineer.

No. 40.

REPORT ON THE WESTERN SECTION, MAPLE CREEK DISTRICT, BY W. A. FLETCHER, B.A.Sc., INSPECTING ENGINEER.

DEPARTMENT OF THE INTERIOR, IRRIGATION OFFICE.
CALGARY, ALBERTA, February 27, 1912.

F. H. PETERS, Esq.,
Commissioner of Irrigation,
Calgary, Alta.

SIR,—I have the honour to submit the following report of my work for the Irrigation Branch of the Department of the Interior, in the western section of the Maple Creek district during the season of 1911.

On May 8, I took charge of my party at Maple Creek. A few inspections were made from the large outfitting camp located near the town, and the remainder of the time spent there was consumed in purchasing supplies, breaking horses and completing the outfitting of the party. The actual field work was commenced on May 29, when our first working camp was established at a point some eighteen miles southwest of Maple Creek.

The territory included in the district allotted to me was covered in a manner very similar to that employed in the previous year, although the route followed was somewhat different. Camps were successively established at the most suitable places, having regard to proximity to the work and at the same time to securing good grazing, water and fuel. From each of such camps all work within a ten or fifteen-mile radius was covered, after which the party was moved to another base in a fresh locality. This plan was adhered to throughout the season, with two exceptions. No good camping place was known to me in the neighbourhood of Medicine Hat, and the six

schemes in that locality were inspected from that town in three days. Seven schemes on Manyberries creek, around Pakowki lake, and on Sevenpersons coulee were inspected by taking one man and a light team on a week's trip from the camp stationed at Eagle Butte. These last mentioned schemes were too widely separated to justify establishing a camp in their neighbourhood and working from the same without considerable loss of time, especially as only inspection work was required.

The remainder of the district was worked from camps established successively at the following ten points: On Downie creek; on Fourmile coulee near Coulee post office; on Sixmile creek at a point about a mile above its mouth; on Battle creek below Wilson's ranch; on Middle creek at Jahn's ranch; on Lodge creek at a point just east of Lynch's ranch; on Lodge creek at W. Mitchell's irrigation scheme; on the irrigation scheme of Jas. English; at Eagle Butte post office, and at Many Island lake.

The total number of inspections made by myself was ninety-three; of this number twenty-three were of licensed schemes, fifty-four of schemes authorized and under construction, and sixteen were new applications. There were, in addition, two applications for permission to extend and enlarge existing schemes.

All of the licensed schemes, with the exception of five, were found in good working condition, and in actual use. The principal crops in evidence were blue-joint hay, oats, potatoes, and some small areas of alfalfa. Although the rainfall was unusually heavy during the season, there was nevertheless some very hot dry weather in the month of June, when those licensees who had water found it advantageous to do some irrigating, more especially on hay lands.

Where grain crops, chiefly oats, are being raised, the almost invariable rule seems to be to have the ground ploughed and worked up during the fall previous and then to give it as thorough a watering as possible with the spring floods. As soon as the soil becomes sufficiently dry, the seed is put in. In many cases snow water from dry coulees is being used to great advantage in this way, both on licensed schemes and on authorized schemes where the works are fairly well advanced. This makes a cheap method of irrigation where topographical features are favourable, and the results are extremely gratifying. In all such cases which came under my notice last year there was sufficient moisture conserved in the seed-bed to have carried the crop through to maturity without aid from the rains of July and August. In fact, these rains were rather a detriment to such irrigated areas, since growth was prolonged in many cases until killed by frost. This would seem to show that one thorough flooding in the spring is sufficient to ensure a fair crop on broken land in any ordinary year, and that applications for water-rights based upon this method should be shown some consideration.

Generally speaking, the larger schemes irrigating two hundred acres and over appear to be the more energetically and profitably operated, although one of the most successful irrigation projects in the district is a small one on Bullshead creek, near Coleridge. From fifty acres of land irrigated on this scheme over $3,500 worth of green feed, grain, vegetables and garden truck was realized in 1911.

While considerable progress was made on the authorized schemes, much more would have been done had the season been more favourable. Since almost all the works are being constructed by the applicants themselves, and since the regular farm and ranch work must be carried on, a wet season, such as that of last year, not only made the ground too wet for earthwork for a great deal of the season, but also prolonged the haying and harvesting to such an extent that few opportunities were left for ditching when dry spells did occur. However, fair progress towards completing authorized schemes was made. The works on four were completed, passed inspection satisfactorily, and the schemes were recommended for the issuing of licenses. Thirteen others were found to be almost finished but needed some small changes and

improvements and could not be recommended until such were effected. Two of these last were reported as finished late in the season but could not then be inspected on account of bad weather late in November; these are being held over for inspection in the spring of 1912.

Of the eighteen new applications dealt with, nine included the purchase of land, one was for domestic purposes, and eight of the applicants already owned the land to be watered. It is seen, therefore, that considerable faith in the value of irrigation is becoming manifest throughout the district, and that something else besides the acquisition of land is desired.

Complete traverses were made of eight schemes, accurately locating the works and irrigable areas and defining the extent of the latter. Portions of four other schemes were traversed to determine and locate the required right-of-way. In all, sixty-five and one-half miles of traverse lines were run during the season. Traverses for right-of-way on three other schemes could not be made, owing to the works not being sufficiently far advanced to locate the same with any degree of accuracy. Three further traverses of entire schemes which were required could not be made owing to the smallness of the party and the limited time available.

Gauge-rods were installed on all ditches specified in the instructions of the district engineer. Altogether, seven of these were placed. Discharge measurements were taken where it was possible to do so, and discharge curves for the ditch-rods were obtained. These, with descriptions of the stations, were forwarded to the Chief Hydrographer at Calgary.

A small Price electric current-meter and two steel weirs, of crest-widths of 15 inches and 36 inches, respectively, formed part of the party's equipment and stream measurements were made wherever convenient. Not many gaugings were taken, however, owing to the pressure of the regular work of traverse and inspection.

As previously stated, much unfavourable weather was encountered throughout the summer and fall. This caused many delays in the field, not only in the actual inspection and traverse work, but also, owing to the heavy trails, in the transport of the outfit from camp to camp. In a wet season, such as that of 1911, one team proved entirely unable to handle the transport wagon with any proper degree of facility, making extremely slow progress, and, at the same time, being taxed much beyond their working powers. Two teams, one each for a democrat and transport wagon, are not enough for the efficient handling of a party over the rough and broken country included in this district and an extra team would greatly expedite the carrying on of the field work. I would also recommend that a saddle be added to the equipment, as many occasions arise when a saving in both time and horseflesh could be made, in such matters as obtaining and forwarding mail, rounding up loose horses, &c.

All but one inspection had been made, when extreme cold, accompanied by a heavy snowfall, occurred on November 7, and work was held up for nearly ten days. As soon as fair weather returned this last inspection was made, and, after storing part of the outfit at Many Island lake, the remainder was moved to Maple Creek, which town was reached on November 18. The remainder of the equipment was stored there and the party disbanded on November 20.

The following is a list of the most essential features of the season's work:—

Number of inspections made	93
Reports submitted	99
Miles of traverse run	65·5
Field plans submitted, including sketch plans	23
Number of days with rain or snow, exclusive of Sundays	63
Miles driven with team and democrat	2,200

Respectfully submitted,

W. A. FLETCHER,
Inspecting Engineer.

No. 41.

REPIRT ON THE EASTERN SECTION, MAPLE CREEK DISTRICT, BY F. T. FLETCHER, B.A.Sc., INSPECTING ENGINEER.

DEPARTMENT OF THE INTERIOR, IRRIGATION OFFICE,
CALGARY, ALBERTA, March 1, 1912.

F. H. PETERS, Esq.,
Commissioner of Irrigation,
Calgary, Alberta.

SIR,—I have the honour to submit herewith a report on irrigation inspection work in my district for the year of 1911.

On May 8th, I took charge of my party at Maple Creek, and, after purchasing the necessary supplies and equipment, moved camp to Hay creek, from which point the actual survey and inspection work commenced. The route followed by the camp and the methods employed in the work of inspection and survey were the same as in previous years, viz.: all work was done from a centrally located camp. Camps were established successively at the following locations:—

Hay creek—May 29th.
East branch Bear creek—June 17th.
Skull creek—June 29th.
Pollock's butte—July 31st.
Galienne coulee—August 15th.
North fork Frenchman river—August 26th.
Fairwell creek—September 15th.
Belanger creek—October 4th.
Battle creek—October 13th.
Belanger creek—October 25th.
Maple creek—November 3rd.

On account of extremely cold weather and deep snow the party was disbanded on November 3rd.

HYDROGRAPHIC WORK.

This work consisted chiefly in measuring small streams on which, as yet, there are no regular gauging stations. A few measurements were also taken at regular stations, but, as the stage of stream-flow during the summer months remained fairly constant, no effort was made to make many of these measurements, as such would only be duplicating the regular work of the district hydrographers.

An effort was made to obtain as accurately as possible the value of s (sine of slope) for the larger streams in the vicinity of Maple Creek, the object being to obtain a fairly accurate value of the co-efficient of roughness, n, to be used in calculations involving Kutter's and Chezy's formulæ. The slope s was usually obtained for a chained distance of half-mile above and half-mile below the gauge on the stream, the difference of elevation of the water-level at these points being ascertained. It was thought that by substituting this value in Kutter's formula, and using different discharges and corresponding cross-sectional areas obtained by gaugings of stream

at these stations, a value of n could be obtained. Unfortunately, it was found extremely difficult to obtain a satisfactory value of s, which could be used for this purpose, for the following reasons:—

(1) The streams are all very small and the low-water channel narrow. At flood stages the water overflows the banks, and, hence, the length of channel is greater at low-water than at high-water, and the value of s therefore changes slightly.

(2) The value of s changes very rapidly on all of these streams; the fall in the half-mile below the gauge on every stream was found to be much less than in the half-mile above. The value of n found from the above value of s and known values of r (mean radius) and q (discharge) should be, however, much more accurate than an assumed value, and would certainly be a good check on such assumed values.

In addition to stream measurements, several gauging stations were established on ditches. Your instructions regarding the establishment of these stations were followed as closely as circumstances permitted, and hence a description of methods employed and kind of station established is unnecessary. It was found impossible, on account of other work, to establish stations on all the ditches, and gauges were placed on the larger schemes only. In all, seventeen gauge- rods were installed and descriptions were forwarded to the Chief Hydrographer.

The instruments used in hydrographic work were a small Price electric current-meter and two weirs, 15-inch and 36-inch crest.

BENCH MARKS.

A commencement was made at the work of establishing bench marks on the different schemes. The elevation of the intake of the ditch was referred to this bench mark and, in many cases, a profile of the ditch was taken with this bench mark as reference. The bench mark established consisted either of a stout wooden peg driven near the intake of the ditch and accurately located, or the highest point of some heavy, immovable rock, and this elevation referred directly to the nearest mound-pin.

INSPECTION WORK AND TRAVERSE.

All work of inspection was done by myself, personally, my assistant helping in necessary survey work in connection with the same. In all, 108 inspections were made and reports forwarded to your office. The office-work connected with this work of inspection is fairly heavy, but, outside of rainy days, when field-work was found impossible, it involved my remaining in camp only some ten additional days. This work was greatly handicapped by the bad weather in the latter part of the season, and on this account it was found impossible to make any second inspection of schemes in my district.

Considerable traverse work was done this season. All schemes valued and recommended for license, with one exception, and several other schemes, the location plans of which were found to be very inaccurate, were traversed. One hundred and sixteen miles of traverse were made during the season, including the traverses of creek-courses, lines bounding irrigable areas, and right-of-way traverses. This necessitated the preparation of thirty-six traverse plans, which work was done by my assistant and his rodman. The necessary calculations in connection with the traverses and the drafting occupied him sixteen days, exclusive of rainy weather. In addition to these plans, some ten sketch plans were forwarded to your office.

PROGRESS OF WORK.

During the past season seven schemes were recommended for license. In addition to these, since the close of the season, four schemes have been reported to the office as

complete and ready for final inspection. Considerable progress has been made in the construction of works in the larger schemes in the Cypress Hills and in all cases the work being done is first-class.

APPLICATION OF WATER.

Practically all of the schemes at present authorized and licensed depend almost entirely on flood-water for their supply. On this account the main object in the application of the water is the growing of fodder, either natural grasses, such as blue joint, or cultivated grasses, such as bromus, timothy or rye grass. Experiments by several of the irrigators are showing that it is quite possible to make good use of spring-flood water in promoting the growth of grain. Mr. W. H. Moore, of Gull Lake, whose source of supply is mainly spring-flood water, prepared his land for seeding and then flooded it early in April. The land was seeded as soon as the water applied had soaked away sufficiently to permit of the seed-drills being used. The result in his case fully justified the experiment. The crop grown was spring wheat and oats.

Messrs. Stearns Bros. and C. E. Stearns, on Jones' coulee, applied spring-flood water to a part of their land before seeding, and the land thus irrigated raised the only crop they harvested last year. These and other experiments show that, where the season is very early, as is the case in many parts of the Cypress Hills, spring-flood water can be used to advantage in raising crops of grain, though it should be borne in mind that in the event of the season being late and very wet, the application of this water might result in souring the land and retarding early growth.

The more successful application of water for growing crops appears to be in the fall of the year. This, of course, is only possible where the schemes are situated on permanent streams in the Cypress Hills, and is especially adapted to this region because the flow of these streams is much greater throughout October than in the summer months. This time for applying the water has been successfully tried by Messrs. Morrison Bros., on the Frenchman river.

To augment their supply of water many of the irrigators are constructing small reservoirs or employing dyking systems, where feasible, to irrigate their hay-meadows. All such efforts should be encouraged in every way, as they prove of value not only to the person constructing such works, but also to other irrigators on the same stream

The following summarizes the work of the season:—

Number of inspections	108
Number of reports submitted	108
Number of days of rain or snow, exclusive of Sundays (May 8 to November 25)	50
Number of miles traversed	116
Number of field-plans submitted	46
Number of miles driven	2,400
Number of gauging stations established on ditches and descriptions prepared	17

Respectfully submitted,

FREDERICK T. FLETCHER,
Inspecting Engineer.

Photo F. T. Fletcher, 1911.

A Four-horse Team Moving Camp.

Photo E. F. Drake, 1911.

The Head-waters of Battle Creek in Cypress Hills Forest Reserve.

No. 42.

CROP REPORT, MAPLE CREEK DISTRICT, BY R. J. BURLEY, B.A.Sc., DIVISION ENGINEER.

DEPARTMENT OF THE INTERIOR, IRRIGATION OFFICE.
CALGARY, ALBERTA, April 1, 1912.

F. H. PETERS, Esq.,
Commissioner of Irrigation,
Calgary, Alta.

SIR,—I have the honour to submit herewith a report on crop conditions in the Cypress Hills district for the year 1911. In this report much of the information is of a general nature, as it is practically impossible to get details of yield, time of planting and time of irrigation, from the majority of the ranchers, who do the greater part of the irrigation, owing to the fact that they seldom thresh their grain and usually make a rough estimate only of the yield in the case of hay, vegetables, &c.

The considerable differences of elevation throughout this district cause great differences in the climate of the various portions, so that on the Elkwater plateau, with an elevation of about 4,600 feet above sea-level, there is frost practically every month in the year, while along the railway track from Medicine Hat (elevation, 2,171 feet) to Maple Creek (elevation, 2,473 feet) and eastward, there is seldom frost between May 1 and September 10. On the other hand, the higher points appear to have the greater precipitation and the growth of natural grasses is much heavier and longer than is the case on the plains below.

The soil on the top of the Cypress Hills plateau is, as a general rule, a very dark vegetable loam, which usually appears to be underlaid with gravel, gravel and clay, or cemented gravel, while on the slopes of the hills and on the plains almost any class of soil can be found from drifting sand to the heaviest 'gumbo' clay. As a general thing the soil on the north side of the hills is a more or less light, sandy loam, excepting in the creek valleys, where it is usually a heavy clay, apparently in the nature of an alluvial deposit. On the south side, however, a somewhat different state of affairs is found, as the greater part of the soil appears to be a clay loam, somewhat stony in places and, upon the whole, of a poorer quality than that on the north slope. The stream valleys are, in most cases, similar in nature on both sides of the hills.

As practically all the irrigation is confined within the limits of the valleys, it will be seen that from the standpoint of irrigated crops it is necessary to deal with a very heavy, sticky class of land, having an impervious subsoil and, to a greater or less degree, poor drainage facilities in the majority of cases. Naturally there are some notable exceptions to this rule and these will be dealt with later on in this report, but in the case of the majority of schemes the land, before water is applied, is baked very hard, has very little grass, but a more or less heavy growth of sage and greasewood. When water is applied, however, the sage is killed and the natural blue-joint grass springs up thickly, forming excellent hay-meadows within two or three years. On the north side of the hills, principally north of the Canadian Pacific Railway line, there are between twelve and fifteen thousand acres of this class of land under irrigation for natural hay each year, and, as a general rule, fairly good results are being obtained, the yield being between one and one and a half tons per acre. This yield could undoubtedly be increased if better methods were adopted, as at present

the owners, holding, as they do, large tracts of land, are quite satisfied to turn on the water when it is available, and to cut whatever crop there is when it is ready. There are many features of this class of irrigation that could be greatly improved, as, for example, the dyking of the flats to hold water for a longer period. Another cause of trouble in such hay-meadows is the thickening of the grass roots under irrigation until they finally choke each other out and stunt the growth, thus cutting down the yield very materially. This can be overcome to a great extent by discing the sod from time to time, thus giving a better and looser root-bed. The condition occasionally met with on the south side of the hills, but seldom seen on the north side, is that of a heavy growth of 'fox-tail' grass, choking out the blue-joint and rendering the meadow useless. This appears to be encouraged by the application of too much water and by allowing water to stand on the land for long periods. Possibly the standing water kills the good grass, giving the other a chance to grow, but, in any event, it renders the meadow practically usetless, and the only remedy appears to be leaving the land dry for several seasons or ploughing the sod under.

On the plateaux or on the higher slopes of the hills the great trouble is with early frosts. However, it may be said that oats and barley usually ripen, but wheat is frequently damaged. Timothy can be grown successfully, and Mr. Jacob Armstrong, near the head of Fairwell creek, is making a success of rather a novel experiment. Three years ago he started discing timothy seed into the prairie sod and this grass is now growing very well. He expects to be able to turn a large area of prairie land into timothy in this way, without going to the expense of breaking it, and it would appear that his expectations will be realized, judging from the showing made last year. He is also experimenting with alfalfa, but as yet has got but little past the experimental stage, although very successful up to the present.

Practically all the common varieties of vegetables are grown with fair success, but during some seasons the less hardy varieties are a failure on account of frost. If this difficulty is overcome, as more land becomes broken, there is no reason why these crops should not be very successful. So far, practically all the vegetables grown are for the owner's use only, and there are very few areas of any size under such crops. On account of the elevation the nights are much colder on the plateaux, so that all crops are considerably later than is the case on the lower land.

CROPS GROWN UNDER IRRIGATION.

While the staple crop on the greater part of the irrigated land in the district is natural hay, it has been demonstrated that timothy, rye grass, redtop, bromus, clover and alfalfa can be grown successfully under irrigation if properly handled. Up to the present the crop of native blue-joint has almost satisfied all demands, and it will always command a good price per ton on account of its excellent quality, so that the owners have been satisfied with a low yield per acre rather than to go to the expense of breaking, preparing and seeding the land to some other crop. No doubt, in the future, as the supply of bench hay runs out and the demand becomes greater, owners of irrigated flats will realize that they are losing money by keeping their flats seeded down to a low-yielding crop and will begin to do some additional work to obtain a better one.

With regard to grain crops it may be said that practically all the cereals are grown to some extent, but oats appear to be the favourite under irrigation, no doubt because the grain is almost all fed on the ranch. These crops appear to yield best when irrigated about the middle of June and a second time about July the 16th to 25th, unless weather conditions interfere; but, in most cases, water is not available at these times, so that some other method must be adopted. Very good success is obtained by a thorough irrigation late in the fall, with a careful working of the land early the next spring before the seed is put in, so that the moisture is conserved. Others have

obtained good results by watering thoroughly in the early spring during the period of spring run-off, and then getting their machinery on the land as soon as it is sufficiently dry on top to put in the seed.

Although last season was extremely wet for this district the benefits derived from irrigation were well illustrated by the results obtained by Mr. W. B. Freel on the Frenchman river. He had put in some twenty acres of oats and had commenced watering them when a very heavy rain caused considerable damage to a large cut near the head of his ditch, making further irrigation an impossibility until too late in the season to be of any value. He had, however, thoroughly watered some six acres and at the time of inspection on August 30, the difference between this area and the rest of the crop was most marked. The irrigated grain was very heavy and stood almost six feet in height, while the rest of it was light and about four and a half feet high.

Photo R. J. Burley, 1911.

Irrigated Oats — H. B. Freel.
Tp. 6, Rg. 23, W. 3rd mer.

Mr. Freel estimated the yield of the two parts at seventy-five and thirty bushels per acre, respectively.

Owing to the fact that the market is very limited, little has been done towards growing vegetables and small fruits, excepting in small patches for the owner's private use, although it has been demonstrated that almost any variety of these may be grown successfully under irrigation at the lower elevations. Mr. H. H. Fauquier, on Hay creek, went into this business quite extensively some years ago, and, in addition to the more common vegetables and fruits, succeeded in growing and ripening watermelons, canteloupes, corn, tomatoes, cucumbers, plums, &c. This shows what can be done by intelligent handling of the land and proves that, so far as climate and soil are concerned, practically all vegetables and small fruits can be grown if water is available and some care is exercised in cultivation. The land in this case is a sandy loam of

good quality and was always carefully worked. On the south side of the hills, near the international boundary, Mr. V. W. Heydlauff has practically duplicated these results, although on a smaller scale, despite the fact that his scheme is a new one and is still unfinished. At the western end of the district, near Dunmore, Mr. Francis Wright last year took a crop valued at $3,500 gross, from an area of fifty-one acres, as mentioned in Mr. W. A. Fletcher's report, and I append hereto a detailed list showing the nature and quantity of the different crops grown by him. Where proper care and attention are given, these yields are not extraordinory. Mr. Fauquier met with equal and sometimes greater success in some crops when he was in the business, while many others scattered through the hills, working on a much smaller scale, have obtained equally good results.

From the above it can be seen that there is a very good field for truck gardening here, and, owing to the prevailing high prices for such produce in the west, such work should prove extremely profitable to the producer when he is so situated as to have easy access to a market.

METHODS OF IRRIGATION USED AND SUCCESS OBTAINED.

In practically all cases where hay is the object of irrigation the water is applied by the method of wild flooding; that is, water is turned out of the stream during high periods and by means of a few directing ditches is made to cover the land to a depth of from three to six inches, flowing slowly over it and back into a natural water-course or to the creek channel itself. Naturally, this method is extremely wasteful of water and is not by any means the most efficient way of covering the land, although it is by far the cheapest and takes the least work. Its wide adoption, no doubt, arises partially from these causes and partially from the fact that the flood periods are usually of too short duration to permit of the water being carried over the land properly by a system of laterals, checks or any other means than by dykes, unless reservoirs are provided.

A system that is an improvement on the above method, and which is being used to a greater degree lately, is that of dykes. This method is identical with the check system, excepting that the dykes are higher than those used on cultivated lands and the water is held to a depth of from one to three feet over the land under the first dyke for a short period—occasionally as long as two weeks—and is then released by means of waste-gates and allowed to flow into the next lower dyke and so on until the whole area has been covered. This method has the advantage of soaking the land more thoroughly and of acting to some extent as a reservoir system, while the waste of water is not nearly so great. The dykes are most successful when constructed on contours at intervals of from one to three feet in vertical height and should be built with long, easy slopes and rounded tops, so that they will allow easy passage of agricultural machinery over them. The systems so far installed are proving very satisfactory and very good results are being obtained from them in the growth of hay. Their value for the irrigation of grain and other crops is doubtful and, although I have never seen the experiment tried, I believe it would prove a failure unless the dykes were very low and comparatively close together.

Lateral systems, as used for hay production, are usually of a very primitive nature and in almost all cases combine with the wild flooding system to produce the desired results. Messrs. Enright and Strong's works probably show the greatest development of any large scheme and they use a system of laterals, dykes and wild flooding over their hay lands, with very good results, as they also have drainage canals cut from the lower portions of the meadows to the river. Last season they were able to cut between eighty and ninety tons of timothy and clover from some thirty-five acres of land which was watered with laterals, but their meadows of natural grass did not produce over one ton per acre. For grain they use laterals several hundred feet apart and flood

the land between them, obtaining very good results. The grain was in excellent condition during the latter part of August last and all indications were for a heavy yield. For potatoes and vegetables water is applied by running small streams down the furrows between the rows, and this method has been found very successful.

In the majority of cases of those growing grain, a somewhat similar method to that used by Messrs. Enright and Strong is employed, with results varying according to the efficiency of the system and the experience of those using the water. The check and furrow systems, excepting as noted in connection with dykes, are practically unused to any large extent, probably on account of the expense involved in levelling and preparing the land. Of course, in the case of gardens where the land is bearing a valuable crop, requiring a great deal of tilling, the furrow method is used altogether, but these cases are seldom met with on any considerable scale at present.

FLOOD-WATER IRRIGATION AND DUTY OF WATER.

Probably the most striking feature of irrigation throughout the Cypress Hills is the large number of schemes depending wholly upon flood water for their supply, also the success which has been attained by this class of schemes. In the case of almost all the streams in this district the water-supply a few miles below the head-waters is of this nature to a greater or less extent, so that, until reservoir systems are installed, it will be necessary for owners to make the best of what they have and to try for the best paying crops that can be successfully grown with the facilities at hand. At present ninety-five per cent or more of such land is used as hay-meadow, and it would appear that such use gives better net returns per acre than grain when the work necessary for the latter is taken into account.

When these heavy valley-lands, composed of what is known in this country as 'gumbo,' but resembling the 'adobe' of New Mexico and the South, are in their natural condition, little or no vegetation is found upon them and, by noting the condition of pools of water left on them after rains, it can be seen that the soil is extremely impervious, so much so that the greater part of the water evaporates, moisture extending into the soil only a few inches. Under irrigation, therefore, it is impossible for such land to absorb the amount of water required by the legal duty of water, and from several years' observations I very much doubt whether more than from three to six acre-inches of water are actually taken in by this land during a season's thorough irrigation. This amount may appear very small, but it should be noted that such land is always moist a few inches below the surface, so that it would appear as though it were as good at retaining moisture as it is in resisting the absorption of it. Good results are almost invariable on this class of soil where only flood-water is available and where only a fraction of the legal duty of water can be applied, but, on the other hand, there are a few cases where water is always available, and such areas have been badly damaged by the rising of alkali and the growth of foxtail grass, through no other apparent cause than the application of too much water.

There are many instances of streams along which the only irrigable land is of this heavy nature and there can be no doubt that the application of the full quantity of water called for by the legal duty of water would, in a short time, absolutely ruin the meadows and render them unfit even for pastures, unless a very elaborate system of tile underdraining were installed and the soil rendered much lighter by manuring or other means. As matters stand at present it is practically impossible for any such amount of water to be applied, as it merely runs over the ground and back into the channel with a comparatively small amount entering the soil. In the case of sandy lands or loam having a gravelly subsoil, water is absorbed quickly and carried off quickly, so that the arbitrary duty of water may be a very

fair quantity in these cases, but in the heavy lands it is probable that the application of so much moisture would result in damage rather than benefit.

This brings up a point of interest in regard to some of the creek valleys, where the water-supply is all granted according to the present basis, but where there are still large acreages which could easily be irrigated if water were obtainable. These lands are of little or no value without water, while under irrigation they become highly profitable as hay-meadows. The adjoining lands under water licenses have a right to use more water than they can put to beneficial use, with the result that the return flow from their lands regains the creek channel below and is lost. The question naturally arises, why not divert this overflow water on to lands adjoining, and from them on to others, until it is exhausted. The reason is, of course, that the Department has already granted rights up to the full capacity of the stream and cannot grant further rights to something which is not there. It is possible that future investigation will prove conclusively that irrigation schemes on this class of land cannot use the quantity of water to which they are now entitled and thus render a portion of their license subject to cancellation for non-use, which would involve a readjustment of rights on the whole stream.

In conclusion, it may be said that while irrigation farming in Canada is still in the experimental stage, enough has been done to demonstrate that success is practically certain in diversified farming and that almost all field crops, vegetables and small fruits can be brought to perfection in this district. The trouble has been, and still is, that the irrigator is satisfied with a comparatively small return per acre from a large area so long as the work and expense involved are trifling, and, as a majority of irrigators are ranchers, the growth of winter feed has been the great desideratum. When the irrigated tracts become broken up into smaller holdings and really careful farming is practised, there is every reason to hope that the success of irrigation will be as great as in the older districts in the United States. Within a few years it is probable that alfalfa, clover and timothy will enter largely into the production of hay and that, as a result of crop rotation and scientific farming, the land will become richer rather than poorer from the uses to which it is put, in addition to returning larger profits to the owners.

Respectfully submitted,

RALPH J. BURLEY,

Division Engineer.

APPENDIX TO CROP REPORT OF R. J. BURLEY.

(Products from irrigated land, 51 acres—N.W. ¼ Sec. 34, Tp. 11, Rg. 5, W. 4th Meridian.)

Irrigation scheme of Francis Wright.

Product.	No. Acres.	Yield.	
Wheat	11	371	bush.
Oats	5	353	"
Peas	1½	60	"
Potatoes	18	3,000	"
Mangels	2	400	"
Carrots	½	600	"
Turnips	1	900	"
Beets	½	200	"
Onions	¼	200	"
Parsnips	¼	25	"
Tomatoes		40	"
Cabbages		10,000	heads.
Corn (green)	¼	2	tons.
Oats and Rye	10	30	"

SCHEDULE OF BENCH MARKS ESTABLISHED IN MAPLE CREEK DISTRICT DURING SEASON OF 1911.

Location.	Elevation.	Remarks.
	Feet above sea level.	
On N. W. corner of Dixon Bros., store at Maple Creek	2472·800	Dom. Gov. B. M. No. 118.
At N.E. corner Tp. 11, R. 27, W. 3rd Mer.	2513·555	I. P. Tempy. Gov. B. M.
At N.E. " " R. 28, "	2520·815	" "
At N.E. " " R. 29, "	2623·173	" "
At N.E. " " R. 30, "	2393·290	" "
At N.E. " " R. 1, 4th	2410·072	Permanent "
	2576·981	Temporary Gov. B. M. (6 ft. N.W. of mound).
At N.E. " Tp. 10, R. 27, 3rd		
At S.E. " Tp. 11, R. 27, "	2500·197	Tempy. Gov. B.M.
At N.E. " Tp. 10, R. 28, "	2677·794	Top of Tp. post.
	2718·513	I. P. Tempy. Gov. B. M. (in W. pit at mound.)
At S.E. " Tp. 11, R. 28, "		
At N.E. " Tp. 10, R. 29, "	2832·612	" "
At S.E. " Tp. 11, R. 29, "	2920·327	" "
At N.E. " Tp. 10, R. 30, "	2744·677	Top of Tp. post.
At N.E. " Tp. 10, R. 1, 4th	2636·556	"
At N.E. " Tp. 9, R. 1, "	3084·014	"
At N.E. " Tp. 8, R. 1, "	3774·666	"
At N.E. sec. 24, Tp. 8, R. 1, "	4436.789	Permanent Gov. B. M.
At N.E. " 34, Tp. 7, R. 29, 3rd	4376·666	" "
At N.E. " 33, Tp. 6, R. 29, "	3663·539	Tempy. "
At N.E. corner Tp. 5, R. 29, "	3415·120	Permanent "
At N.E. " Tp. 5, R. 30, "	3472·356	Top of Tp. post.
At N.E. " Tp. 5, R. 1, 4th	3580·588	Permanent Gov. B. M.
At N.E. sec. 24, Tp. 5, R. 1, "	3445·481	" "
On south bank of Maple creek at east boundary of Sec. 16, Tp. 11, R. 26, W. 3rd M.	2465·335	" "

The datum of the elevations listed above has been carried from the elevation of the Dominion Government bench mark number 118 on the northwest corner of Dixon Bros.' store at Maple Creek, which has an assumed elevation of 2,472·800. In order to get the datum of Canadian Pacific Railway levels at Maple Creek it is required to apply a correction of plus 0·945 feet. The levels were all checked by two independent circuits and in reducing were corrected for curvature and refraction. In reducing the levels the differences between the two circuits were equally divided and in reducing the elevation of any bench mark set on one circuit the correction to the elevation was made in the ratio of the distance from the last bench mark set with a reduced elevation.

No. 43.

REPORT ON THE CALGARY DISTRICT BY J. C. MILLIGAN, C.E., INSPECTING ENGINEER.

DEPARTMENT OF THE INTERIOR, IRRIGATION OFFICE.
CALGARY, ALBERTA, March 11, 1912.

F. H. PETERS, Esq.,
Commissioner of Irrigation,
Calgary, Alta.

SIR,—I have the honour to submit herewith my report of the work done by the party under my charge in the Calgary district, Alberta, on irrigation surveys, during the season of 1911.

LIMITS OF DISTRICT AND HOW TERRITORY IS COVERED.

The district mapped out for inspection by myself and party during the summer of 1911 is bounded on the north by the north boundary of township 24; on the west by the first range of the Rocky Mountains; on the south by the south boundary of township 3; and on the east by the Calgary and Edmonton railway, the Peigan Indian reserve, and the east boundary of range 29, west of the fourth meridian.

The territory was covered with the aid of a light camping outfit, and camps were located within convenient driving distance of a group of irrigation schemes, so that the largest possible number of schemes could be inspected from each camp.

GENERAL CONDITIONS OF IRRIGATION WORKS IN THE DISTRICT.

The Calgary district can be divided into two distinct parts, viz.: the general farming or prairie country, and the ranching, or foothills, country.

The general farming, or prairie, country is within a semi-humid area, where the rainfall is generally sufficient to ensure a good crop. All the irrigation works should, therefore, have been designed for intermittent work, which means the storing of water to ensure a good supply during droughts. This matter has never been taken into account, and the result has been that in droughts, when water was particularly required, none was obtainable, as out on the prairie all the streams had run dry. This has had a very discouraging effect on the farmers, who consider that water, to be of any value to them, should be available during droughts. If water were available, irrigation could then be used successfully and be, what it should be in this part of the country, an insurance against crop failure. As a result of these occasional droughts, irrigation is now considered not worth the trouble and most of the schemes on the prairie section have been allowed to go to ruin and in a great many cases licenses have been abandoned.

In the foothills, or ranching country, where irrigation is used exclusively for hay and green-feed crops, the same conditions have not existed; consequently the irrigation schemes, although not in first-class order, are used to a large extent, and some interest is taken in them. Range is now very limited in extent, and within the last year almost every rancher has been compelled to erect fences to protect his land from being overrun by his neighbours' stock; consequently he is now placed in the position of having to grow as much hay as possible on the limited area of land at his disposal.

It is in this district that irrigation is beneficial in all years, as hay crops can stand continual irrigation up to the cutting season, without fear of detriment. The ranchers are, therefore, realizing the benefits of irrigation, and in the future it will probably play an important part in farming in the foothills; works will be kept in order, and good results will be obtained.

EXTENT AND CHARACTER OF IRRIGATION DONE.

During the season of 1911, sufficient moisture fell in the Calgary district to ensure a good plant growth; very little irrigation was therefore used, and there was little or no opportunity of judging what actual irrigation does take place. The general method of irrigation adopted is flooding by means of contour ditches, which is the only suitable method for this part of the country, as the nature of the irrigated land is rolling. The only conclusion to be arrived at, from an examination of the schemes in the prairie district, is that little or no irrigation has taken place for several years. The works are generally in poor condition and in a great many instances the ditches are practically destroyed. This condition applies to the irrigation schemes having their sources of supply in small creeks with uncertain flow. Irrigation schemes, having their source of supply in the larger streams with more certain flow, are generally in better condition but, on account of the climatic conditions in 1911, very little irrigation was done.

In the foothills district a fair amount of irrigation took place. The method used was flooding by means of contour ditches in the spring and early summer. Irrigation was also used in the fall and it should be possible to collect some data of results during the coming summer. In this district irrigation was not practised in a thorough manner, with the result that hay crops were very patchy, showing that no system had been observed in the distribution of water. In the prairie district eight irrigation systems were in use, four to irrigate hay-meadows and four to irrigate general garden truck; in the foothills district twenty four systems were in use irrigating hay-meadows.

SUGGESTIONS FOR BETTERMENT OF CONDITIONS.

In the past it has been the practice to grant licenses for irrigation schemes at high and flood stages of streams. It is suggested that this be discontinued, unless under certain circumstances, that is, along with storage reservoirs, or where only hay is to be irrigated. For a period of some thirty days between June 15 and July 15, and for a short time in the fall after the harvest has been taken off, water can be beneficially applied to land for general crops. At these times there is practically no high water or flood in any of the streams; therefore licenses which are granted on this basis are of no value without storage capacity. Of course, the licensee may use water with regard to the priority of his license, but in years when irrigation is required all the available water is used by the licensees holding rights at low-water stage. As a great many of the streams in the prairie district go completely dry during some years, it is suggested that these streams be tabulated, and that no licenses be issued unless storage capacity is also provided, or unless hay only is to be grown.

There is another remedy for this matter, but it may hardly be considered feasible at present owing to its great cost. If storage reservoirs were built at convenient points in the mountains or foothills the difficulties of a permanent water-supply would be eliminated. These reservoirs could be built at the expense of the government, and a *pro rata* sum charged to each licensee on each particular creek, the rate being so fixed that the cost of the work and its upkeep would be repaid to the government within a fixed period.

PERSONNEL AND EQUIPMENT OF PARTY.

The party consisted of one engineer in charge, with rodman, teamster, and cook, and was equipped with a light camping outfit, which included two teams and two democrats, with a saddle-horse. The instrumental equipment of the party was as follows:—

One set draughting instruments.
One dumpy level (Gurley with compass).
One mountain transit (Gurley).
One small Price electric meter.
One stop-watch.
One 12-inch weir.
One 15-inch weir.

The work consisted of inspecting irrigation schemes, both licensed and authorized; surveying and setting out new schemes; reporting on the feasibility of proposed irrigation schemes; helping licensees of irrigation schemes, both with advice and by designing new structures; gauging streams and irrigation canals; placing gauge rods in irrigation canals, and making final measurements of work done on completed schemes.

On account of a late start and my lack of familiarity with the district, I found it impossible to make a complete survey of all the schemes in the district. The tour of inspection was begun on May 28 and, in all, twenty-five camps were made. Work was carried on during the months of June, July, August, September and October, but had to be abandoned on November 11 on account of deep snow and low temperature. Work was again started in December, but for the same reason it had soon to be abandoned.

SUMMARY OF WORK.

Number of inspections made during season 1911	111
Gaugings of creeks and irrigation ditches taken	37
Final measurements of work done	2
Gauge-rods placed in irrigation canals	9
Inspections of waterworks made	2
Lateral systems laid out	2
Drainage systems laid out	2
Number of surveys made	13
Miles of traverse run	19·5
Number of plans made	16
Distance travelled with team and wagon	2,254 miles.
Number of camps made	25
Number of working days on inspection work	141
Number of wet days	19½
Number of days moving camp	24

Respectfully submitted,

J. C. MILLIGAN,
Inspecting Engineer.

No. 44.

CROP REPORT, CALGARY DISTRICT, BY J. C. MILLIGAN, C.E., INSPECTING ENGINEER.

DEPARTMENT OF THE INTERIOR,
IRRIGATION OFFICE,
CALGARY, ALBERTA, March 11, 1912.

F. H. PETERS, Esq.,
Commissioner of Irrigation,
Department of the Interior,
Calgary, Alta.

SIR,—I have the honour to submit herewith my crop report for the Calgary district for the season of 1911.

This district is bounded on the north by the north boundary of Township 24; on the south by the International boundary between Canada and the United States; on the west by the first Range of the Rocky mountains, and on the east by the Calgary and Edmonton railway and the Blood Indian reserve.

The district consists of two sections: prairie or general farming lands, and foothills or ranching lands. It is difficult to define a boundary between these two sections, as the ranching country is only being opened up and it is claimed that some ranching land, so designated a short time ago, is in reality good farming land. This may or may not be the case, and only time can show. It is certain, however, that throughout a large part of the foothills very severe frosts take place at nights, even as early as July, sometimes severe enough to freeze water to a thickness of over half an inch.

Only a small portion of this district is devoted to general farming and this part lies adjacent to the railway line. It is comparatively low-lying and flat, and is outside the frost belt, which lies along and among the foothills. This part of the country comprises probably the best wheat land in Alberta. It is an old settled district and is well populated. Wheat is the main crop, but all crops common to the Canadian West are grown here successfully. In the Pincher Creek and Cowley districts winter wheat is the principal crop and large yields are produced.

It is claimed that winter-killing of wheat is practically unknown here, and that a good crop is assured every year. The partial crop failure in 1911 cannot be attributed to winter-killing, as patchiness was remarkable for its absence, and crops seemed to be in splendid condition at the time of inspection.

In the foothills, or ranching country, which includes all the country lying west of a line nine to twelve miles west of the Calgary and Edmonton railway, and consists of the hills and valleys adjoining the Rocky mountains, ranching is carried on. Although the range is becoming more crowded year by year, there is still a large ranching business done. The only crops grown here are for local feed, and consist of green oats, timothy hay, bromus and irrigated wild prairie hay. All these crops grow luxuriantly in this district, and with the aid of irrigation, which is used in a great number of cases, timothy occasionally yields three tons to the acre. Timothy is the main crop, and it is usually sown with a nurse crop of oats, which is cut as green feed the first year.

In a great many places in the valleys of the foothills timothy now grows wild, especially on the low-lying parts along stream beds. Bromus is only grown to a very limited extent, and a good crop is always assured. Clovers seem generally to kill out

the first or second year. Alfalfa, or lucerne, is seldom grown, as very little success has been achieved with it. This probably is due to improper methods of cultivation, rather than to the climate.

A great many trials have been made to grow it, but, so far, with very little success, as winter-killing seems to be the rule during the first winter. The experience of Mr. George Lane on his Willow Creek ranch (Sec. 5, Tp. 14, Rg. 29 west of the 4th meridian) is, however, an exception to the rule, and goes to show that, if reasonable attention and care are given to its cultivation, alfalfa can be grown successfully. At present Mr. Lane has 250 acres in alfalfa, 100 acres of which has been yielding crops for a number of years. No winter-killing has been observed, and no inoculation has been used either on the land or with the seed. The method of cultivation employed was as follows: land was selected that had been cropped for some time; it was then ploughed deeply, disced thoroughly, dragged and levelled; seed was then sown one inch deep and no more, and land was corrugated twenty inches apart for irrigation. About the first of June the seed was sown, care being taken that regular seeding took place. Water was not applied before the fall, and the first year's crop was cut, leaving a long stubble. After the first year the crop was irrigated either twice or thrice, according to the amount of moisture in the soil. The usual time that water was applied was after the first cutting at the end of June, and once in August after the second cutting. If, however, the fall proved to be very dry, another irrigation was given in September. Two cuttings of the crop were made and from two and one half to three tons per acre were harvested.

Some of the farmers sowed alfalfa during the spring of 1911, and in one case, that of Mr. Quail, of Claresholm, in Sec. 36, Tp. 11, Rg. 28 west of the 4th meridian, a good crop was taken off. This crop was grown on some twenty acres of land that had been previously seeded to winter wheat, but, owing to a bad winter-killing, it was reseeded to alfalfa. Some information should be secured regarding the condition of this crop during the season of 1912.

Respectfully submitted,

J. C. MILLIGAN,
Inspecting Engineer.

No. 45.

REPORT OF SPECIAL INSPECTIONS BY P. J. JENNINGS, C.E., SPECIAL INSPECTING ENGINEER.

DEPARTMENT OF THE INTERIOR, IRRIGATION OFFICE.
CALGARY, ALBERTA, March 4, 1912.

F. H. PETERS, Esq.,
Commissioner of Irrigation,
Calgary, Alta.

SIR,—I have the honour to submit the following report upon the work done during the season of 1911, on 'Special Inspections.'

This work was taken over by me on the 17th of May, 1911. After spending some five days in the Calgary office upon the perusal of files and the collection of the necessary plans, &c., I started out on the first tour of inspection on May 21. Owing to the early freeze-up and the extreme cold weather it was not possible to continue this work, economically, after November 28, 1911.

AREA OF TERRITORY COVERED.

The inspections made during the season covered a territory extending from the International boundary on the south to a point as far north as township 67, as far as Crowsnest Pass to the west, and to the east as far as range 14, west of the 2nd meridian. The area within the scope of 'Special Inspection' work includes the provinces of Alberta and Saskatchewan, which together have a total area of some 504,190 square miles. It will be readily understood that in order to reach the many widely scattered schemes throughout this great area long train journeys and equally long drives, often through very sparsely settled country, had to be accomplished.

CLASS OF INSPECTIONS.

The inspections, which were varied in character, covered a wide field of engineering and included small pumping schemes for railway water-tanks, coal mines, etc., larger pumping schemes for municipal waterworks and irrigation, gravity systems of water-supply for both municipal and irrigation purposes, and drainage works for the reclamation of marsh lands. The pumping schemes included the use of a great variety of pumps and a still greater variety of motive power for driving them.

Inspections to determine the feasibility of proposed schemes often required very careful investigation and the acquisition of much local information, the quantity of water available being, in most cases, the most difficult point to decide in order that other interests might be protected.

The explanation and interpretation of the Irrigation Act in regard to the ownership, on private lands, of waters required for various purposes, was a matter that had to be repeatedly explained. The general ignorance of the existence of the Irrigation Act and its application was noted in many instances, in both provinces especially in Saskatchewan.

PROTESTS.

A good deal of time was taken up in enquiring into schemes where protests had been filed. It was, however, usually found that the basis of a protest was due to lack of knowledge regarding the limitations of the privileges sought by the applicant. In other cases it could be traced to jealousy or to old outstanding grievances which had no bearing whatever on the case.

The applications for water at high and flood stages from streams of short-lived, or small, summer flow, are usually the ones where most protests are met with. Misunderstanding usually arises from the fact that little, if any, attention has been given to the most important feature of the applicant's published notice, where the stage of the stream at which water may be diverted is set forth. When this is properly examined the protests are usually withdrawn.

Protests were met with, in some cases, from settlers living from twelve to fifteen miles below the point of the proposed diversion. These protests are usually for loss and damage through the assumed loss of a regular supply of water for domestic use due to the works above them. Where little, if any, information exists regarding the flow of small, fluctuating streams, such as exist on the prairies, many difficulties arise in the settlement of these disputes. It has, therefore, often been necessary to spend considerable time upon investigations, which would otherwise not have been necessary, in order to ensure the passage of sufficient water for the domestic needs of the settlers below during the periods in which it has been ascertained that they are entitled to it. These periods can only be defined when has been ascertained by experiment the stage of the stream at which the losses in transit, etc., between the two points in question exceed the flow. Until this information is procured it is impossible to outline a settlement equitable to both sides.

DRAINAGE.

Drainage for the reclamation of swamp and submerged lands has also had some attention in this year's (1911) inspection work. The difficulty found with this work was the lack of facilities to take soundings in order to check the correctness of the plans submitted and to determine the feasibility of the scheme. In cases where drainage work had already been undertaken, some excellent hay lands had been reclaimed. As a general rule, these schemes are very beneficial to the surrounding country and are usually welcomed by the settlers. The chief feature of this work has been the investigation of protests against the granting of the application. In some cases these protests have been well founded and the applications have been disapproved, while in others there has not been found sufficient ground for protest.

DIFFICULTIES ATTRIBUTABLE TO WIDELY SCATTERED INSPECTION.

There are many difficulties which occur on this work through the schemes being so widely scattered which add greatly to the cost of each inspection, but, at the same time, are unavoidable. In the first place it would not be economical to take a competent assistant out on this work owing to the unavoidable loss of time in getting from one place to another and the consequent high cost of transportation. The result is that wherever a survey, a line of levels or an important stream gauging is required, it is necessary to employ inexperienced helpers. This not only impedes progress until the helpers have become familiar with the work, but there are also constant worry and danger of incorrect work.

SCHEMES INSPECTED, COST, &C.

The number of schemes inspected and reported upon during the season amounted to 78; of these schemes 39 were in connection with irrigation, 23 for industrial purposes, eleven for municipal and domestic purposes, four for drainage, and one special inspection. In connection with these 78 schemes, seven amended plans were prepared, one scheme was surveyed and complete plans made for the works, and three explanatory plans were made to accompany reports. In order to carry out this work it was necessary to travel over four different railway systems, the total rail-mileage amounting to 5,340 miles. To reach the many outside inspections it was necessary to travel 1,909 miles with team and wagon.

The total expenditure on this work for the season, including my own salary, amounted to $1,827.88 for the 78 inspections made, or at the rate of $23.43 per inspection. When it is considered that for each inspection made it was necessary to travel, on an average, 93 miles, and that to the cost of this must be added other incidentals, such as board and accommodation, team and man-hire and a proportion of the time lost through bad weather, the cost does not appear excessive.

The number of days lost on account of bad weather was 14; lost in travelling, approximately, 60; Sundays, 28; making a total of 102 days. The total number of days available, including Sundays, was 192; thus 90 days were left for 78 inspections, or at the rate of 1·1 days per inspection. For the whole season this would work out at the rate of 1 inspection for 2·3 days.

On account of the large number of inspections that are already on hand for the season of 1912 it will be possible to work in a great many more inspections on each tour, and, by a careful arrangement of the inspections to be made on each tour, the average cost per inspection can undoubtedly be reduced. It is impossible to limit or define the cost per inspection, as the amount of work varies so greatly with each scheme, and it is, therefore, only possible to strike a general average cost for the season.

Respectfully submitted,

P. J. JENNINGS,

Special Inspecting Engineer.

No. 46.

REPORT OF P. M. SAUDER.

DEPARTMENT OF THE INTERIOR, IRRIGATION OFFICE,
CALGARY, ALBERTA, May 3, 1912.

R. H. CAMPBELL, Esq.,
Director of Forestry,
Ottawa.

SIR,—I have the honour to submit herewith a brief report from Mr. P. M. Sauder, Chief Hydrographer, upon the work of Stream Measurements which has been done during the past season, 1911-12.

Your obedient servant,

F. H. PETERS,
Commissioner of Irrigation.

REPORT OF P. M. SAUDER, C.E.

DEPARTMENT OF THE INTERIOR, IRRIGATION OFFICE,
CALGARY, ALBERTA, March 31, 1912.

F. H. PETERS, Esq.,
Commissioner of Irrigation,
Calgary, Alta.

SIR,—I have the honour to submit the following brief report on the work of Stream Measurements during the past year.

ORGANIZATION AND SCOPE OF WORK.

As the result of an increased appropriation we were able to extend the work very much during the past year. Considerable reconnaissance was done and a number of new gauging stations were established. In the spring of 1911 field operations were commenced with 98 regular stations and at present we are studying the regimen of flow at 132 regular stations along the various streams in Alberta and Saskatchewan, as well as securing records of the quantity of water diverted by 30 ditches for irrigation purposes. Most of the stations on ditches were established by, or at the request of, the irrigation inspecting engineers. Winter records, which are so valuable for power investigations, have been given considerable attention lately and records have been secured on almost all the important streams in the two provinces during the past winter.

The methods of carrying on the investigations were similar to those of previous years. Local residents were engaged to observe the gauge-height at regular gauging stations. These observations were recorded in a book supplied by the Department and at the end of each week the observer copied the week's records on a postal card which was sent to the chief hydrographer by the first convenient mail. The district hydrographers made regular visits to the gauging stations, usually once in every three

weeks. They examined the observers' records, made discharge measurements and collected such information and data as would be of use in making estimates of the daily flow at the station. The results of the gaugings were transmitted by a postal card to the chief hydrographer. The records of the gauge-height observers and the hydrographers were copied from the postal cards to regular forms in the office at Calgary, and filed. At the close of the open season part of the engineers returned to the office and assisted in the final computations and estimates of run-off. Gauge-height-area, gauge-height mean-velocity, and gauge-height-discharge curves were plotted and rating tables constructed. Tables of discharge measurements, daily gauge-height and discharge, and monthly discharge were also compiled. These records are being recopied and will be embodied in the third annual report of the Progress of Stream Measurements, which will be completed in a month or six weeks.

The organization in 1911 was very similar to that of the previous years. The territory covered having been very much increased during 1911, the staff was increased to include ten assistant engineers, a recorder, a computer and a clerk The territory was divided, for administrative purposes, into ten districts, viz.: Banff, Calgary, Macleod, Cardston, Milk River, Western Cypress Hills, Eastern Cypress Hills, Wood Mountain, Moosejaw and Batt'eford. In each district there was an hydrographer, and while in the field he had an assistant and was equipped with the necessary gauging and surveying instruments. In the Banff, Macleod, Moosejaw and Battleford districts the hydrographer travelled by train or hired livery and stopped at hotels and stopping houses, while in the other districts they were supplied with a team, light wagon and light camping outfit.

BANFF DISTRICT.

This district includes the following regular gauging stations:—

Stream.	Location.	Date Established.
Bow river	S.E. 28-28-16-5	July 18, 1910
"	N.E. 35-25-12-5	May 25, 1909
"	N.W. 32-24- 8-5	Feb. 1, 1912
Cascade river	S.E. 19-26-11-5	Aug. 16, 1911
Devils creek	S.E. 29-26-11-5	June 18, 1910
Ghost river	N.E. 23-26- 6-5	Aug. 17, 1911
Jumpingpound creek	Sec. 30-24- 4-5	May 7, 1908
Kananaskis river	N.E. 33-24- 8-5	Aug. 31, 1911
Pipestone river	S.W. 27-28-16-5	Aug. 31, 1911
Spray river	Sec. 25-25-12-5	July 15, 1910

Bow river, with its many important tributaries, is playing a very material part in the industrial and agricultural development of Alberta. As is well known, large tracts of land lying east of Calgary and also in the vicinity of Medicine Hat are to be irrigated from it. The whole of the normal flow and a large portion of the high-water have already been granted for irrigation purposes. The market for power is increasing and preparations are being made to increase the output of the existing plants and to construct new ones. During 1911 a survey under the direction of the water-power branch of the Department made extensive investigations on the upper regions of Bow and Elbow rivers. With a view to a very comprehensive study of the flow of these streams, several new gauging stations were established and almost all the stations in this district have been maintained during the whole of the past winter. In a few cases the conditions have been so unfavourable that gauge-heights could not be obtained

all winter, but in almost every case discharge measurements have been made regularly at intervals of about two weeks. A large number of miscellaneous measurements at other points and on other streams were also made during the year.

During the months of April and May, 1911, H. C. Ritchie, Grad. S.P.S., was in charge of the field-work in this district. On the first day of May, when Mr. Ritchie was placed in charge of the construction of the rating station, Benjamin Russell, B. Sc., was placed in charge. About the middle of July Mr. Russell was transferred to reservoir-site surveys and Hilton Brown was placed in charge. Mr. Brown left the service in September to resume his studies at the University of Toronto, and V. A. Newhall, B.A.Sc., was in charge of the work in this district from that time until the end of February, 1912, when he resigned from the staff, and H. C. Ritchie has been in charge since that date. The final computations for this district were made by H. R. Carscallen, B.A.Sc.

CALGARY DISTRICT.

This district includes the following regular gauging stations:—

Stream.	Location.	Date Established.
Berry creek	N.E. 21-23 13-4	May 30, 1911
Blood Indian creek	S.W. 10-23- 8-4	June 26, 1911
Bow river	Sec. 13-21-19-4	Aug. 20, 1909
"	N.E. 15-24- 1-5	Nov. 25, 1910
C. P. R. canal	N.E. 36-22- 1-5	May 9, 1908
Elbow river	S.E. 15-24- 1-5	May 8, 1908
Findlay and McDougall ditch	S.W. 31-18-29-4	June 17, 1911
Fish creek	S.W. 26-22- 3-5	May 13, 1907
Highwood river	N.W. 6-19-28-4	May 28, 1908
"	N.W. 17-20-28-4	Oct. 3, 1911
Little Bow ditch	S.W. 6-19-28-4	Aug. 1, 1910
Nose creek	N.W. 13-24- 1-5	April 24, 1911
Pekisko creek	N.W. 8-17- 2-5	Oct. 6, 1911
Sheep river	N.W. 22-20-29-4	May 25, 1908
N. B. Sheep river	S.W. 12-21- 3-5	May 22, 1908
S. B. "	S.E. 17-20- 2-5	May 23, 1908
Stimson creek	N.E. 14-17- 2-5	Oct. 6, 1911

It will be noted that, while the western portion of the old Calgary district has been formed into a separate district, a number of new gauging stations have been established and the territory extended so that this is still a large and important district. Some attention was given to a study of the flow in the tributaries of Red Deer river, but, owing to the distance and difficulty of reaching these, the investigations were not as extensive as desired. The data obtained are, however, of considerable value, as previously there were practically no data at all. Regular gauging stations were established on Berry and Blood Indian creeks. The gauging station on Highwood river at High River is not very satisfactory and a new station has been established near Alderside. If the observer at the new station proves satisfactory, the old station will be abandoned. Stations have also been established on Pekisko and Stimson creeks, tributaries of Highwood river. The station on Bow river near Bassano was established and is maintained by the irrigation department of the Canadian Pacific Railway Company. Mr. A. S. Dawson, Chief Engineer, has very kindly given us copies of the gauge-height records and the results of their gauging. Our hydrographer also makes regular measurements at this station.

H. C. Ritchie was at first in charge of this district also, but, when he was placed in charge of the construction of the rating station, L. R. Brereton was placed in charge of the field-work in this district. After Mr. Brereton left the service in October

to resume his studies at the University of Toronto, gaugings were discontinued at all the gauging stations in this district except those on the Bow and Elbow rivers. These were included in the Macleod district and were looked after during the winter months by N. M. Sutherland. The final computations for this district were made by H. R. Carscallen.

MACLEOD DISTRICT.

This district includes the following regular gauging stations:—

Stream.	Location.	Date Established.
Belly river	N.W. 1-19-22-4	Aug. 31, 1911
Canyon river	N.E. 14- 6- 2-5	July 6, 1910
Connely creek	S.E. 36-7 - 2-5	July 31, 1909
Cow creek	N.E. 14-8 - 2-5	May 26, 1910
Crowsnest river	N.E. 26-7 - 2-5	Sept. 7, 1907
"	N.E. 36-7 - 4-5	July 28, 1910
"	S.W. 12-8 - 5-5	July 28, 1910
Mill creek	S.W. 18-6 - 1-5	July 7, 1910
Mosquito creek	N.E. 30-16-28-4	Aug. 1, 1908
Muddypound creek	Sec. 27-11-28-4	July 27, 1908
Nanton creek	Sec. 20-16-28-4	Aug. 3, 1908
Oldman creek	N.E. 34-7 - 1-5	Sept. 15, 1908
"	N.W. 10-9-26-4	July 12, 1910
Pincher creek	N.E. 22-6 -30 4	Aug. 13, 1906
Southfork river	S.E. 2- 7- 1-5	Aug. 5, 1909
St. Mary river	N.E. 26- 7-22-4	Oct. 13, 1911
Todd creek	S.W. 19- 8- 1-5	Aug. 3, 1909
Trout creek	Sec. 33-11-28-4	July 7, 1911
Willow creek	S.W. 25- 9-26-4	July 1, 1909

This district was well organized soon after the survey was commenced and few changes were made and few new stations established during the past year. The new stations on Belly and St. Mary rivers will furnish valuable data. The importance of St. Mary river as a source of water-supply for irrigation purposes and its possibilities as a source of power are well known and the records at the new station will serve to make the data more complete. The discharge of Belly river near Lethbridge is the drainage of practically the whole of the southwestern portion of the province of Alberta and records at this point will be very valuable for general statistical purposes and, in connection with short series of measurements, will serve as the basis for estimating the flow at other points in the drainage basin. The conditions at the old station on Oldman river near Macleod have very much improved and last year this station was re-established. For some time we were unable to secure an observer at any suitable site on Trout creek above the intakes of the ditches but last year one was secured and a new station was established and the old one abandoned.

Gauge-height observations and discharge measurements have been taken throughout the past winter at all the regular gauging stations on the larger and more important streams. A large number of miscellaneous discharge measurements, which will be very valuable as general information, were also made during the year.

Owing to the coal miners' strike, industrial development in the Crowsnest district was slightly retarded during 1911. The water-supply is, however, becoming more important, and, while there is no necessity for establishing any additional gauging stations, there should be no interruption in the records at those already established. A. W. P. Lowrie, Grad. S.P.S., was in charge of the field-work in this district until the end of September, when he returned to the University of Toronto

to resume his studies. N. M. Sutherland, Grad. of the Royal Military College, has been in charge since Mr. Lowrie left. The final computations for this district were made by H. J. Duffield, C.E., and G. H. Whyte.

CARDSTON DISTRICT.

This district includes the following regular gauging stations:—

Stream.	Location.	Date Established.
A. R. & I. canal	S.W.21- 2-24-4	July 26, 1910
Belly river	S.E. 21- 6-25-4	May 27, 1909
"	N.E. 5- 2-28-4	Nov. 1, 1911
Christianson ditch	S.E. 12- 3-28-4	Sept. 14, 1911
Crooked creek	S E. 23- 2-29-4	Sept. 15, 1909
Fidler ditch	S.E. 19- 1-26-4	Sept. 13, 1911
Lee creek	N.W .10- 3-25-4	June 28, 1909
Mami creek	N.E.18- 2-27-4	Aug. 13, 1909
N. B. Milk river	N.E.13- 1-23-4	July 21, 1909
"	Sec. 18- 2-20-4	July 17, 1909
Ralph creek	S.W.21- 2-24-4	May 17, 1911
St. Mary river	Sec. 25- 1-25-4	By A.R. & I. Co., 1905.
Waterton river	N.E. 8- 2-29-4	Aug. 26, 1908

While a station has been maintained on Belly river near Stand Off for some time, the importance of this stream as a possible supplementary supply for the A. R. & I. Canal justified the establishment of another station in the vicinity of Mountain View. A cable station was therefore established on the N.E. quarter of Sec. 5, Tp. 2, Rg. 28, west of the 4th meridian, at West's ranch, last fall and has been included in this district.

It was impossible to secure an observer for the gauge on the North Branch of Milk river in Sec. 18, Tp. 2, Rg. 20, west of the 4th meridian, during 1911, but discharge measurements were made at every opportunity.

For several years past the Water Resources Branch of the U. S. Geological Survey has maintained a gauging station on St. Mary river near the International Boundary. Our gauging station at Kimball is only a few miles below and it is thought that a joint station should be maintained. A self-recording water-gauge could be installed, and, by making comparisons of the results of the gauging made by the hydrographers of both countries, records of a high degree of accuracy and results which would be most satisfactory to both countries could be obtained. It is hoped that satisfactory arrangements can be made and a joint station established in the near future.

There are several streams of some importance emptying into the Waterton lakes, but, as no observers are available, regular gauging stations have not been established on these. Miscellaneous discharge measurements of these and several other streams in the district were made whenever possible during the past year.

Winter records were taken at the stations on Belly river, Lee creek, St. Mary river and Waterton river.

L. J. Gleeson, B.Sc., was in charge of the field-work in this district until the end of November, when he returned to the office to make the final computations, and D. D. Macleod, B.A.Sc., was in charge of the field-work during the winter months.

There are only a few irrigation ditches in this district and the hydrographer therefore makes the necessary inspections. Unless urgent, these are usually made in the late summer or early fall when the streams are low and almost stationary and need not be gauged as often as usual.

MILK RIVER DISTRICT.

This district includes the following regular gauging stations:—

Stream.	Location.	Date Established.
Deer creek	S.W. 15-1-12-4	May 26, 1911
"	N.E. 26-1-12-4	May 27, 1911
Manyberries creek	S.E 3-5-6-4	June 17, 1910
Milk river	N.E. 21-2-16-4	May 18, 1909
"	S.W. 35-1-13-4	Aug. 2, 1909
"	S.W. 21-2-8-4	Aug. 5, 1909
"	S.E. 3-1-5-4	Aug. 7, 1909
N.B. river	S.W. 19-2-18-4	July 15, 1909
S.B. "	N.W. 31-1-18-4	July 14, 1909

It was impossible to secure an observer for the gauge on the North Branch of Milk river on the southwest quarter of Sec. 19, Tp. 2, Rg. 18, west of the 4th meridian, during 1911, but discharge measurements were made at every opportunity.

As has been pointed out in former reports, the bed of Milk river is composed almost entirely of sand and loose material, which shifts continually. Discharge measurements had, therefore, to be made at short intervals, and even then considerable difficulty was experienced in compiling reliable estimates of the daily discharge.

As there have been several applications for water for irrigation purposes in the vicinity of Pakowki lake, special attention was given to the records on Manyberries creek. Not only will these be useful in studying the water-supply in this stream, but, by comparing the areas of the watersheds, a fair estimate can be made of the probable run-off in other streams in the Pakowki lake drainage.

It will be noted that two gauging stations have been established on Deer creek. This is only a small stream, but a dispute has arisen between two licensees and data are required at the two points to determine the seepage. As these stations are close to the regular route of the hydrographer, little time is lost in making the gauging and the results are of some interest.

A large number of miscellaneous discharge measurements of the small streams draining into Milk river were made during the year.

In this district, also, the hydrographer makes inspections of, and reports on, irrigation works.

N. M. Sutherland was in charge of the field-work in this district during the month of April, but for the remainder of the open season J. E. Degnan was in charge. Winter measurements were made during the past winter at the regular station on the northeast quarter of Sec. 21, Tp. 2, Rg. 16, west of the 4th meridian, by D. D. Macleod. The final computations for this district were made by J. E. Degnan.

A large number of miscellaneous gaugings, which will be valuable as general information, were made in this district during 1911. No winter records were taken.

M. H. French was in charge of the field-work and also made the final computations. He left early in March of this year for the field so as to be on hand to gauge the first spring freshets.

EASTERN CYPRESS HILLS DISTRICT.

This district includes the following regular gauging stations:—

Stream.	Location.	Date Established.
Axton ditch	N. E. 23-7-21-3	Aug. 12, 1911
Bear creek	S.E. 18-11-23-3	June 22, 1908
E. B. Bear creek	S.E. 21-10-23-3	Aug. 18, 1909
W. B. "	S.W. 32-10-23-3	Sept. 16, 1909
Belanger creek	S.W. 18-7-25-3	June 12, 1909
Beveridge ditch, west branch	N.W. 18-10-24-3	June 5, 1911
" east branch	N.E. 7-10-24-3	June 9, 1911
Blacktail creek	S.W. 31-6-23-3	Aug. 3, 1909
Bone creek	N.W 34-8-22-3	July 2, 1908
Braniff ditch	S.E. 30-11-23-3	July 22, 1911
Bridge creek	N.W. 11-11-22-3	July 29, 1909
"	S.E. 33-10-22-3	April 25, 1911
Cross ditch	N.W. 15-7-22-3	Sept. 9, 1911
Davis creek	N.E. 29-6-25-3	May 24, 1909
Enright and Strong ditch	N.E. 25-6-22-3	July 31, 1908
Fairwell creek	N.W. 30-6-24-3	June 10, 1909
Fearon and Moorehead ditch	N.E. 29-10-22-3	July 6, 1911
" "	N.E. 33-10-22-3	July 4, 1911
" "	S.E. 33-10-22-3	July 6, 1911
N. B. Frenchman river	N.E. 16-7-22-3	July 25, 1908
Frenchman river	N.E. 31-6-21-3	July 31, 1908
Hay creek	N.E. 30-10-25-3	April 22, 1909
"	S.W. 29-10-25-3	July 4, 1910
Jones coulee	N.E. 5-8-10-3	Sept. 23, 1909
Lonepine creek	N.W. 27-7-26-3	July 17, 1909
Moorehead ditch	N.W. 25-10-25-3	June 10, 1911
Morrison ditch	S.W. 26-6-21-3	Aug. 22, 1911
Needham ditch	S.W. 30-11-23-3	June 22, 1911
Piapot creek	N.E. 18-11-24-3	June 17, 1908
Pollock ditch	N.W. 22-7-21-3	Aug. 10, 1911
Rose creek	Sec. 26-7-22-3	May 2, 1911
Skull creek	N.W. 10-11-22-3	June 29, 1908
"	N.E. 29-10-22-3	April 8, 1911
Sucker creek	N.W. 24-6-26-3	May 26, 1909
Swift current	S.W. 22-7-21-3	May 18, 1909
"	Sec. 17-10-19-3	May 27, 1910
"	Sec. 18-10-19-3	June 15, 1910

The remarks regarding the conditions in the Western Cypress Hills district apply also to this district. The greatest irrigation development has been in the Frenchman River drainage basin, and special efforts are being made to get gaugings in this locality during high-water and flood stages of the streams. This, however, is a large district with many long drives, and it is impossible always to be on hand at a particular station when the stream is high. There has also been difficulty in securing good observers. The records have, however, improved considerably during the past year.

Several gauges were installed on irrigation ditches by F. T. Fletcher, irrigation inspector, but, as some of the ditches in this district were not used during 1911, and most of the gauges were not installed until after the irrigation season, few records of the flow have been secured.

As a large amount of water is diverted from Frenchman river above the old gauging station, the records have not been altogether satisfactory. It was, therefore,

WESTERN CYPRESS HILLS DISTRICT.

This district includes the following regular gauging stations:—

Stream.	Location.	Date Established.
Anderson ditch	S.W. 23-6-3-4	Sept. 23, 1911
Battle creek	S.W. 2-6-28-3	July 5, 1910
"	N.E. 33-5-29-3	June 3, 1909
"	N.E. 3-3-27-3	May 10, 1910
Bullshead creek	N.W. 15-9-5-4	Oct. 9, 1911
Cheeseman ditch	S.W. 12-8-29-3	June 24, 1911
Gaff ditch	Sec. 25-5-29-3	July 11, 1911
Gap creek	N.E. 31-11-26-3	May 3, 1910
"	S.W. 3-10-27-3	April 25, 1909
Gilchrist Bros. ditch	S.W. 11-5-27-3	Oct. 16, 1911
Grosventre creek	S.E. 27-9-4-4	Oct. 10, 1911
Lindner ditch	Sec. 10-6-29-3	July 26, 1910
Lodge creek	Sec. 12-1-29-3	Aug. 13, 1909
"	S.W. 15-6-3-4	July 22, 1909
E.B. creek	S.E. 1-7-3-4	Oct. 7, 1911
E.B. Mackay creek	N.W. 36-10-1-4	Oct. 13, 1911
W.B. "	S.W. 23-10-2-4	Oct. 12, 1911
McShane creek	Sec. 4-10-27-3	April 23, 1909
McKinnon ditch	N.W. 20-4-26-3	Oct. 20, 1911
Maple creek	N.E. 16-11-26-3	May 9, 1908
"	S.E. 28-11-26-3	May 4, 1910
Marshall ditch	N.E. 33-5-29-3	July 11, 1911
Marshall and Gaff ditch	S.W. 25-5-29-3	July 11, 1911
Middle creek	S.W. 35-5-1-4	June 21, 1910
"	S.W. 30-5-29-3	July 20, 1909
"	N.E. 4-2-29-3	June 13, 1910
Oxarart creek	N.E. 20-6-27-3	June 15, 1909
Richardson ditch	S.E. 2-5-27-3	Oct. 14, 1911
Ross creek	N.W. 24-9-3-4	Oct. 11, 1911
Sage creek	Sec. 9-1-2-4	Aug. 10, 1909
Sixmile coulee	N.W. 36-6-29-3	July 4, 1911
"	N W. 29-7-28-3	July 22, 1909
Spangler ditch	Sec. 6-7-28-3	July 10, 1911
Starks and Burton ditch	S.E. 17-11-5-4	Oct. 9, 1911
Stirling and Nash ditch	Sec. 22-3-27-3	July 11, 1911
Tenmile creek	S.W. 4-6-29-3	July 21, 1909
White ditch	S.W. 1-9-27-3	June 15, 1911

The majority of applications for water for irrigation purposes during the past few years have come from the Cypress Hills, and, as apparently almost the total flow of many of the streams has already been granted, the records in this district are very important. It is impossible to obtain records on every stream in the district, but stations have been established and are maintained on all the more important streams and, by a careful comparison of watersheds, fair estimates of the probable flow can now be made for many of the smaller and less important streams for the same year. There are, however, very big differences in the run-off for different years, and it will be some years before the records will show the extremes of flow and a reliable mean.

During the past year, M. H. French, who was in charge of the field-work in this district, made a reconnaissance of the country surrounding Old Fort Walsh and the heads of Battle, Lodge, Mackay, Ross and Bullshead creeks and established several new stations. W. A. Fletcher, irrigation inspector, established the gauging stations on most of the irrigation ditches in this district, but, as some of the ditches were not used during 1911 and in other cases the gauge was not installed until after the irrigation season, few records of the flow in the ditches have been secured.

A heavy rain and snow storm in September caused an unexpected flood in many of the streams in this district and the run-off during the fall was higher than the average.

decided to establish two cable stations at points above East End. The cables were stretched late last fall, but, owing to bad weather, the hydrographer was unable to finish these stations. They will be completed and put in good shape this spring, and it is expected that better and more satisfactory records will be obtained. The records on Bridge and Skull creeks have been much improved by the additional data secured at the new stations above the intakes of Fearon and Moorehead's ditches. A gauge was placed on Mule creek, but, as a satisfactory observer could not be secured, no records except periodic discharge measurements were secured.

The storm in September also raised the streams in this district but not as much as in the Western Cypress Hills district.

A large number of miscellaneous gaugings which will be valuable as general information were made in this district during 1911. No winter records were taken.

G. H. Whyte was in charge of the field-work and also made the final computations in this district. It was planned that he should leave in March of this year for the field, so as to be on hand to gauge the first spring freshets, but the 1912-13 appropriation not being available, he cannot leave until after the first of April.

WOOD MOUNTAIN DISTRICT.

There is only one regular gauging station in this district, namely:—

Stream.	Location.	Date Established.
Frenchman river	Sec. 5-5-14-3	May 23, 1910

During 1911, a study was made of the water-supply and possibilities of irrigation development in a large and partially settled district in the southern part of Saskatchewan, including the drainage basins of Lake Chaplin, Lake Johnston, Big Muddy lake, Poplar creek, Rocky creek and the lower part of Frenchman river. Early in June, N. M. Sutherland and myself left Swift Current and made a circuit of the western portion of this district. I returned to Calgary at the end of June and the investigations were continued by Mr. Sutherland.

An account of the work done in this district is given in a separate report by Mr. Sutherland. For this work Mr. Sutherland was provided with a light camping outfit, one man and three horses. He travelled about 1,660 miles and reported 109 gaugings. While many of the reports showed that the streams were dry, nearly dry, or had water standing in pools, it should be remembered that a trip had to be made to the stream to learn the condition. Reports on streams even when dry are just as important as when they are running as they show the actual conditions of the stream at that time.

As a result of the investigations during 1911, it has been decided that the possibilities of irrigation in this district are so limited that there will be no necessity to carry on any further reconnaissance on stream-measurement work for the present.

As suggested by Mr. Sutherland, in a few years time the farmers in this locality may wish to use the water from springs for irrigation purposes, and, when such occasions arise, no doubt investigations will have to be made of the schemes.

The records of flow for the regular station on Frenchman river were not very satisfactory. At first we could not secure an observer, and then beavers built a dam below the gauge and caused the water to back up on it. As these difficulties still exist, and there will be no hydrographer in the district during 1912, it has been decided to abandon this station.

MOOSEJAW DISTRICT.

This district includes the following regular gauging stations:—

Stream.	Location.	Date Established.
Boxelder creek	N.E. 2-12-30-3	May 24, 1909
Bridge creek	S.E. 23-13-19-3	Mar. 29, 1911
Bullshead creek	Sec. 16-12- 5-4	July 26, 1909
Long creek	S.E. 10- 2- 8-2	June 22, 1911
Mackay creek	N.W. 26-11- 1-4	July 29, 1909
Moosejaw creek	N.W. 14-15-25-2	April 13, 1910
"	N.W. 16-16-26-2	April 7, 1910
"	N.W. 19-11-18-2	June 21, 1911
Qu'Appelle river	S.W. 33-19-21-2	May 12, 1911
Ross creek	N.W. 31-11- 2-4	July 28, 1909
S. Saskatchewan river	N.W. 31-12- 5-4	May 31, 1911
Seven Persons river	N.E. 30-12- 5-4	April 27, 1910
Souris river	N.E. 11- 2- 8-2	June 23, 1911
"	N.E. 36- 2- 1-2	June 26, 1911
"	Sec. 6- 4-26-1	July 20, 1911
Swift Current creek	S.W. 30-15-13-3	April 30, 1910

It is imperative that records should be continued on Moosejaw creek for several years, and, as there are a number of important streams crossing, and in the vicinity of, the railway between Medicine Hat and Broadview, and between Moosejaw and Melita, it was decided to have an hydrographer look after these by train.

Some time was spent in reconnaissance to find the most suitable sites before the new stations were established. Besides those shown above, stations were established on Qu'Appelle river at points north of the towns of Qu'Appelle and Indian Head, but the current was so sluggish at these two points that the records were not satisfactory and the stations have been abandoned.

J. C. Keith, B.A.Sc., was in charge of the field-work in this district. After the stations had been established he did not retain a regular helper but engaged locally any help he required. Mr. Keith made a number of miscellaneous gaugings and inspected several works to divert water for domestic and industrial purposes.

Winter records were taken at the stations on Moosejaw creek near Moosejaw and Qu'Appelle river at Lumsden during the past winter. They were included in the Batttleford district during that period.

Final computations for this district were made by M. H. French and G. H. Whyte.

BATTLEFORD DISTRICT.

This district includes the following regular gauging stations:—

Stream.	Location.	Date Established.
Battle river	S.E. 19-43-16-3	June 17, 1911
Red Deer river	S.E. 20-38-27-4	Dec. 2, 1911
North Saskatchewan river	N.W 33-52-24-4	May 14, 1911
"	N.E. 29-43-16-3	May 18, 1911
"	River lot No. 76	Oct. 2, 1911
South "	S.W. 28-36-5-3	May 27, 1911

While the North and South Saskatchewan rivers are not likely to be of importance for irrigation purposes, they are large streams and may be utilized for power and irrigation purposes. The watersheds are large and records on these streams will also be of considerable value for general statistical purposes.

Investigations in this district were commenced in March, 1911, when miscellaneous gaugings were made on the North Saskatchewan river at Edmonton and Battleford by W. H. Greene.

In May, H. R. Carscallen was placed in charge of this district and at once established gauging stations at Edmonton, Battleford and Saskatoon. Later, a station was established at Prince Albert, by J. C. Keith.

In 1910, Mr. Keith reconnoitred Red Deer river in the vicinity of Red Deer and found that the most suitable site for a regular gauging station was at a traffic bridge west of Innisfail. Arrangements were made for an observer, but he failed to perform the duty. Gaugings were made at regular intervals at this station during 1911, but no gauge-height observations were secured. In November a further reconnaissance was made, and as the cross-section has improved, and conditions are now fairly good, a station was established at the traffic bridge in the town of Red Deer.

Mr. Carscallen had charge of the field-work in this district until the end of July, when he received leave of absence. After that Mr. Keith included this district in his route. Gaugings were continued during the winter at all the stations except the one on Battle river. Mr. Keith resigned on February 29, and H. J. Duffield was then placed in charge of the field-work in this district. Different members of the staff have done parts of the final computations for this district, but they are only partly finished. They will be finished as soon as possible.

On account of the distance between the stations the travelling and living expenses of the hydrographer are somewhat higher than in the other districts. For several months the hydrographer worked without a regular helper and hired locally what help he required, but, as the rivers in this district are very large, much skill is required in making accurate measurements, particularly the soundings, and so much time was lost with an inexperienced helper that it was decided that the hydrographer should have a regular helper.

RATING METERS.

H. C. Ritchie acted as resident engineer on the construction of the rating station, the design and construction of which was carried out under your personal direction, and is, I understand, taken up in your report.

On the completion of the rating station Mr. Ritchie was transferred to the National Parks Branch and V. A. Newhall was detailed to rate the meters.

All the meters of the survey, except four which were not used during 1911 and one which was badly damaged, were rated and tables were carefully compiled for each. Three meters belonging to the British Columbia Railway Belt Hydrographic Survey and one belonging to the irrigation department of the Canadian Pacific railway were also rated. A number of meters were re-rated just before freeze-up last fall and all the hydrographers are provided this spring with newly rated meters. The spare meters will be rated as soon as possible, and, whenever an hydrographer has reason to believe that the rating of his meter has changed, a newly rated meter will be sent out to him and he will return the old meter. Meters will be rated periodically to test them. It is proposed this year to keep an hydrographer at headquarters to rate meters, look after the taking of gravel from Bow and Elbow rivers within the limits of the city of Calgary, and do any special hydrographic work that may arise.

BENCH-MARKS.

In previous years, when establishing regular gauging stations, the gauge was usually referred to a bench-mark on a wooden stake or stump of a tree. These were

easily shifted or destroyed and were not satisfactory. During 1911, permanent iron bench-marks were established at sixty-two regular gauging stations. Except where the gauge can be referred to a bench-mark on a concrete pier or other permanent structure, all the new gauges, and as soon as possible all the old gauges, will be referred to permanent iron bench-marks. An assumed elevation has been given to each bench-mark but it is expected that the actual elevation above mean sea-level will eventually be determined.

OFFICE-WORK.

As above intimated, the reports of the gauge-height observers and the hydrographers are transmitted to the office by post cards. These are copied on office forms and filed in a cabinet which is carefully indexed and where they can be referred to at any time without trouble. As the engineers completed their computations, the results were entered on convenient forms and filed in the same cabinet.

A cabinet made up of four styles of drawers is used for filing the records. The top section is used for filing the gauge-height books of the observers and the current-meter note-books of the hydrographers. The gauge-height books are filed alphabetically according to the names of the gauging stations, while the current-meter note-books are filed alphabetically according to the names of the hydrographers. The next section contains the post cards sent in by the observers and the hydrographers. Both of these are filed alphabetically according to the names of the gauging stations. The third section is made up of map drawers and contains the gauge-height-area, gauge-height-mean-velocity and gauge-height-discharge curves, and plotted cross-sections, which are filed alphabetically according to the names of the gauging stations. The same section contains the maps showing the outline of the drainage basins filed numerically according to the number of the sectional sheet. The rating curves for the current meters are also filed in this section numerically according to the office numbers of the meters. The bottom section of the cabinet consists of letter-size pockets alphabetically arranged for each gauging station. The tables of gauge-heights, discharge measurements, daily gauge-height and discharge, monthly discharge, and a description of the station and memos of any changes are filed in these pockets. The different rating tables for each meter are also filed numerically in this section and another drawer contains the monthly reports of the meteorological service.

The copying and filing of the reports of the gauge-height observers and the hydrographers is entrusted to the office recorder. While doing this he must carefully examine all records to see that there are no errors or mistakes, and where there are doubtful or impossible records it is his duty to have the data corrected or ascertain the cause of the unusual condition. He also makes out the pay list for the observers and conducts the correspondence relating to the records.

We did not have a regular recorder until about the end of July when R. H. Goodchild was engaged. He is to be placed on irrigation inspections and G. H. Nettleton will be placed in charge of the records.

All computations made by the survey are checked before being used or published. For this reason, as far as possible, men with with some technical education or students in science are engaged as helpers. The gaugings are computed by the helper and his work is checked by the hydrographer. In some instances, where there is a great deal of driving and camping out, the hydrographer cannot secure a helper who can compute discharges, and in that case he computes the discharges himself and his computations are checked in the office. Gaugings of the flow under ice are usually made by using the multiple-point method and vertical-velocity curves have to be plotted to determine the mean velocity in the vertical. The computation by this method is long and tedious and cannot be done by the hydrographer in the

field. There are, therefore, a great many computations to be made in the office and the services of a computer have been required. As a result of not having one, a large amount of checking and computing had to be done by the hydrographers after they returned to the office, and for that reason the computation of daily discharge for 1911 had not been all completed when spring arrived and the hydrographers had to leave for the field. Those that are unfinished are mostly for the months of November and December, when ice conditions prevailed, and considerable time has to be spent in computing the discharge. During the winter months R. J. Srigley, one of the helpers, was utilized as a computer. He is, however, going out in the field again as a helper and a computer is urgently required.

FUTURE WORK.

Investigations will be continued during the coming year in all the old districts except Wood Mountain, and every effort will be made to extend the territory covered by the survey, but the scope of the work is of course limited by the appropriation and staff available.

There are a number of important streams which rise in the mountains west of the Calgary and Edmonton branch of the Canadian Pacific railway. With the advent of railways, industries will soon be started in this district and the water-supply will be an important factor. A small party, such as operated in Wood Mountain district during 1911, should, I think, be placed in this district in the near future.

An effort will be made during the coming year to collect data regarding the flow in the streams along the Grand Trunk Pacific railway west of Edmonton. As soon as funds and staff are available, I think the survey should be extended to include the Athabaska River drainage basin.

I do not think it necessary to elaborate on the importance of continuing observations during the winter on the more important streams. The minimum flow occurs during that season and should be determined for use in considering power schemes. While it was realized that the streams got very low during the winter, the results of the investigations in many cases show much lower discharge than was expected. An instance of the value of winter records may be cited in the case of the Elbow river. Estimates of the possible power development, based on records of the flow during the open season, were found to be far too high when records of the winter flow were taken.

I would also repeat my suggestion of last year that the survey should be extended eastward to include the streams in the province of Manitoba. As the market for power is increasing, the time is approaching when every site will be developed. Reliable estimates of the possible power development cannot be made without a knowledge of the water-supply, and, as records should extend over a period of several years to show the extremes of flow and a reliable mean, it is important that the studies be commenced at the earliest possible date.

The water-supply is one of the most important resources of a country, and an accurate knowledge of the flow of water in nearly all important streams is essential for the solution of many problems in connection with navigation, water-power, irrigation, domestic and industrial water supplies, sewage disposal, mining, bridge-building, river-channel protection, flood prevention, and storage for conservation of flood-waters. The records of the survey are being used quite extensively now by engineers and I think the time is near at hand when the field operations should be extended to include other parts, if not the whole, of the Dominion.

Respectfully submitted,

P. M. SAUDER,
Chief Hydrographer.

No. 47.

REPORT OF N. M. SUTHERLAND, DISTRICT HYDROGRAPHER.

DEPARTMENT OF THE INTERIOR, IRRIGATION OFFICE,
CALGARY, ALBERTA, October 5, 1911.

F. H. PETERS, Esq.,
Commissioner of Irrigation,
Calgary, Alta.

SIR,—I have the honour to submit the following report on the work done in the Wood Mountain district, during the summer of 1911.

In accordance with your instructions, dated May 23, 1911, I proceeeded to Maple Creek, Saskatchewan, where I received my camp outfit, including horses, &c., from Mr. R. J. Burley.

On June 6 we left Maple Creek and proceeded along the Canadian Pacific railway to Swift Current, arriving there on June 10. At Swift Current we met Mr. P. M. Sauder and, accompanied by him, we left Swift Current on June 11.

We at first travelled south from Swift Current and inspected Pierce, Notukeu and Bull creeks. There are small flats along these creeks which are suitable for irrigation and during dry years require irrigation to grow a crop. The water-supply, in this district, however, is very limited. When the snow is melting, or during periods of heavy and continuous rain, there are small floods, but in a dry year, as nearly as can be learned from the older settlers, the flow in these streams gradually diminishes and stops altogether early in the summer. We did not establish any regular stations or gauge-rods at any of these creeks, as at Pierce creek the only available place to gauge it was some three miles from Mr. Pierce's house and at Notukeu and Bull creeks the land is homesteaded and there is no one with permanent residence, and therefore no gauge-rod readers were available.

From Bull creek we proceeded to Huff's ranch on the Frenchman river and re-established the gauge on the northwest quarter of Sec. 5, Tp. 5, Rg. 14, west of the 3rd meridian. From Huff's ranch we followed the north shore of the Frenchman river to Seventy-Mile crossing in Sec. 32, Tp. 3, Rg. 13, west of the 3rd meridian, where we crossed the river, and, after following the south shore for a couple of miles, pulled west out on the benchland and did not touch the river again until we crossed it in Sec. 4, Tp. 1, Rg. 10, west of the 3rd meridian, near the international boundary. Along the Frenchman river there are large flats, which are quite suitable for irrigation, but there is little opportunity of storing water. Most of the level land has been filed on by homesteaders.

Following the international boundary towards the east, we crossed a very rolling prairie which is quite suitable for ranching and grazing purposes. There are a number of streams flowing south and southeast, which had water in pools. From what we could learn from the older settlers, these streams remain in this condition almost every summer but do not have any flow except during the spring freshets.

The streams were all of this nature until we reached Rocky creek in Tp. 1, Rg. 6, west of the 3rd meridian. This creek had a flow of over three second-feet, and is fed by some very strong springs and drains several townships. It has a constant flow and would probably irrigate several hundred acres. Near the international boundary this stream traverses a large flat of several hundred acres which could be irrigated. After following upstream for a few miles we found that Rocky creek passed through bad lands which were impassable with a wagon. We therefore left the creek and

turned northeastward, and, after crossing a very hilly district quite suitable for ranching and grazing purposes, we crossed Rocky creek in Sec. 18, Tp. 2, Rg. 4, west of the 3rd meridian. In this locality the creek flows through a narrow valley, with little opportunity to irrigate. Rainy weather had made travelling very difficult, and, as our supply of oats and food was almost exhausted, we decided to go to Wood mountain for supplies. On reaching there we found that there was no store and we could not get either groceries or oats. It was, therefore, decided to leave the boundary line and inspect Wood river.

One branch of Wood river rises near Wood Mountain post office. This had almost ceased flowing, but a rain storm started a very small flow while we were there. There was a small flow into Twelve-Mile lake, but no overflow. Following this branch of Wood river, which had a little water in pools, we reached the main stream on Sec. 6,

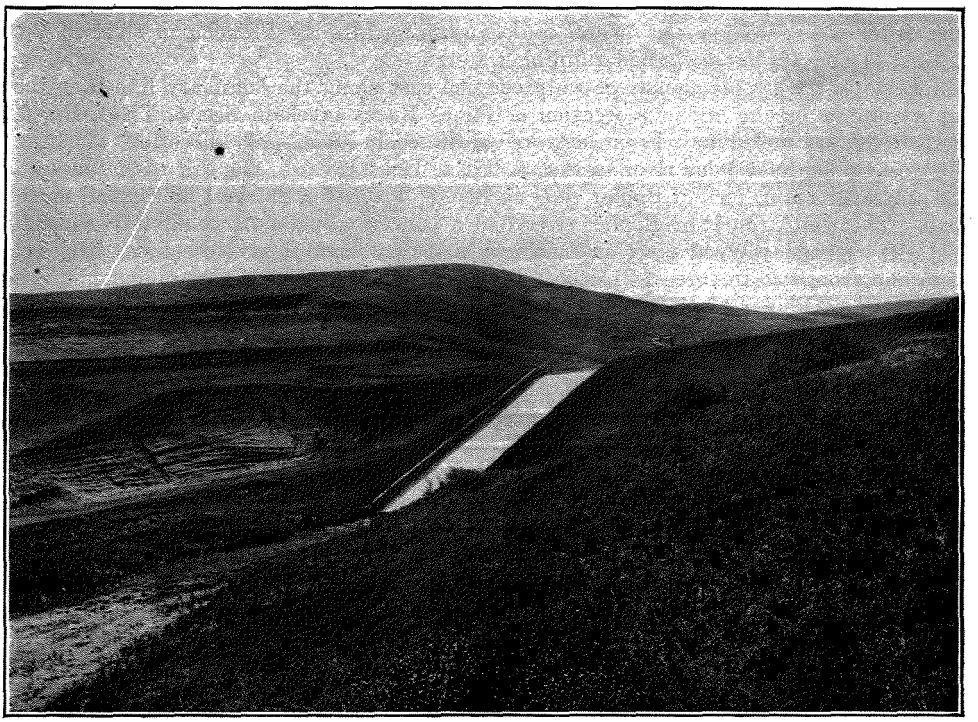


Photo F. T. Fletcher, 1911.
Canadian Pacific Railway dam at Gull Lake, Sask., for station water-supply.

Tp. 8, Rg. 5, west of the 3rd meridian, near Capital post office and inspected it at several points between Capital and Lake Johnston. There is only a very small flow in this stream, and, as it has a very small fall, there is scarcely any current at all. It was impossible to find a place where a meter could be used near Capital. We made a slope measurement, but owing to the dense growth of grass in the channel the results were very unsatisfactory. We made a gauging on Sec. 31, Tp. 10, Rg. 4, west of the 3rd meridian, near Gravelbourg, and found the discharge to be about 6·5 second-feet, but it was impossible to gauge the river near Lake Johnston.

Wood river has a very small fall and is more of the nature of a long slough than of a running stream. The channel is from twenty to fifty feet wide, and is from two to five feet deep. The bottom is composed of soft clay and is covered with weeds and grass. There is so little fall that it would be impossible to take out water by gravity

and a dam would flood a large area of good agricultural land. The drainage basin includes a very good agricultural district, but there is little possibility of irrigation development. Notukeu creek had a small flow near its mouth but Pinto and Wiwa creeks were practically dry at their mouths. There was no flow at all from Lake Chaplin to Lake Johnston and there has not been for several years.

Mr. Sauder left the party at Courval post office, on June 28. Following Mr. Sauder's instructions, I proceeded north to Morse and then to Swift Current.

From Swift Current we proceeded south over the same route as that followed on the previous occasion as far as Seventy-Mile crossing in Tp. 3, Rg. 13, west of the 3rd meridian. On this occasion we struck east from Seventy-Mile for several miles and then south, coming to the Frenchman river in Sec. 34, Tp. 2, Rg. 12, west of the 3rd meridian. We crossed the river here and followed the west shore to McArthur's ranch, Section 18, Tp. 2, Rg. 11, west of the 3rd meridian. Here we left the river and struck southeast across the bench until we reached the boundary line, and then east to the river. We passed several coulees running into the Frenchman river in Tp. 2, Rgs. 11 and 12, but none had running water.

Leaving the Frenchman river we proceeded east along the boundary line over the same route as on the previous occasion as far as Rocky creek in Sec. 5, Tp. 1, Rg. 6, west of the 3rd meridian. From here we continued in an easterly direction, touching the west branch of Poplar river in Sec. 5, Tp. 1, Rg. 3, west of the 3rd meridian, and the centre, or main, fork of Poplar river in Sec. 8, Tp. 1, Rg. 29, west of the 2nd meridian. The west branch of Poplar river had a very small flow of about 0·08 second-feet. It resembles Wood river in many ways, being from thirty to seventy five feet wide and from two to three feet deep. It is full of weeds and is very sluggish. The main fork of Poplar river is also sluggish in many places. The banks are very low for some distance on both sides and are probably covered with water during the early spring. The discharge of this stream was 0·8 second-feet.

On account of running short of provisions we travelled north from Poplar river to Willowbunch. Here, on account of my teamster giving notice of leaving, I decided to return to Swift Current.

From Willowbunch we followed the pole trail to Wood Mountain and then took the old police or Hudson Bay trail to Seventy-Mile crossing. From Willowbunch to Wood mountain, we did not pass any streams, although there is considerable moisture supplied by springs. On leaving Wood mountain we travelled by a good trail over a rolling country which brought us across the head-waters of Wood river, which consists of about twelve creeks running north and northeast. Of these creeks only four had running water in them, and, as the country is rolling, there is little possibility of irrigation. Leaving the head-waters of Wood river we crossed the head-waters of several creeks running south into the Frenchman river. These followed deep coulees, but did not have any flow at that time. Apparently the only time of the year that these creeks flow is during the time that the snow is melting or during very heavy rains. From Seventy-Mile crossing we travelled north to Notukeu creek by way of Huff's ranch following the same trails as we did when going south. We then travelled along Notukeu creek to the northeast quarter of Sec. 29, Tp. 9, Rg. 12, west of the 3rd meridian, passing Pierce creek on the way. Pierce creek had a very small flow at its mouth, but I do not think that this flow would be added to if Mr. Pierce were to discontinue using the north fork of this creek for irrigation purposes. The flow above his head-gates is very small and would in all probability disappear before reaching Notukeu creek. After leaving Sec. 29, Tp. 9, Rg. 12, west of the 3rd meridian we travelled north to the head-waters of Whisky (or Russell) creek in Sec. 36, Tp. 11, Rg. 13, west of the 3rd meridian. This had a discharge of 1·5 second-feet, but there is little possibility of irrigation. From this point we travelled northwest to Swift Current and did not pass any further streams on the way.

After obtaining another teamster I again left Swift Current and travelled south to the Frenchman river at the boundary line, inspecting Pierce, Notukeu and Bull

creeks on the way, also the Frenchman river at Huff's ranch. We followed the same route as on the previous occasion with the exception that when travelling from Seventy-Mile crossing to the boundary line we followed the west shore of Frenchman river as far as Heinrich's ranch in Tp. 1, Rge. 11, west of the 3rd meridian, before striking west to the bench. There are flats along the Frenchman river between McArthur's ranch and Heinrich's ranch which could probably be irrigated by storing water in the coulees which run into Frenchman river.

From Frenchman river we followed the boundary line over the same route as on the former trip as far as Poplar river, inspecting Rocky creek and others crossed on previous occasions. Levels were run on Rocky creek and the west branch of Poplar river. The fall in Rocky creek taken in Sec. 5, Tp. 1, Rg. 6, west of the 3rd meridian, is 2·225 feet per mile, while that in the west branch of Poplar river in Sec. 5, Tp. 1, Rg. 3, west of the 3rd meridian, is 0·5 feet per mile.

From Poplar river (Sec. 1-1-29-2) we continued east over a very rough rolling prairie, crossing the east fork of Poplar river in Sec. 4, Tp. 1, Rg. 26, west of the 2nd meridian. This river has a large flat in Tp. 1, Rg. 26, west of the 2nd meridian, which could be irrigated. The discharge of the river on August 23 was 4·98 second-feet. The country between ranges 25 and 23 was so rough that we had to travel some distance south of the boundary line. No streams were passed until we reached Beaver creek in Sec. 5, Tp. 1, Rg. 23, west of the 2nd meridian, which had a flow of 0·539 second-feet. The country around Beaver creek is very rolling and unsuitable for irrigation. We continued east until we reached Sec. 4, Tp. 1, Rg. 22, west of the 2nd meridian, and, striking a good trail here leading to Plentywood, Montana, and being about out of oats and provisions, we decided to go there to replenish our supply.

From Plentywood we travelled due north to the boundary line at Sec. 1, Tp. 1, Rg. 21, west of the 2nd meridian, and from here to Big Muddy police detachment, in Sec. 10, Tp. 1, Rg. 22, west of the 2nd meridian. There is a large flat here of heavy soil which leads from Big Muddy lake. We followed this flat until we came to the lake and found that there is a very great deal of alkali both at the lake and all along the valley. Leaving Big Muddy lake we travelled west, crossing the head-waters of Beaver creek in Tp. 2, Rg. 24, west of the 2nd meridian. The country was very rolling and the creeks were either dry or had water standing in pools; none were flowing. On striking the trail to Willowbunch we followed it until we reached the town.

From Willow Bunch we travelled southwest to Fife lake and then to J. M. Knox's ranch in Sec. 28, Tp. 3, Rg. 3, west of the 2nd meridian. We passed Hay-meadow creek, which has a very large flat along it, and had a discharge of 13·26 second-feet. This, however, was taken after a very heavy rain and the normal discharge of the creek is very probably somewhat less. At J. M. Knox's place there is a large flat which covers the greater part of the northwest and southwest quarters of Sec. 28, Tp. 3, Rg. 30, west of the 2nd meridian. In a coulee in Sec. 29, Tp. 3, Rg. 30, west of the 2nd meridian, there is a large spring which could be used to irrigate the land owned by Mr. Knox. Owing to the porous nature of the soil, which is a heavy sandy loam, the water from this spring disappears in the NW. quarter of Sec. 28, Tp. 3, Rg. 30, west of the 2nd meridian. Although the country is very hilly for some miles west and south of this point and is probably more suitable for ranching purposes than for agriculture, there are numerous springs throughout the district which lead into small flats which could with small expense be irrigated. Many of the settlers in this district are from the western states and have used irrigation previous to the time of their coming to Canada to live. We made a short trip to a small creek in Sec. 2, Tp. 4, Rg. 1, west of the 3rd meridian, which had a discharge of 0·994 second-feet; there are small flats of about ten acres each which could be irrigated. From J. M. Knox's place we travelled to Mr. Franks' place in Sec. 17, Tp. 4, Rg. 1, west of the 3rd metridian. There is a fine large spring in the SW. quarter of Sec. 17, Tp. 4, Rg. 1, west of the 3rd meridian, which forms the head-waters of Hay-meadow creek. The

fall for several hundred feet from the spring is 1 foot in 100 feet. Mr. Franks could use this spring to irrigate about ten acres in the quarter-section south of him. From this point we travelled to Wood mountain and then followed the same route as we did while Mr. Sauder was with us, as far as Lynthrop in Sec. 1, Tp. 7, Rg. 4, west of the 3rd meridian, taking gaugings of Wood creek in Sec. 20, Tp. 4, Rg. 3, west of the 3rd meridian, and near its mouth at Twelve Mile lake in Sec. 4, Tp. 6, Rg. 3, west of the 3rd meridian. At the latter point the discharge was 4·36 second-feet. This rather large flow was caused by recent heavy rains.

From Lynthrop we travelled northwest to Gravelbourg, crossing Wood river in the NW. quarter of Section 18, Tp. 10, Rg. 4, west of the 3rd meridian. There is a very good cross-section at this point, and it is the only good place to take gaugings which we met with along the Wood river. The discharge here was 5·21 second-feet. Levels were run along Wood river in Section 31, Tp. 10, Rg. 4, west of the 3rd meridian, which gave a fall of but 0·5 feet per mile. While at Gravelbourg we made a trip north, crossing Notukeu and Wiwa creeks, and touched Wood river in Section 4, Tp. 13, Rg. 4, west of the 3rd meridian. On account of the river being very low the result obtained at the latter point was poor.

On leaving Gravelbourg we travelled west along the township line between Townships 10 and 11 as far as Notukeu creek in Section 5, Tp. 11, Rg. 10, west of the 3rd meridian. The discharge here was 11·76 second-feet. Striking north we crossed Russell creek near its mouth at Section 17, Tp. 11, Rg. 10, west of the 3rd meridian (discharge, 1·183 second-feet), and Mosquito creek in Section 20, Tp. 11, Rg. 10, west of the 3rd meridian. From this latter creek we travelled northwest to Swift Current. On receiving your instructions, dated at Calgary on September 18th, I took the transport and camp equipment to Maple Creek, disposing of it there as per your instruction.

With regard to further work in the Wood Mountain district, there is little possibility of irrigation development outside of the Frenchman river, Rocky creek. and some very small schemes in the townships on the west side of Fife lake, and I do not consider that further data in this district are of sufficient importance to warrant the expense of keeping an outfit in this district another year.

Respectfully submitted,

N. M. SUTHERLAND,
District Hydrographer.

No. 48.

SPECIAL REPORT OF THE COMMISSIONER OF IRRIGATION ON LEVELLING OPERATIONS DURING 1911.

The development of a system of levels over the country is the first step towards studying the possibilities of conserving the natural water-resources and ascertaining how much of the water can be put to beneficial use and where it can be so used. Levelling operations would connect the widespread areas in such a way as to determine the possibilities of taking water from the great river-systems and using their latent potentiality in the form of power production or for irrigation, industrial or domestic purposes. Without making any close investigation it may be said that there is more land that would be benefited by irrigation than there is water available for it, and, therefore, steps should now be taken to ascertain the possibilities of making the maximum use of the water available.

The necessity for this kind of information may not be urgent to-day, but undoubtedly will be in the future, and it is far better to set to work now to develop this information in accordance with a well-thought-out general plan than to take

it up hurriedly, at widely separated points, and at greatly increased cost, whenever special information is urgently required.

Some years ago, when the possibilities of irrigation in Canada were first realized, the government undertook some levelling operations which were, to a large extent, the means of developing the possibilities of the two great irrigation schemes now under construction, viz.: the Canadian Pacific Railway scheme at Calgary and the Alberta Railway and Irrigation Company's scheme at Lethbridge. If this work is taken up again it is quite possible that equally great potentialities may be developed in the future.

This work is not a new departure by any means. The idea of developing levels in Western Canada is mainly with a view to developing the natural water-resources, but in all the older countries of the world the topographical features of the land have been developed to a large extent for reasons of general utility. The complete topography of England has been developed by the war department, mainly, it is understood, for the purpose of studying schemes of defence. The topography of practically the whole of the state of New York has been developed to five-foot contours, and the following extract from a paper published in *Engineering News*, September 15, 1910, by E. M. Douglas, Geographer, United States Geological Survey, Washington, D.C., gives a good idea of how much of this work has been done generally in the United States:—

'Exact figures for the total number of miles of line run are not available, but the reports of the U.S. Geological Survey show that since 1897, when such work was authorized by Congress, there have been run over 200,000 miles by that bureau alone, in connection with which more than 24,000 substantial metal bench-marks have been established. The levelling by the Corps of Engineers, United States Army, along the Mississippi and Missouri rivers, amounts to over 5,000 miles. The Lake Survey, in connection with its work, has run nearly 1,000 miles; the Coast and Geodetic Survey more than 13,000, and the Reclamation Service and other bureaus add to the total, so that in all there have been not less than 225,000 miles of line run from which accurate elevations have been determined for more than 30,000 bench-marks on stone or metal.'

The idea in carrying on this work is first, to establish a basic net over the country by levelling over all township lines and setting permanent bench-marks at every township corner. This would give a very good idea of the general topographic features of any section of the country and would be the means of gaining the so-much-needed comparative elevations between the different parts of the country. This work would be carried on first in those districts where the settlement is greatest or where the greatest need for the information is anticipated. Then, when any person undertakes to develop any particular scheme of water-supply or conservation he can tie his detail survey on to any bench-mark which may be convenient and thus relate the elevations of his scheme (which are absolutely the keystone to any water-supply or water-conservation scheme) to the elevations of the surrounding rivers, reservoir-sites, or benchlands, and thus be in a position to work intelligently and without waste of time and money.

The carrying on of this work, and the tabulating of the results by issuing the information in map form, might well be looked upon as an economic method by which the Dominion government might pursue its policy of developing the west by putting in the hands of corporations, companies and the public at large information which would allow them to become acquainted with the possibilities that exist of putting to commercial use Canada's vast water-resources which to-day in the west are, for the most part, lying idle and going to waste.

During the season of 1911 one party was operated in the Maple Creek district with a view to making a start on this work to ascertain how it may best be carried out and to gain some idea of its cost. The result, however, was very unsatisfactory on account of an unfortunate series of circumstances which resulted in very little work being done, the figures of cost, therefore, showing out of all proportion. The weather conditions were adverse, the country in which the party operated turned out to be exceptionally rough, and the services of the engineer in charge, who resigned

at the close of the season's work, proved to be most unsatisfactory. The results of the work are published in this report in the form of a table showing the location and elevations of the points determined. (See page 191.)

In order to indicate the class of levelling work that was aimed at, the instructions that were given to the engineer in charge of the party are reproduced here:—

INSTRUCTIONS FOR LEVELLING.

General Instructions:—

1. The lines run shall, as a rule, be the township lines, but section lines may be run exceptionally to avoid heavy bush or very bad country.

2. There will eventually be established a permanent bench-mark at every township corner. This will be done by a party that will follow the levelling party. The levelling party shall drive one 30-inch iron post at every township corner, leaving 4 inches projecting. The top of this post shall be used as a temporary bench-mark, from which the elevations will be transferred to the permanent bench-mark later. These posts should be planted within six feet of the township corner post and be located from it, and at the place where they will be the least liable to disturbance.

(NOTE.—The permanent bench-marks should have been set immediately, but they were not available ti l late in the season.)

3. The leveller shall get an elevation upon every natural permanent bench-mark that he can find along the line, and his notes of its description and location should be full enough so that no trouble may be experienced in finding it in future. A cold chisel and hammer should be used for establishing bench-marks in rock.

4. At all township, section and quarter-section corners an elevation shall be taken, on top of the post, and also on the ground at the base of the post.

5. The location of all stream-crossings shall be noted, and an elevation taken on their high and low water marks. Small, unimportant stream-beds should have their cross-sections sketched, showing high and low-water elevations. Larger and more important streams should have their cross-sections developed with the hand level, showing high and low-water elevations.

6. From every line run the leveller shall sketch in as much of the topography on both sides of the line as he can, without leaving his level to do it.

Instructions re Instrument work:

1. The rodman shall carry a note book, in which he shall enter all the rod readings. The leveller shall set the target on the rod and then the rodman shall note the reading of the rod in his note book. He shall then not touch the target but carry the rod to the level man, who shall then read the rod and note it in his level book. He shall then compare the reading he has in his level book with the reading marked down by the rodman in his note book. This rule is made to eliminate any chance of the rod being wrongly read.

2. Whenever the weather (high wind, rain, or 'boiling') is so bad that accurate readings cannot be taken the work should be discontinued.

3. Foresights and backsights shall be of equal length, in so far as is possible. The level man shall have a column in his note book for distances, and every time he reads on a turning point he shall read the distance of the rod with the stadia wires and shall note this distance in the columns of his note book, and then between each bench-mark the leveller shall manipulate the length of his sights so that between each bench-mark the sum of the lengths of the foresights shall be equal to the sum of the lengths of the backsights.

4. The level must be examined daily, or oftener, if necessary, for adjustment; the especially important adjustments are the lines of collimation and the level bubble. The steel pegs furnished must be used at all turning points, and in every case they shall be firmly driven into the ground before the rod is held upon them.

5. The rod shall always be plumbed with a rod level.

6. Bench-marks, or turning points, left at the termination of the work at night, or for rain or other causes, must be selected with great care and located in such a manner that there will be no danger of their being disturbed or tampered with, in order that the rod may be again held on the exact spot.

7. In the ordinary routine of work the two level men shall start at the same corner of a township, and shall run over the township lines in different directions, and when they meet they shall check on each other at least once in every township. The maximum error of closure allowed will be 0·021 feet $\sqrt{}$ distance in miles, or the miles shall be re-run. In locating this error of closure, in order to avoid the duplication of work, it may be advisable, instead of running back on the township lines, to run down the centre line of the township.

8. As each township circuit of levels is completed the error of closure shall be divided up between the two levellers in the proportion of the distances they have run. The elevations of the township corner bench-marks shall be at once adjusted in the following manner:—correction to bench-mark elevation: leveller A's part of closure error = distance from initial point of township to B.M.; total distance run by leveller A; the corrections always being made in the right direction.

9. All the computation in figuring the errors of closure shall be shown in neat work in the leveller's books, so that they may be referred to afterwards.

10. The leveller shall always keep his book indexed up to date, and every day's work must show the figures used in checking the notes, which must be done daily.

No. 49.

REPORT OF THE COMMISSIONER OF IRRIGATION ON RESERVOIR-SITE SURVEYS.

The carrying on of the work of reservoir-site surveys is the detailed development of special conservation schemes based upon the topographic network developed by the levelling operations. The remarks regarding the desirability of carrying on this work are noted in the report on levelling operations and apply also in this case. It should be stated that it is not proposed to carry this work to excess, but merely to inaugurate a policy which will make it possible to deal with the really important problems of conservation as they come up and within a reasonable time to develop them and properly and definitely dispose of them.

If this work is not done in considering, for instance, watersheds of an international character, Canada must be under a great disadvantage as compared with the United States, where most elaborate surveys of this kind have been carried on for years. Under the terms of the Waterways Treaty the details of the division of waters of St. Mary and Milk rivers are entrusted to a joint board of commissioners. In discussing all the questions in connection with this matter, the Canadian Commissioners cannot advisedly argue for the mode of division most beneficial to Canada without considering the question 'how much of the flood waters or late fall waters can be stored out of the streams in our own territory?' When these questions come up for consideration there will be a sad lack of information, while, on the other hand, the United States Commissioners will have all these data on their side available for reference. This case is cited merely as an instance of what the lack of this class of knowledge will mean to Canada in the future.

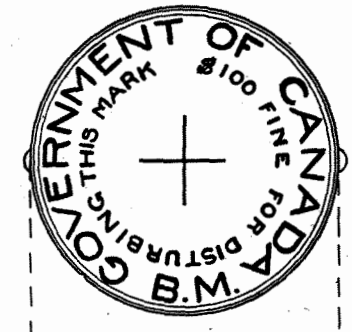
The work of this character which had been planned for the past season was upset by a special survey being made of the Bow River reservoirs under the direction of another branch of the Department after all arrangements had been made by the irrigation office to operate a party on this work. The early misunderstandings in connection with the matter, and the later necessary reorganization made the work very late in starting and it was, therefore, confined to a reconnaissance of the Oldman river at the Gap and of the proposed diversion from the South Saskatchewan river near Elbow, Saskatchewan, for supplying water for domestic purposes to that dry country in the vicinity of Moosejaw and Regina. The report on the first mentioned work was submitted to the Water-power Branch of the Department for action and the report on the latter is dealt with separately in this report.

With regard to the proposed diversion from the South Saskatchewan river there is, apparently, a feeling in the minds of many people in the west that the scheme is visionary. It cannot be denied that the scheme is one of great magnitude, involving large expenditure, and that it will require the most careful consideration of experts before it is undertaken, but the fact remains that there is a dry section surrounding Moosejaw and Regina (roughly speaking) within which no large cities or towns can flourish unless an adequate supply of good water for domestic purposes is secured, and the further fact is self-evident that the only available source of such supply is the South Saskatchewan river.

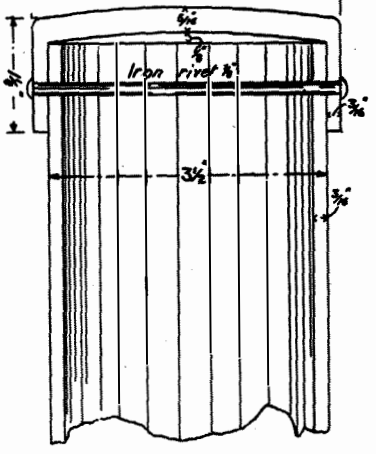
DEPT. OF THE INTERIOR

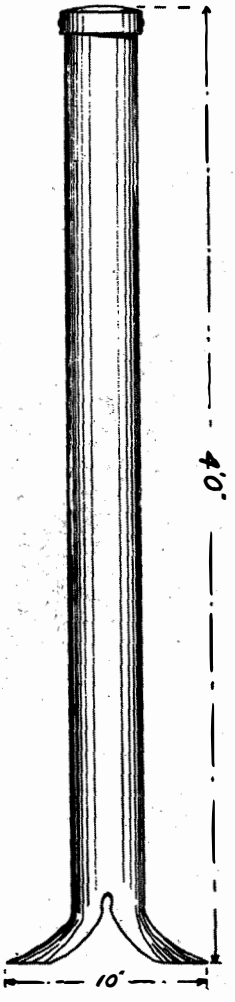
IRRIGATION OFFICE

PLAN OF PERMANENT IRON BENCH MARK



Half Size





No. 50.

REPORT BY THE COMMISSIONER OF IRRIGATION

ON THE

PROPOSED SOUTH SASKATCHEWAN RIVER DIVERSION CANAL.

HISTORICAL.

Although this scheme has lately been taken up by the government of the province of Saskatchewan it should not be forgotten that the credit of first calling attention to the possibilities of the scheme lies with the irrigation office of the Department of the Interior. Mr. J. S. Dennis first mentions this scheme in his official report for the year 1894, again in the year 1895, and in 1896 published a map showing the location of the proposed canal.

REPORT OF WORK DONE DURING SEASON OF 1911, BY B. RUSSELL, C.E.

When Mr. Russell was instructed to undertake this work it was realized that because of the lack of funds to equip the proper field-parties he would not be able to do more than make merely a preliminary investigation. One proposition in connection with this scheme, which has been looked upon with some favour latterly, was the proposition to pump the water out of the South Saskatchewan river over the height of land and deliver it into the head-waters of the Qu'Appelle river. Mr. Russell's work was confined entirely to developing the critical elevation along these lines and his work consisted of running a series of level lines over several heights of land which showed possibilities of feasibility. Mr. Russell was at this work for one month from August 15 to September 14, and had the assistance of only one rod man and a team and driver.

The results of all Mr. Russell's work is plainly set forth on the plans and profiles submitted in connection with this report, but for purposes of convenient reference the results may be set forth as follows:—

The height of land of Aiktow creek in township 24:—

High-water level in river	1,632	feet.
Height of land, head of Qu'Appelle river	1,720	"
Difference of elevation	88	"

The height of land of Sage creek in township 23:—

High-water level in river	1,644	feet.
Height of land, head of Summit creek	1,916	"
Difference of elevation	272	"

The height of land of Shellstone creek in township 21:—

High-water level in river	1,672	feet.
Height of land, head of Thunder creek	1,975	"
Difference of elevation	303	"

All the elevations given above are to the datum of the Canadian Pacific Railway levels.

It should be noted that the pumping of water over the height of land of Shellstone creek would allow the water to run by gravity down to the city of Moosejaw and from there down into the Qu'Appelle river.

The project of pumping the water over the Aiktow creek height of land and allowing it to flow down the Qu'Appelle river would probably be useless, as it would deliver the water into Buffalo Pond lake at an elevation of 1,627 feet, which is about 117 feet below the elevation of the city of Moosejaw. Then, allowing a grade in the Qu'Appelle river of two feet per mile, as the crow flies, the elevation of the water in the Qu'Appelle river at a point southeast of Regina (about twenty miles from Buffalo Pound lake) would be about 1,587 feet or 275 feet below the elevation of the city of Regina. The bed of the Qu'Appelle river is, moreover, of such a character, viz.: black swamp earth, that any water turned into it for domestic purposes would be badly polluted.

Mr. Russell also developed a cross-section of the South Saskatchewan river at a point about midway between the mouths of Aiktow and Sage creeks for the purpose of making a preliminary study of the cost of a dam. This section will give probably as small a cross-sectional area for a dam as any section that can be found on the river in this vicinity. It was also ascertained that the fall of the river water-service in townships 21 to 24, a distance of 31 miles, is 40 feet, or an average fall of 1·3 feet per mile.

STUDY OF PUMPING AND HIGH LEVEL GRAVITY SCHEME.

Before proceeding with this short study it may be stated that this scheme is a very large one and will be very expensive. It is, therefore, impossible for any person to give an advised judgment on the matter until the topographical features of the country have been fully developed, and the feasibility of dam construction in the South Saskatchewan river fully probed. This study is, therefore, made without any of the requisite information being available, and it must be accepted only as a rough, preliminary study made in an attempt to point out what appears to be the most feasible scheme, together with a rough approximation of the cost.

The purpose to be attained by this scheme is to serve that dry country in what may be termed the Moosejaw and Regina districts, and the basis of the study is the requirement to deliver a gravity supply as far east as Regina and at the elevation of the rails of the Canadian Pacific Railway in that city. The quantity of water to be diverted has been taken as stated in the application made by the government of the province of Saskatchewan, which is about 200 cubic feet per second.

It is submitted, as a matter of opinion only, that the only feasible scheme is to place a dam in the South Saskatchewan river and develop there enough water-power to pump the required quantity of water to a sufficient height on the side-hill of the river from whence it can be run by gravity to meet the requirements of the situation, which is to deliver a gravity supply at the elevation of the Canadian Pacific Railway at Regina. The supply must be delivered during both summer and winter for domestic purposes, and, with this end in view, the available water-power in the river has been based on the figures of minimum winter flow.

The cost of a gravity line has been estimated by assuming that the water would be carried in a circular reinforced concrete pipe. It has been assumed that the demand for water will be equal from the intake to the delivery at Regina, where a flow of 50 cubic feet per second has been allowed, and the total length of 170 miles of pipe line has, therefore, been divided into four sections having, from the intake on, carrying capacities, respectively, of 200, 150, 100 and 50 cubic feet per second. The excavation cost has been based on a level section cut for the trench sufficient to bury and cover the pipe everywhere with six feet of earth. In computing the cost of the dam the section used is that one taken in township 24 between Aiktow and Sage creeks, but, in order to suit the assumed scheme, the dam must be placed somewhere in townships 22 or 23. One fact alone which is liable to make the estimate of the cost of the dam seriously in error is that the bottom of the South Saskatchewan river

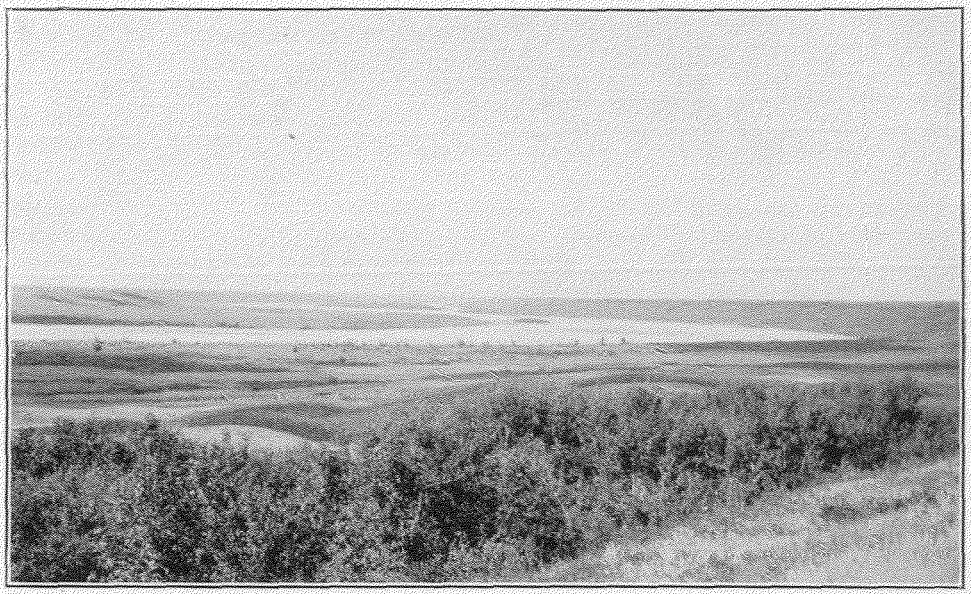


Photo F. H. Peters, 1911.

The South Saskatchewan river at Elbow, Sask.

Photo F. H. Peters, 1911.

A typical view of the Qu'Appelle river, north of Tugaske, Sask.

is known to be most treacherous for the foundations of any structure, and no definite information whatsoever has been gained on this point.

The small-scale map accompanying this report shows the position of the dam and the location of the proposed pipe line, while the calculations following hereafter have been made in such a way that they may be read through understandingly by any person who has followed this preliminary discussion. The unit prices assumed in the estimate are understood to include the cost of many small details and incidentals which have not been calculated. For example, it will not be possible to obtain the minimum excavation section for the pipe line throughout, which will make the quantity of excavation much higher than that calculated.

In conclusion attention may again be drawn to the fact that this study is only a rough approximation and that nothing further can be attempted until the many controlling elements of the scheme have been fully developed by the carrying out of the proper surveys and also river borings to develop the possibilities of a dam foundation.

DETAILED DISCUSSION.

To find the height of dam necessary.

Argument.

H_R = head required for turbines in river to pump Q_C into pipe.
Q_R = available L. W. flow in river assumed = 3000 c.f.s.
C_1 = efficiency of turbines and direct connected centrifugal pumps assumed = 52%
C_2 = loss due to friction in pipes from pump to delivery assumed = 10%
H_C = height of lift to pipe.
Q_C = quantity required in pipe assumed = 200 c.f.s.
Formula $H_R \times Q_R \times C_1 \times (1-C)_2 = H_C \times Q_C$

Study.

Regina elevation	1,862 feet.
Length of canal	170 miles.
Grade of canal = 1 in 10,000 or 0·528 ft. per mile.	
Head required for canal = intake to Regina	89 feet.
Intake of canal (Boldenhurst St.) elevation	1,951 "
L. W. natural at dam (about)	1,653 "
Head required at dam (H_R)	37 "
Top of dam	1,690 "
Lift required—top of dam to canal intake	261 "

To find the cost of the dam.

The dam section developed on the river gives a cross-sectional area from the river-bottom to the crest of the dam, 37 feet above the lower pool, of 118,000 square feet. A preliminary study of the cost of the dam was made by Mr. W. G. Bligh, M.I.C.E., based on a concrete dam of the arched buttress type. The dam-section used was a very economical one, but of a somewhat bold design, and a rough estimate based on it gave a cost of $600,000. Owing to the uncertainty of the foundations and the many contingencies that might arise it would not be safe to estimate the cost of the dam at any less than $1,000,000.

To find the cost of turbines and pumps.

Theoretic H.P. required = ·001892 Q.H. = 12,600.
Allow cost at $15 per H.P. = $189,000.

To find the cost of pressure pipes from pumps at dam to intake of concrete pipe line.

Q = 200 cu. ft. per second.
V = 3 s.f.
A = 67 sq. ft.
R = 4·6 feet (one large pipe).
Area plates required, including laps, 29 sq. ft. per ft. run.
Half-inch wrt. iron plates, weight per foot run, 580 lbs.
Cost, at 6 cts. per lb., about $35 per foot run.
Cost for 1 mile, $184,800.

To find the cost of concrete pipe.

Argument.

1·30 bbl. cement at $3.00	$3.90
0·44 cu. yd. sand at $1.25	0·55
1 cu. yd. stone at $1.50	1.50
Total cost ingredients 1 cu. yd. concrete	$5.95
Cement and stone	$5.95
55 lbs. steel at 3 cents	1.65
Forms, labour, and materials	1.85
Mixing and placing concrete, labour	0·85
Placing steel at 0·2 cents	0·11
Bending steel at 0·06 cents	0·03
Moving forms	0·30
Cost in place, 1 cu. yd. concrete	$10.74
Superintendence, plans, contingencies, &c.	1.26
Total cost in place, 1 cu. yd. concrete	$12.00

To find the cost of excavation.

Argument.

Excavation, cu. yd.	$0·30
Back fill, cu. yd.	0·10
Cost per cu. yd.	0·40
Superintendence, plans, contingencies, &c.	0·05
Total cost, 1 cu. yd. excavation	0·45

To find cost of pipe line.

The grade throughout has been figured at 1 in 10,000 and the discharge of the pipe has been calculated by the Chezy-Kutter formula, using 'N' = ·012.

Study.

Section No. 1, length 42 miles, capacity 200 c.f.s. (see diagram No. 1$_1$).

243,714 cu. yds. concrete at $12.00	$ 2,924,568
Cost per mile, $69,632.	
1,757,818 cu. yds. excavation at 45 cents	791,018
Cost per mile, $18,834.	
Total cost	$ 3,715,586
Total cost per mile, $88,466.	

Section No. 2, length 42 miles, capacity 150 c.f.s. (see diagram No. 2,).

222,192 cu. yds concrete at $12	$ 2,666,304
Cost per mile, $63,481.	
1,576,935 cu. yds. excavation at 45 cents	709,621
Cost per mile, $16,895.75.	
Total cost	$ 3,375,925
Total cost per mile, $80,379.	

Section No. 3, length 43 miles, capacity 100 c.f.s. (see diagram No. 3,).

152,633 cu. yds. concrete at $12	$ 1,831,596
Cost per mile, $42,595.	
1,354,915 cu. yds. excavation at 45 cents	609,712
Cost per mile, $14,179.34.	
Total cost	$ 2,441,308
Total cost per mile, $56,774.34.	

Section No. 4, length 43 miles, capacity 50 c.f.s. (see diagram No. 4,).

127,912 cu. yds. concrete at $12	$ 1,534,944
Cost per mile, $35,696.37.	
1,164,715 cu. yds. excavation at 45 cents	524,122
Cost per mile, $12,206.70.	
Total cost	$ 2,059,066
Total cost per mile, $47,885.25.	
Total cost of pipe line laid, 170 miles	$11,591,885

Summary of estimate of cost.

Cost of dam	$ 1,000,000
Cost of turbines and pumps	189,000
Cost of pressure pipes	184,800
Cost of concrete pipe line	11,591,885
	$ 12,965,685
Total cost, about	$ 13,000,000

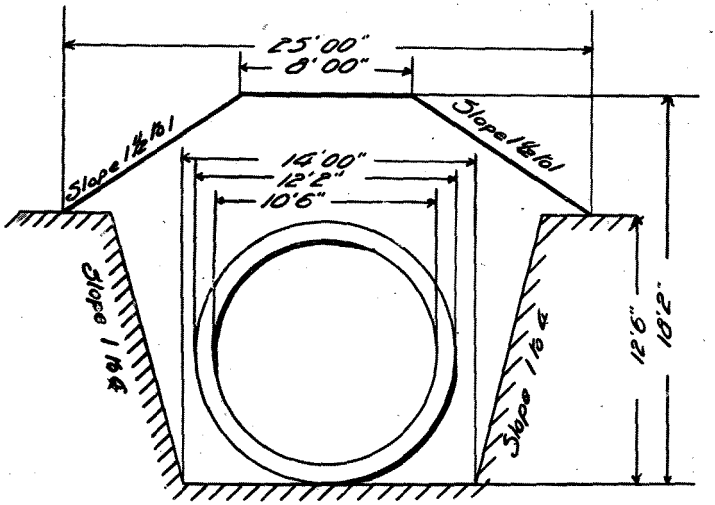


Diagram No. 1.
Showing pipe and excavation for Section No. 1

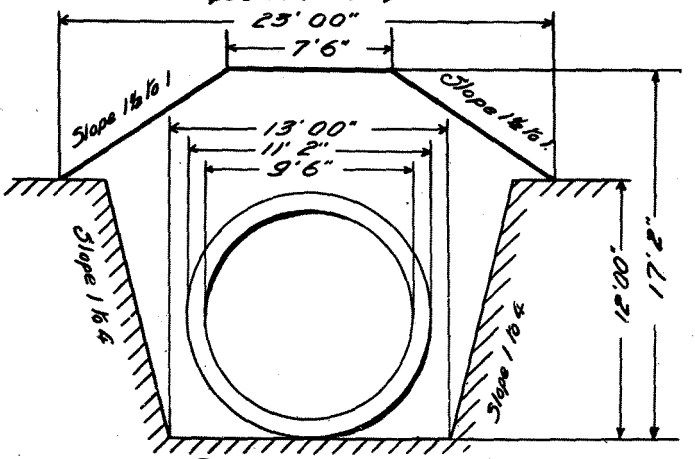


Diagram No. 2.
Showing pipe and excavation for Section No. 2.

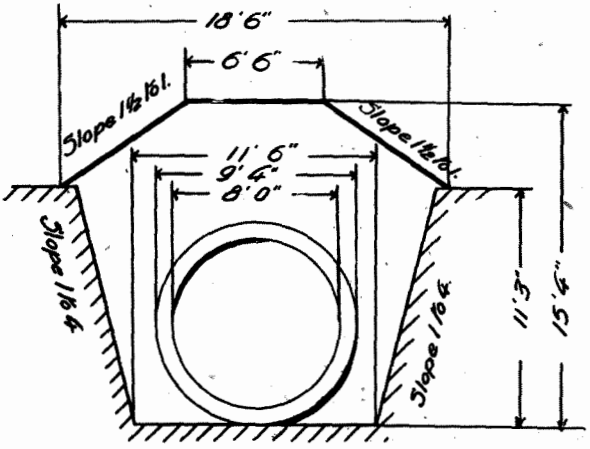


Diagram No. 3.

Showing pipe and excavation for Section No. 3.

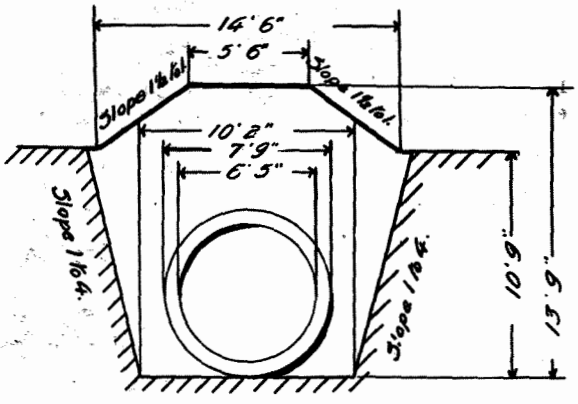


Diagram No. 4

Showing pipe and excavation for Section No 4.

No. 51.

REPORT ON THE CURRENT-METER RATING STATION AT CALGARY, ALBERTA, BY THE COMMISSIONER OF IRRIGATION.

The work of stream measurements has been carried on by the Irrigation Office, Department of the Interior, for a long period of years in the provinces of Alberta and Saskatchewan, but it was not until the early part of 1909 that the great importance of this work was recognized by the Department, and at that time a special Hydrographic Surveys Branch was organized under Mr. P. M. Sauder, C.E., from which time the work of stream measurements has been carried on systematically and extensively.

Prior to this time a current-meter rating station had been established on a slack-water mill-pond on Bow river, at Calgary, but its equipment was never very satisfactory and it finally fell into bad repair and its use was discontinued. Along with the formation of the hydrographic surveys branch was considered the matter of establishing an up-to-date and efficient current-meter rating station, as it was realized that without this equipment, by which means all current meters used could be frequently rated, the current-meter records would be liable to serious errors.

No active steps were, however, taken in the matter until the winter of 1910, when the plans, specifications and estimate of cost for the station and equipment were prepared by the commissioner. The contract for the work was let to the firm of Jones, Blackshire and Lyttle, of Calgary, on May 29, 1911, and was completed by them on July 21, 1911. In carrying out the construction, the steel reinforcing, the steel rails, the cement and the cars were supplied by the Department, and the city of Calgary laid the water-supply pipe to the edge of the rating-station property. Everything else was included in the contract, except some small electrical fittings which were installed after the work was completed under the commissioner's supervision. The total cost of the station and equipment was $4,475.39. The total estimated cost for the station was $4,690.24.

In designing the work the aim was to devise the most perfect apparatus possible for rating the current meters and to create a permanent structure, so that it was early decided to use concrete in the construction of the necessary tank.

As no stretch of still water having a suitable length and depth was available, it was necessary to create a tank, and in studying its design two points had to be principally considered. First, as the water-supply had to be taken from the city mains, the tank had to be made proof against any leakage, as the city authorities were not willing to guarantee any large supply of water such as might be required if any serious leakage from cracks developed in the tank. Secondly, the cross-sectional water area was required as small as possible and yet of sufficient dimensions to guard against any 'following-on' movement of the water, in running the meters through the tank. To overcome the first difficulty a heavily reinforced structure was designed, such that on being emptied and exposed to the weather in winter no temperature cracks could develop, and the inside faces of the tank were waterproofed by Sylvesters' process. In deciding on the proper cross-section of the tank to overcome the second difficulty no data were obtainable, but with the tank as constructed no following-on movement, or undue disturbance of the water, has been observed, even with the largest meters tested at velocities as high as ten feet per second. The length of the tank (250 feet) was adopted in order to bring the cost of the structure within the limits of the amount of money available, but provision has been made in locating

the tank for its future extension to a length of 500 feet, which is desirable in order to attain the highest degree of accuracy.

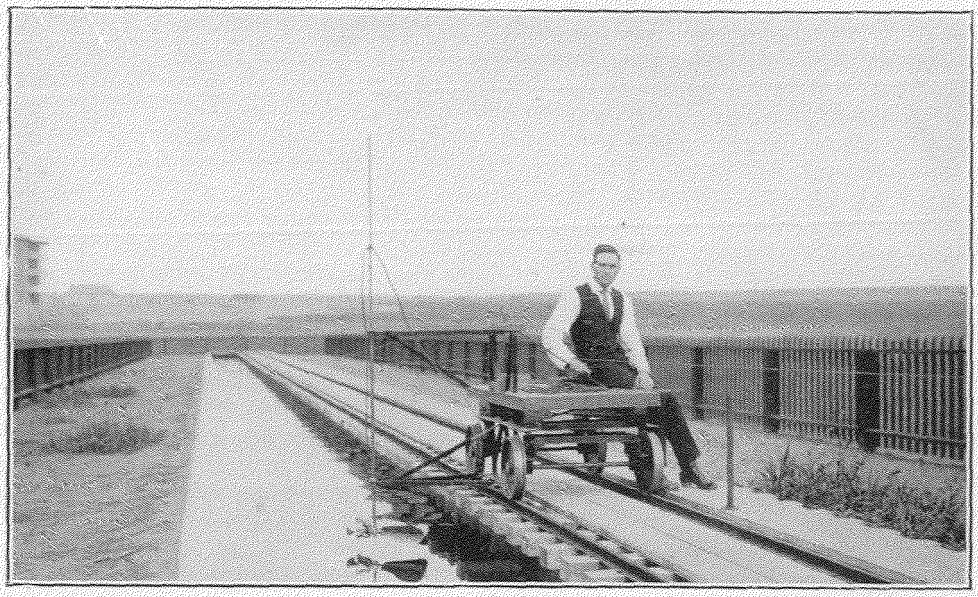
The several points referred to in the description of the station may be made clear by referring to the accompanying plates. The main features of the station are a car on which the current meter is mounted and by means of which it is then run through the water in the tank at different, uniform rates of speed. The three elements—the distance, the time and the number of revolutions of the meter—are mechanically measured, and from these the velocity of travel of the current meter through the water is related to the revolutions per second of the meter, which relation of revolutions to velocity constitutes the rating of the meter.

The concrete tank is 250 feet long, with an inside width and depth of 6 feet by 5 feet 6 inches, and the depth of water to be maintained is 5 feet. The floor and walls are 8 inches thick and are reinforced heavily, longitudinally and transversely, with ½-inch round, mild steel rods, in order to absolutely prevent any temperature cracks in the concrete. The concrete was specified as a mixture of 1 part Portland cement to 7 parts clean river gravel, to have at least 15 turns in a good machine, and to be placed wet and thoroughly tamped. All the interior faces were thoroughly spaded, in order to create a smooth, close-grained surface to which to apply the Sylvesters' wash. All steel rods at joints were overlapped sixteen inches and it was specified that they were to be wired so as to have contact throughout the whole of the length. The tank floor was laid on an 8-inch foundation of large stones overlaid with smaller stones and gravel, in order to provide thorough drainage for any water which might leak through the tank, so that when the tank is emptied in winter and exposed to the weather no heaving might result from any water being lodged under the tank bottom. The soil beneath is of sandy character, which is permeable to water. The water supply is from a 2-inch iron pipe laid from the city mains, and a 6-inch tile drain 224 feet long, fitted with an iron gate valve at the tank, allows the tank to be emptied at any time into the Bow river. After the tank was completed all the inside faces were treated with two coats of Sylvesters' wash. The tank has been exposed, empty, to several cold snaps with the thermometer at thirty degrees below zero, and no cracking of the concrete has resulted, except a few hair-line cracks near the top of the walls. As regards the waterproofing, two observation shafts were left along the tank sides, running down to the foundation, and no leakage whatever was observed during the summer when the tank was full, except a slight dampness at the bottom of the side walls. It should be noted that another reason why it was desired to make the tank leakproof is that it is intended to obtain records of evaporation at the tank in future seasons.

The track laid along the side of the tank for the car is of 16-pound rails and laid to a gauge of 32⅜ inches on 4 x 6-inch ties, fish plates and bolts being used at every joint. In laying the track the greatest care was exercised to get it laid solid and as level as possible, with close rail-joints, in order that the car should run as smoothly as possible. The measured run of the car is 200 feet, 25 feet being left at each end of the track in which to speed up the car, and the track at one end runs into the car house, where the car is kept under lock and key when not in use.

The original idea was that the car should be mechanically driven by an electric motor working on one of the axles of the car. It is an essential that the rate of travel of the car over its measured course should be uniform, but after much consideration it was found impossible to devise any method of control by which the rate of travel of the car could be kept uniform (without acceleration) throughout its run, if driven by an electric motor or other mechanical means. The car is, therefore, propelled by hand, but its design is such that an electric motor can be easily attached at any future date if any means can be devised of overcoming the difficulty mentioned above.

The main features in the design of the car have been copied from the car used by the Bureau of Standards, United States Government, at the current-meter rating



General view of the Current Meter Rating Car at rest.

The Current Meter Rating Car in motion.

station, at Washington, D.C., blue prints of the design of which were kindly loaned by an officer of the Bureau of Standards. The main features of the car are that the axles run in roller bearings and the platform is attached to the front axle by a pinion joint, which makes the level of the platform entirely dependent on the rear axle, and thus any tendency of the platform to be twisted, due to uneven tracks, is overcome. It is thought that this arrangement eliminates practically all the sharp vertical movements which might otherwise be transmitted to the current-meter in its travel through the water. Two horizontal iron arms project from the car to the centre of the concrete tank. When rating the meter with the rod suspension, the meter rods are clamped in these horizontal arms. When rating the meter with a cord suspension and weights, the vertical cord is run down through the sockets used for clamping the meter rods, and a removable iron arm is used for attaching a wire stay-line to the meter. The car wheels have solid flanges and all the iron in the car is of heavy section, the idea being that, with a heavy car running in easy bearings, it would be easier to maintain a uniform rate of travel than with a light car.

In making the run with the meter the count of the revolutions of the meter and of the time interval are both automatically registered in the car house by electric apparatus. The electric circuits from the car into the car house are made by two trolley wires above the car and one wire laid along the ties between the tracks. The circuit from the meter for the count of the revolutions is made by the two trolley wires, while the circuit for the time interval is made by the ground wire with one auxiliary wire, and one of the trolley wires is used for the return.

The diagram submitted will show the layout of the electric circuits clearly. The distance over which each run is made is 200 feet and this distance is marked by two rods set up vertically on the ties at the side of the car. On the car platform are two electric switches, with long arms projecting over the edge of the car platform, and these, engaging with the two rods at 200 feet interval, close the electric circuit for this interval, running through the commutator box on the meter, and thus the revolutions of the meter over the interval of 200 feet are transmitted to the car house, where they are registered by two electric registers set in series in order to check each other on the count. Some difficulty was experienced at first in getting the electric registers to count accurately when running the meters at high velocities, but this difficulty was overcome by always overhauling the commutator box on the meters and making a fine adjustment of the make-and-break apparatus therein. It will be seen that this method of counting the revolutions is liable to be slightly in error, owing to the fact that the registers do not take any count of the fractional revolution of the meter at either end of the run. This error, however, would be reduced to a minimum by increasing the length of the run.

The time interval is counted by a stop watch, which is operated by a simple electro-magnet, with a padded lever attachment, designed by the commissioner, in exactly the same manner that a stop watch is operated by hand. At each rod, marking the 200-foot interval, the circuit running through the stop watch via the two ground wires has inset a one-nipple push-switch, and lugs, underneath the car, make and break the circuit as the car passes these two points, thus starting and stopping the watch at the respective ends of the 200-foot run and thereby counting the time taken by the car in making the run of 200 feet.

The procedure adopted in rating the meter is to make 20 runs for each meter with velocities varying from 0·5 feet per second to 10 feet per second, the increments in velocity for each run from the low speed to the high being as uniformly distributed between the limits as possible. From the data thus gained the revolutions per second, with their corresponding velocities per second, are computed, the points plotted, and among them the most probable curve is drawn. From the rating curve thus constructed the rating table is prepared for use in the field and office, showing

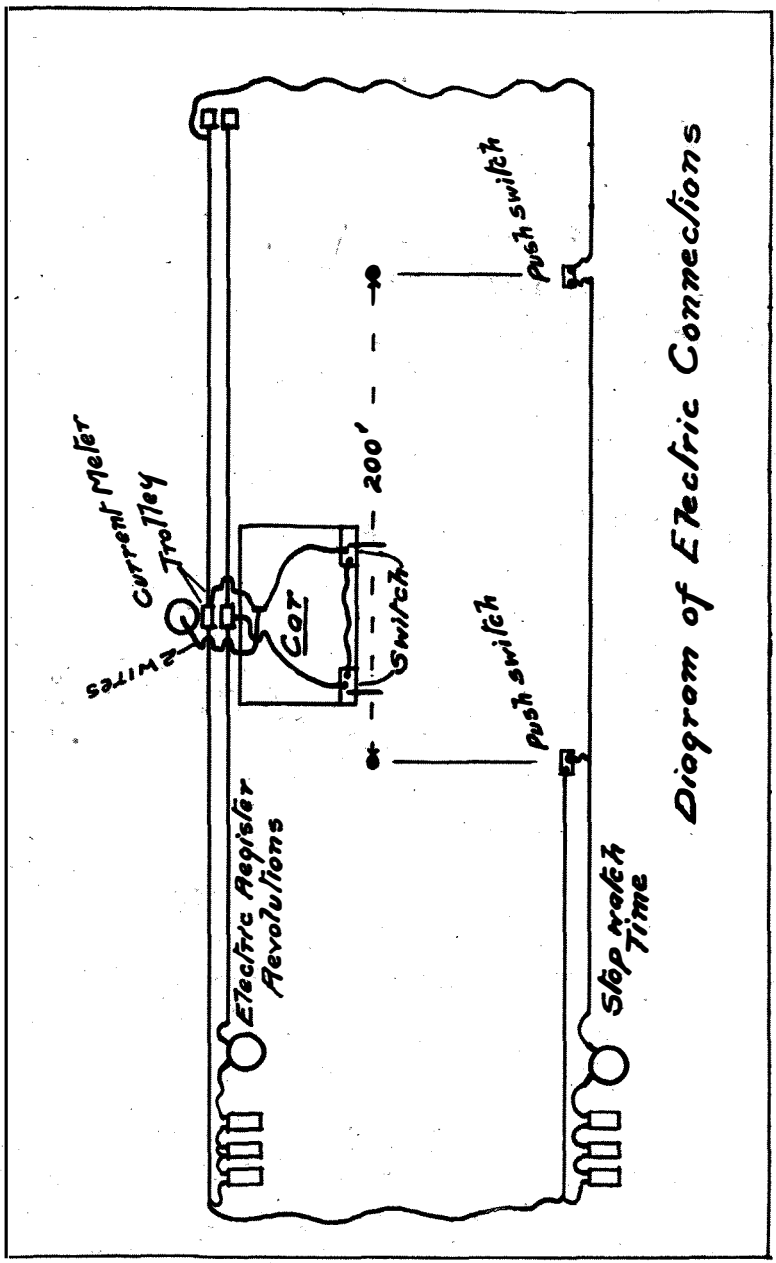


Diagram of Electric Connections
Electric Register Revolutions
Stop watch Time
Push switch
Push switch
200'
Switch
Car
Current Meter
Trolley
Wires

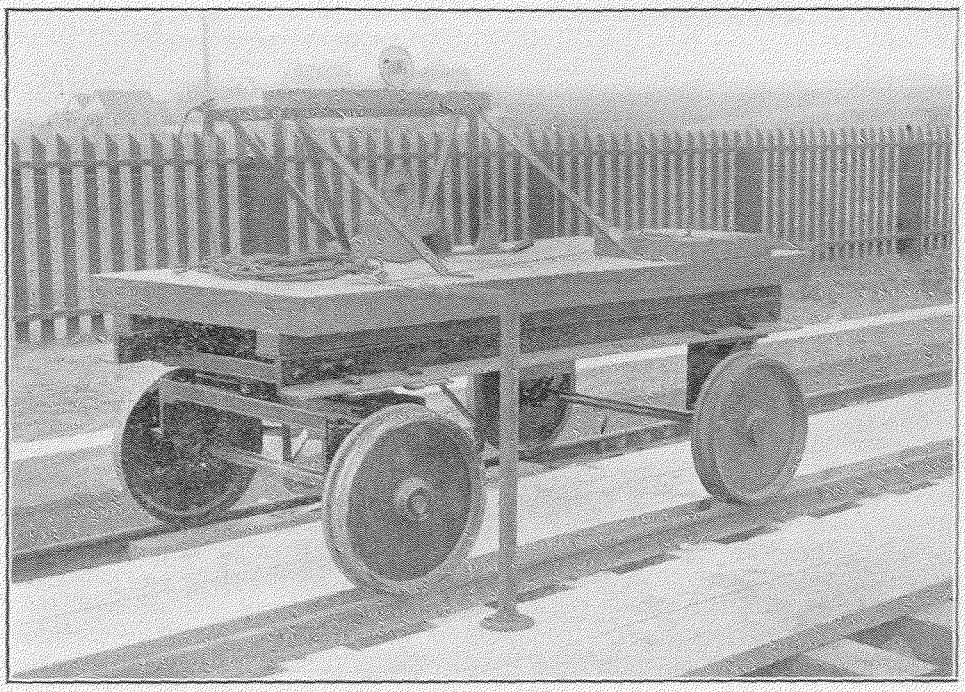
in convenient tabular form the velocities corresponding to the various revolutions per second of the meter from zero velocity up to 10 feet per second. It should here be noted that the rule in the service is not to measure any stream at a section where the average velocity falls below 0·5 feet per second, and a velocity of 10 feet per second is about the highest met with in practice.

Mathematically, the most probable curve is that drawn from values found from normal equations by the method of least squares. It is considered, however, that the method adopted of taking the values from a curve carefully plotted as noted is quite accurate enough to meet all practical requirements, and the saving of time and labour by using this method is very great.

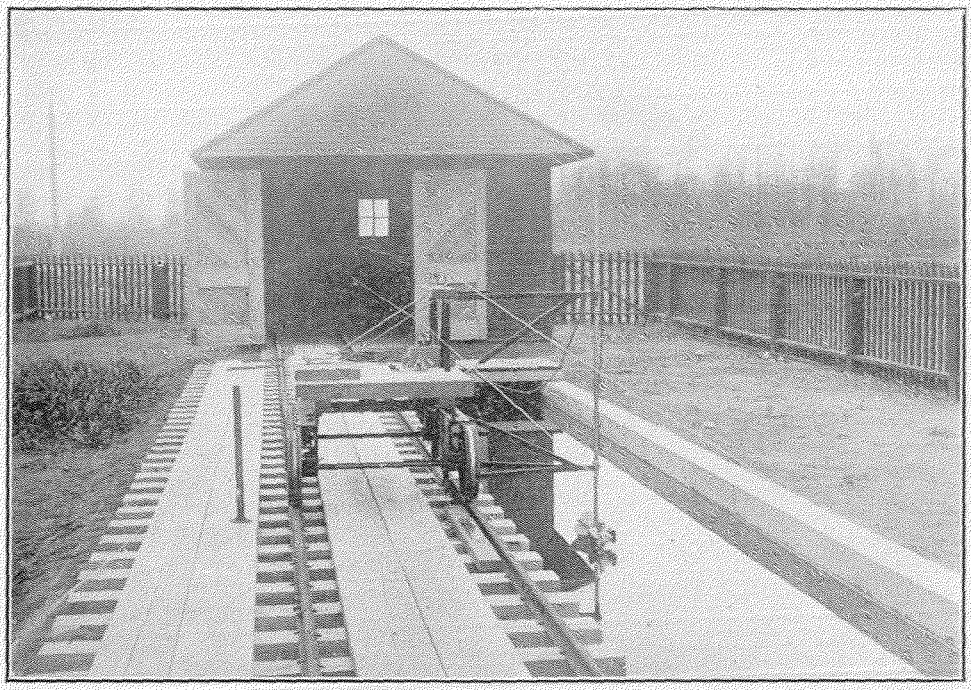
For the purpose of keeping a graphical office record of the successive ratings of the meters a separate sheet is prepared for each meter. On this is first plotted, for purposes of comparison, the standard curve for the meter (Gurleys' standard curve for all Price electric meters) and all succeeding ratings of the meter will be plotted on the sheet in different coloured inks, with notes as to the date of ratings, conditions of the meter, &c., until the confusion of many curves will require the preparation of a new curve sheet. Revolutions per second are plotted as ordinates to a scale of 4 inches to one revolution per second, and velocities in feet per second are plotted as abscissæ to a scale of 4 inches to 2 feet per second. For velocities up to 3 feet per second, an auxiliary curve is drawn with the velocity scale increased to 4 inches to 1 foot per second, to allow for greater precision in taking the quantities off the curve.

It is the intention to carry on extensive experimental work in order to determine the various conditions that affect the rating of the current-meter, especially as it is desirable to rate every large meter using the two methods of suspension; that is, by meter rods and by cable with stay-line. With the limited time available during the past season it was possible to rate the meters only with the rod suspension. Some of the results obtained, however, are surprising, and worthy of note. The commissioner has had a lengthy experience with the use of the Gurley No. 600 large electric meter, and his idea has always been (and he knows that it was shared by other men of experience) that with continued use, on account of the pivot bearings constantly wearing, the friction was increased and that the revolution of the meter was thereby retarded. The experience of the past summer in rating nine of these meters has indicated that, after considerable use, the meters run fast instead of slow. The evidence indicates that with considerable use the bearing points in the meter wear themselves smoother than they come new from the makers, and hence have less friction than when they are new. The experiments, however, have not been exhaustive enough to prove anything conclusively beyond the fact that, except when perfectly new, no current meter can be relied upon unless it is carefully and frequently rated. The new medium-size type of electric meter (Gurleys' No. 623) has been adopted by this office for the first time this year, and, therefore, no experiments could be made on worn meters of this type. Five meters of this type were tested, of which two had been in light use for one season and three were perfectly new. All of these gave a rating curve practically the same as the standard curve issued by Gurleys, but in every case showing the meter running a little faster than Gurleys' standard.

Of the small electric meters (Gurleys' No. 618) nine were tested and all showed nearly the same results, although four of them had been in use for two seasons and five of them were new. At low velocities the new curve coincided with Gurleys' standard curve, but as the velocities increased the new curve dipped below the standard, which means that the meter was running slower than the standard. This may have been due to the bending, at high velocities, of the small meter rods by which the meter was suspended from the car. This bending from the vertical of the meter rods was actually noticed to take place, but no opportunity was obtained to use a stay-line to keep the rods vertical and thereby test the effect of the bending on the rating



View of Current Meter Rating Car, showing trolleys and switches.



End view of Current Meter Rating Car, showing car house behind

of the meter. As indicated above, it is the intention to carry on extensive experiments in the future to determine the effect of the method of suspension of the meter on the rating. In practice, all of the large streams are measured by suspending the meter in the stream with a cord and employing a stay-line to hold the meter up against the current. Under these conditions, especially with high velocities, there is a tendency for the meter to sway continually from side to side at right angles to the current, and it will be interesting and important to determine what effect this has on the revolutions of the meter. Identical conditions will not be obtainable at the rating station, as the length of the cord suspension will, of necessity, be much shorter than that used either from a cable-car station or from a highway-bridge station, and this factor will no doubt enter largely into the amount of sway that the meter will have. Four rating curves are submitted with this report, in order to show graphically actual results obtained in rating meters of different types during the past summer. Explanatory notes have been added (which do not appear on the original office copies) and the curves were selected to show typical cases.

Mr. V. A. Newhall had charge of all the meter ratings during the past season, and, under his direction, the working parts of the station were finally tuned up and the electric switches and recording apparatus were finally adjusted and improved to overcome difficulties met with in operation. To him, also, the commissioner is indebted for the notes on the behaviour of the several types of meters on being rated.

In conclusion it may be said that the irrigation office is prepared to rate any meters that may be sent in by any engineers or others desirous of having their current-meters tested, and a certified rating table will be prepared and returned with the meters. A small fee will be charged to cover only the actual time of the engineer and his assistant employed in making the rating and preparing the table and this fee will be based on the salaries paid to the men by the Department.

TABLES OF PRECIPITATION AND TEMPERATURE IN ALBERTA AND SASKATCHEWAN.

These tables have been prepared from the reports of the Meteorological Service of Canada, and old reports of the irrigation office at Calgary, and both rain and snow have been included under the head of precipitation by estimating ten inches of snow as equivalent to one inch of rain. The headings of the several columns will make the tables quite clear. The tables are being published in their present form in order to facilitate the study of the conditions of precipitation and temperature, both for the whole year and for the irrigation season, as they have actually existed during that period of years for which official records have been gained. It is hoped that the tables will prove useful and instructive in studying the question of water-supply as affecting irrigation.

TABLE OF PRECIPITATION AND TEMPERATURE AT BANFF, ALBERTA.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1895					Snowfall, 92·5.
1896	15·86	5·65	34·3	50·9	
1897	23·40	13·70	34·7	52·8	
1898	20·58	13·86	35·5	52·0	
1899	26·34	17·04	34·0	49·3	
1900	23·29	13·36	37·3	51·0	
1901	19·27	12·10	36·5	49·9	
1902	30·59	21·51	34·8	49·7	
1903	24·82	14·97	35·1	49·9	
1904	14·80	6·70	36·4	51·8	
1905	15·97	11·01	36·8	51·5	
1906	14·78	8·78	37·5	52·6	
1907	23·56	14·89	34·8	49·9	
1908	21·09	10·96	36·82	52·42	
1909	21·56	8·15	33·46	51·64	
1910	16·08	7·65	36·95	51·00	
1911	19·17	10·47	33·51	49·70	
Mean for period	20·68	11·91	35·53	51·00	

TABLE OF PRECIPITATION AND TEMPERATURE AT PINCHER CREEK, ALBERTA.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1895	20·23	12·43			Records not complete
1896					
1897		10·16	39·2	56·6	Rainfall = 11·46. Records not complete.
1898					No records.
1899					"
1900					"
1901		12·73	41·3	53·7	Records not complete
1902	27·57	22·66	39·1	55·3	
1903	18·05	13·35	39·4	63·4	
1904	9·48	7·32	39·7	55·3	
1905	14·52	9·78	40·9	55·7	
1906		18·40	41·5	56·0	" "
1907					No records
1908					Records not complete
1909	25·91	13·89	37·42	55·46	
1910		9·15		55·58	" "
1911					" "
Mean for period	19·28	12·98	39·81	56·34	

TABLE OF PRECIPITATION AND TEMPERATURE AT MACLEOD, ALBERTA.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1895	.....	.....	.....	.....	Records not complete
1896	12·73	8 71	40·8	59·2	
1897	12·77	7·43	41·8	61·4	
1898	13·58	9·95	42·2	60·0	
1899	17·76	11·63	38·7	56·8	
1900	10·08	6·79	43·1	58·6	
1901	12·21	9·95	42·4	56·4	
1902	.....	7·48	.....	57·1	Records not complete
1903	.....	5·43	.....	56·0	" "
1904	5·34	3·71	39·8	55·6	
1905	11·63	6·75	41·9	58·2	
1906	20·82	15·18	40·3	56·5	
1907	12·48	9·20	39·2	54·3	
1908	18·11	13·77	41·76	57·7	
1909	14·78	10·02	38·76	57·8	
1910	.....	.....	44·19	58·78	Records not complete
1911	.....	15·15	38·66	55·42	" "
Mean for period	13·52	9·41	40·97	57·49	

TABLE OF PRECIPITATION AND TEMPERATURE AT LETHBRIDGE, ALBERTA.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1902	28·13	24·48	41·5	56·9	
1903	14·82	10·74	41·7	57·0	
1904	11·40	7·33	42·4	60·2	
1905	13 78	10·24	43·7	60·1	
1906	22·48	16·60	43·7	59·9	
1907	15·50	11·75	41·4	57·0	
1908	16·16	11·94	43·98	59·78	
1909	11·69	7·57	39·98	59·72	
1910	7·34	4·16	44·88	59·98	
1911	22 03	17·29	39·67	57·08	
Mean for period	16·33	12·21	42·29	58·76	

TABLE OF PRECIPITATION AND TEMPERATURE AT CALGARY, ALBERTA.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1885	12·91	9 32	37·05	53·6	
1886	11·32	5·98	38 04	56·2	
1887	13·69	9·12	33 86	54·1	
1888	17·51	11·29	35·15	54·6	
1889	11·59	6·41	39·54	54·7	
1890	14·94	10·86	35·68	54·5	
1891	10·44	8·74	37·71	55 0	
1892	7·91	5·13	36·12	53·6	
1893	11·05	7·17	31·76	53·9	
1894	11·71	8·02	37·17	55·3	
1895	15·12	10·99	36·76	53·1	
1896	16·05	8·12	36·00	55·6	
1897	20·58	15·02	37·10	57·8	
1898	15·58	11·84	37·80	56·6	
1899	26·15	21·46	34 70	53·0	
1900	17·57	12·18	38·60	54·1	
1901	22·31	16·47	39·20	53·3	
1902	34·57	30·75	37·00	52·7	
1903	22·77	19·91	37·50	52·6	
1904	11·89	8·71	36·90	54·2	
1905	14·12	10·02	39·00	54·6	
1906	16·24	13·50	39·30	55·6	
1907	14·96	11·48	36·70	52·66	
1908	18·25	15·68	40·69	56·02	
1909	16·03	11·98	35·97	55·78	
1910	11·79	8 53	37·88	54·98	
1911	19·38	15·08	35·67	52·68	
Mean for period	16·16	11·99	36 99	54·47	

TABLE OF PRECIPITATION AND TEMPERATURE AT EDMONTON, ALBERTA.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In	In.	Deg. F.	Deg. F.	
1895	14·68	8·99	36·7	54·6	
1896	15·24	8·89	34·8	56·0	
1897	14·55	10·93	36 7	58·3	
1898	10·91	6 68	38·2	58·5	
1899	20·89	15·30	34 6	54·9	
1900	27·81	17·73	37·8	55·8	
1901	27·53	21·19	39·0	55·1	
1902	20·66	16·35	36·9	55·2	
1903	21·06	15·05	37·6	54·5	
1904	18·87	11·52	36·1	55·6	
1905	15·56	12·98	39·6	56·9	
1906	.....	10·47	.....	57·3	Records not complete.
1907	9·88	4·94	35·2	53·4	
1908	.....	13·57	.....	56·76	" "
1909	12·88	9·01	33·88	57·20	
1910	14·93	11·05	38·38	55·66	
1911	20·67	17·05	35·99	55·46	
Mean for period	17·74	12·45	36 76	55·95	

TABLE OF PRECIPITATION AND TEMPERATURE AT MEDICINE HAT, ALBERTA.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1883	1·55				Oct., Nov., Dec.
1884	14·93	11·27	37·77	59·9	
1885	9·37	6·77	42·67	61·5	
1886	6·72	4·02	42·27	64·0	
1887	9.89	7·55	37·78	60·8	
1888	14·54	12·26	38·64	60·5	
1889	7·98	5·09	42·42	61·2	
1890	9·13	7·16	39·67	61·6	
1891	13·65	9·41	41·34	61·4	
1892	12·24	7·03	39·69	61·6	
1893	14·60	8·38	37·15	60·4	
1894	13·14	8·16	41·48	62·4	
1895	14·13	9·84	39·70	59·1	
1896	17·88	9·33	39·90	61·2	
1897	17·27	10·41	39·90	63·6	
1898	15·90	7·73	40·90	62·1	
1899	22·28	15·97	39·90	59·7	
1900	21·39	13·52	43·60	62·2	
1901	20·80	15 79	43·30	59·6	
1902	13·90	9·41	41·50	59·9	
1903	9·90	8·03	41·90	59·9	
1904	9·70	5·93	42·00	62·2	
1905	8·99	6·81	43·80	61·8	
1906	12·62	9·31	48·00	62·4	
1907	6·86	4·89	40·70	59·46	
1908	10·22	7·83	44·69	63·18	
1909	9·80	7·16	41·13	63·62	
1910		5·19		62·44	Records not complete
1911		10·85		60·46	" " "
Mean for period	12·99	8·75	41·22	61·37	

TABLE OF PRECIPITATION AND TEMPERATURE AT SWIFT CURRENT, SASKATCHEWAN.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1886	10·62	5·17	37·62	60·7	
1887	18·01	12·17	31·73	57·4	
1888	14·09	8 94	35·37	57·5	
1889	10·46	6·73	39·02	57·9	
1890	17·50	10·14	36·02	58·0	
1891	24·55	16·16	36·76	57·2	
1892	20·25	10·42	35·90	58·4	
1893	13 87	6·80	33·78	57·5	
1894	9·66	5·80	38·03	61·3	
1895	12·33	9·46	36 60	56·9	
1896	14·11	9·32	37·70	59·0	
1897	16·24	11·24	38·00	62·1	
1898	15·25	9·37	37·90	59·7	
1899	19·38	14·91	35·50	57 1	
1900	14·60	11·52	40·80	60·8	
1901	18·58	14·86	40·20	59·0	
1902	17·64	13·99	38·40	57·6	
1903	18·38	13·68	38·20	56·6	
1904	12·84	8·37	37·50	58·5	
1905	15·68	12·61	40·10	58·9	
1906	19·02	13·72	39·80	58·7	
1907	13·17	8·56	35·80	55·1	
1908	12·60	5·82	39·71	59·6	
1909	19·26	16 60	36·02	59·6	
1910	10·47	7·84	40·67	57·8	
1911	14·28	10·95	.....	.....	Records not complete.
Mean for period	15·49	10·58	37·48	58·5	

TABLE OF PRECIPITATION AND TEMPERATURE AT CHAPLIN, SASKATCHEWAN.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1883	2 20				Oct., Nov., Dec.
1884	18·94	12·08	34·24	60·48	
1885					Record not complete
1886		3·63		56·14	" "
1887	5·37	2·05	34·97	61·06	
1888	4·91	1·86	35·81	60·66	
1889	3·78	1·88	39·91	61·94	
1890	5·26	1·98	38·13	59·96	
1891			37·72	60·80	" "
1892					" "
1893	2·91	0 72	34·21	62 00	
1894	4·08	0·72	37·19	62·28	
1895	5·58	2·52	34·30	51·60	
1896	9·66	5·41	34·60	57·30	
1897	6·56	2·77	35·00	60·50	
1898	6·40	3·73	36·20	61·10	
1899	5·90	3·61	33·10	56·00	
1900	4·77	1·84	38·00	59·10	
1901	4·42	2·30	37·60	58·70	
1902	9·26	6·32	37·50	59·10	
1903					" "
1904					" "
1905	11·63	6·75		60·60	
1906	20·23	11·90	36·10	57·60	
1907	24·08	14·93	30·90	52·72	
1908	15·11	7·99	35·78	56·92	
1909	22·13	16·01	33·19	58·32	
1910	13 29	9·42	37·56	56·60	
911	20·48	13·32	32·58	54·86	
Mean for peri d	9·87	5·81	35·64	58·72	

TABLE OF PRECIPITATION AND TEMPERATURE AT MOOSEJAW, SASKATCHEWAN.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1895			33·7	56·1	Rainfall 9·32 in.
1896			33·3	56·9	" 9·89 in.
1897		3·23	33·8	6 01	Precipitation for year not known.
1898			34·3	57·4	Rainfall 8·02 in. snowfall not known.
1899		11·18	32·1	55·9	Rainfall 12·04 in.; snowfall not known.
1900			36·3	58·7	Precipitation for year not known.
1901		12·90	36·5	57·5	Rainfall 12·75 in.; snowfall not known.
1902		9·26	34·8	55·5	Rainfall 9·73 in.; snowfall not known.
903		15·97	34·3	54·6	Rainfall not known.
1904		11·56	33·2	55·8	Rainfall 12·53 in.; snowfall not known.
1905	18·72	16·02	36·5	56·8	
1906		14 39	36·7	58·2	
1907		8·08	31·5	52·7	Rainfall 9·20 in.; snowfall not known.
1908					Records not complete.
1909	18·94	14·95	35·11	60·3	
1910	12·60	9·13	38·98	58·4	
1911		11·69		56·6	Records not complete.
Mean for period	16·75	11·53	34·72	56·9	

TABLE OF PRECIPITATION AND TEMPERATURE AT REGINA, SASKATCHEWAN.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1883	.....	4·29	.....	.....	May, June, July.
1884	11·46	7·91	.....	.....	Records not complete.
1885	4·89	1·01	32·81	55·90	
1886	1·90	0·29	32·92	60·54	
1887	2·42	1·43	30·54	57·80	
1888	10·75	6·43	31·63	57·70	
1889	4·39	1·61	36·49	58·04	
1890	13·63	9·55	34·17	57·32	
1891	14·82	11·14	33·21	56·56	
1892	12·52	7·35	31·52	56·95	
1893	8·05	3·54	30·17	58·06	
1894	.....	2·74	.....	61·48	May, June, July.
1895	11·30	9·14	32·20	56·00	
1896	18·90	14·31	32·40	57·30	
1897	9·32	5·53	33·20	59·50	
1898	13·28	11·45	32·80	57·50	
1899	.....	7·93	32·00	55·60	Records not complete.
1900	11·81	9·61	.....	59·40	" "
1901	19·02	16·07	35·30	58·30	
1902	15·22	13·19	35·50	54·90	
1903	.....	13·58	33·50	55·00	" "
1904	15·38	10·48	32·10	55·40	
1905	18·05	14·78	35·00	56·30	
1906	18·81	14·02	35·80	58·10	
1907	14·17	11·63	.....	.....	" "
1908	14·24	9·48	34·75	56·56	
1909	20·27	16·12	32·42	58·56	
1910	13·81	10·16	36·30	56·12	
1911	18·55	13·41	31·88	55·26	
Mean for period	12·67	8·89	33·19	57·31	

TABLE OF PRECIPITATION AND TEMPERATURE AT QU'APPELLE, SASKATCHEWAN.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1895	11·23	6·70	33·0	55·5	
1896	21·63	15·01	33·1	57·1	
1897	12 65	8 38	34 0	59·7	
1898	21·65	14·24	34·2	57·7	
1899	19 25	11·75	32·1	55·8	
1900	16·52	9·69	36·4	59 6	
1901	26·47	16·05	36·3	58·2	
1902	24·37	14·44	35·7	56 7	
1903	20·09	15·53	35·6	55·3	
1904	22·22	11·92	34·0	56·3	
1905	24·57	19·73	37·0	57·0	
1906	20·39	13·14	37·2	59·1	
1907	18·53	14·76	.....	.....	Records not complete.
1908	18·69	10·14	36·0	56·9	
1909	25·75	17·52	32·9	57·9	
1910	20·66	13·52	36·8	55·7	
1911	.....	.....	.....	.....	Records not complete.
Mean for period	20·25	13·28	34·9	57·2	

TABLE OF PRECIPITATION AND TEMPERATURE AT INDIAN HEAD, SASKATCHEWAN.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1895	.....	.....	33·0	55·8	Records not complete.
1896	.....	.....	32·3	56·7	Ann. rainfall 11·19 in.
1897	.....	13·05	33·1	59·7	Records not complete.
1898	20·63	16·03	33·3	57·3	
1899	.....	9·84	31·5	55·9	" "
1900	15·46	11·84	35·5	59·2	
1901	23·26	17·42	35·1	58·3	
1902	16·01	10·49	34·2	56·0	
1903	18·95	14·99	34·1	55·1	
1904	20·09	11·45	32·7	55·8	
1905	22·77	18·45	36·2	56·6	
1906	17·61	11·64	36·4	58·6	
1907	18·13	14·65	31·6	52·6	
1908	18·31	10·96	35·6	57·2	
1909	19·59	14·08	33·2	58·7	
1910	.....	12·64	36·7	57·3	Records not complete.
1911	23·62	15·75	32·4	56·2	
Mean for period	19·54	13·55	33·9	56·8	

TABLE OF PRECIPITATION AND TEMPERATURE AT BATTLEFORD, SASKATCHEWAN.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1891	....	7·27	..	57·28	
1892	11·06	10·07	34·03	58 26	
1893	10 95	9·34	30·81	56·98	
1894	13·47	9 33	34·92	59·46	
1895	12·01	10·17	32·70	54·90	
1896	12·93	8·35	32·50	58·00	
1897	16·53	13·62	34·00	60·20	
1898	14·24	9·50	34·00	58·90	
1899	18·42	14·34	32·40	56·80	
1900	20·41	26·71	34·90	58·20	
1901	16·57	12·47	35·70	57·40	
1902	13·49	9·40	34·30	56·50	
1903	16·06	11·46	33·90	55·40	
1904	16·60	10·38	33·40	56·50	
1905	10·62	8·79	37·10	57·60	
1906	16·64	7·88	36·80	59·20	
1907	10·11	8·81	32·20	54·80	
1908	15·92	12·27	35·13	57·46	
1909	9·62	8·85	30·52	59·90	
1910	7·85	7·38	36·50	57·34	
1911	....	16·87	....	55·76	Records not complete.
Mean for period	13·55	10·63	33 99	57·47	

TABLE OF PRECIPITATION AND TEMPERATURE AT SASKATOON, SASKATCHEWAN.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1895	....	....	.....	.....	Records not complete.
1896	....	.....	.....	....	" "
1897	....	....	.....	.....	" "
1898	.....	.....	.. . .	....	" "
1899	....	.....	.....	.....	" "
1900	.. ..	....	.....	58·7	" "
1901	....	.....	....	56·7	" "
1902	....	....	31·7	54·0	" "
1903	.....	. .....	31·5	55·1	" "
1904	19·50	12·81	31·7	54·7	
1905	10·85	9·14	34·9	55·6	
1906	19·51	12·81	31·7	54·7	
1907	10·38	7·77	30·1	52·6	
1908	14·15	9·68	... .	56·9	" "
1909	15·87	11·09	32·03	59·72	
1910	10·75	8·97	36·23	56·40	
1911	19·42	13·08	31·92	55 08	
Mean for period	15·05	10·67	32·42	55·85	

TABLE OF PRECIPITATION AND TEMPERATURE AT PRINCE ALBERT, SASKATCHEWAN.

Year.	Precipitation.		Mean Temperature.		Remarks.
	Total for Year.	Total for Irr. Season.	For Year.	For Irr. Season.	
	In.	In.	Deg. F.	Deg. F.	
1895	14·14	8·67	31·8	54·7	
1896	19·64	10·11	30·6	55·8	
1897	18·03	10·46	32·4	57·7	
1898	15·79	8·90	32·7	56·7	
1899	29·88	21·51	30·5	55·0	
1900	22·40	15·41	33 2	56·4	
1901	19·46	14 00	34·0	56·5	
1902	20·01	13·83	33·2	55·4	
1903	16·87	10·50	32·2	53·4	
1904	16·60	10·69	31·7	54·6	
1905	19·27	14 08	34·9	56·1	
1906	17·05	8·71	34·5	56·7	
1907	.....	.....	.....	.....	Records not complete.
1908	.....	.....	.....	.....	" "
1909	18·64	11·37	30·95	57·98	
1910	7·40	3·88	35·03	55·42	
1911	.....	13·24	.....	54·30	" "
Mean for period	18 13	11·69	32·69	55·71	