PROVINCE OF ALBERTA

Research Council of Alberta. *Report No. 31.*

University of Alberta, Edmonton, Alberta.

SOIL SURVEY DIVISION

Preliminary Soil Survey of The Peace River-High Prairie-Sturgeon Lake Area

BY

F. A. WYATT
Department of Soils
University of Alberta, Edmonton, Alberta

(Report published by the University of Alberta at the request of Hon. Hugh W. Allen, Minister of Lands and Mines)
1935

Price 50 cents.

PROVINCE OF ALBERTA

Research Council of Alberta. *Report No.* 31.

University of Alberta, Edmonton, Alberta.

SOIL SURVEY DIVISION

Preliminary Soil Survey of The Peace River-High Prairie-Sturgeon Lake Area

BY

F. A. WYATT

Department of Soils

University of Alberta, Edmonton, Alberta

(Report published by the University of Alberta at the request of Hon. Hugh W. Allen, Minister of Lands and Mines)

1935

Price 50 *cents.*

LETTER OF TRANSMITTAL.

DR. R. C. WALLACE,
Director of Research,
Research Council of Alberta,
University of Alberta,
Edmonton, Alberta.

Sir:—

I beg to submit a report entitled "Preliminary Soil Survey of the Peace River-High Prairie-Sturgeon Lake Area," prepared in co-operation with Dr. J. L. Doughty, Dr. A. Leahey and Mr. A. D. Paul. A soil map in colors accompanies this report.

This report is compiled from five adjacent surveys conducted between the years 1928 and 1931. It includes all of two and parts of the other three surveys. The area included in the report is about 108 miles square with McLennan as the approximate geographical center.

Respectfully submitted,

F. A. WYATT.

Department of Soils,
University of Alberta,
Edmonton, Alberta,
April 15th, 1935.

TABLE OF CONTENTS

Preliminary Soil Survey of the Peace River-High Prairie-Sturgeon Lake Area

BY

F. A. WYATT*

The present report and accompanying map are compiled from the field surveys of five individual parties conducted between the years 1928 and 1931 inclusive. It contains the entire mapped area between Aggie and Bezanson covered by Ward's party in 1930; the entire area between High Prairie and Peace River coverd by Holowaychuk and Paul in 1931; a small part of the Lesser Slave and Swan Hills area covered by Doughty in 1928; a small portion of the southern part of the area between the Peace River and Fort Vermilion on the east side of the river covered by Doughty in 1930; and the southern portion of the area between Grimshaw and Keg River covered by Leahey in 1929. In addition information is included for the area between Peace River and Bluesky. This latter portion (Peace River-Bluesky) has not been included in a definite survey, but in the course of our ordinary field duties we have been able to secure the approximate location of the various soil areas. No soil surveys have been made of that portion of the mapped area between the Smoky and Peace rivers from Watino to Belloy.

Description of the Area.

The area covered by the report is located west and northwest of Lesser Slave Lake (see sketch map, Plate I). It is found within and adjacent to the Peace River-High Prairie-Sturgeon Lake area. The town of McLennan is approximately the geographical center of the area. The borders of the mapped area extend from 50 to 60 miles north, south, east and west from McLennan. A more specific location is that area between R. 11, W. of the 5th Meridian, and R. 2, W. of the 6th Meridian, and Tps. 69 to 86 inclusive. The area is approximately square, being 108 miles north and south by about 108 miles east and west, thus giving 11,644 square miles of territory (7,465,000 acres, of which 6,445,000 are mapped).

The general topography of the mapped area is undulating to rolling, with rough parts occurring along the main drainage courses and again in certain parts of the hilly sections. The extreme difference in elevation varies from about 1,100 feet at the water level on the Peace river at the northern part of the area to about 4,000 feet on the top of the Swan hills in the southeastern corner of the area (Tp. 69, R. 12). However, the elevations of the plateau part of the mapped area vary from approximately 2,000 to approximately 2,500 feet. There are a few hilly sections with elevations from

*Grateful acknowledgment is hereby made to Dr. J. L. Doughty, Dr. A. Leahey, Messrs. A. S. Ward, N. Holowaychuk and A. D. Paul, who were responsible for the field surveys covered by this report.

about 2,500 to 2,900 feet. These rougher hilly areas are found in the following locations: A part of the Clear Hills plateau in the northwestern part of the mapped area, the Puskwaskau hills just north of Sturgeon lake, the hilly elevation just south of Snipe lake, and the northern slope of the Swan hills in the southeastern corner of the area. In addition to the above rough hilly areas there is considerable rough land along the main drainage courses and their tributaries.

The water level of the main drainage courses, such as the Smoky and Peace rivers, is from 800 to 1,000 feet below the general level of the adjacent plateau.

DRAINAGE.

The main drainage of the mapped area has its outlets through the Peace and the Athabaska river systems. The greater part of the area (about 4/5) is drained through the Little Smoky and Peace rivers, together with their tributaries, whereas only the extreme southeastern part (about 1/5) is drained through Lesser Slave lake and the Athabaska river. There is a very small area near Utikuma lake which has its outlet through this lake and the Wabiskaw river into the Peace.

The most important tributaries entering the Little Smoky river from the east are: Sweathouse creek draining the area south of Snipe lake, Snipe creek (draining Snipe lake), the creek draining Iroquois lake and adjacent territory, Peavine creek and Racing creek (draining Magloire lake). Those entering the Little Smoky from the west are Sturgeon creek (draining Sturgeon lake), Clouston and Wabatanish creeks draining the country to the east and north of Puskwaskau hills, the Puskwaskau river draining the country to the west of the above hills, the Simonette river draining the extreme southwestern portion. The latter two streams have their outlet into the Smoky river.

The Bearhead and Benjamin creeks unite to form Harmon river. These streams drain the country south and east of Peace River. The Harmon enters the Peace at Peace River. The northern and northeastern part of the area has its drainage outlet through the Cadotte river and its tributaries.

The northwestern corner of the mapped area has its drainage outlet through Bear creek (draining Cardinal lake) and then through the Whitemud river into the Peace.

Most of the streams entering the Peace and Smoky rivers have eroded valleys from one-half to one mile wide and about as deep as the river valleys where they enter the main streams. At distances of several miles from the Peace and Smoky rivers the valleys have decreased in size and depth until they no longer form rough and eroded lands.

The most important streams tributary to Lesser Slave lake are the following: From the south and west Driftpile river, Sucker creek, East Prairie and West Prairie rivers, Iroquois creek; from the west and north Heart river, Salt and Shaw creeks. In general

none of these streams have deep cut valleys as have those entering the Little Smoky and the Peace river.

Low lying and flat areas, subject to intermittent flooding, are found at various places along stream courses and adjacent to the lakes. The most extensive area where serious flooding occurs at rather frequent intervals consists of the hay meadows adjacent to Lesser Slave lake and also along the streams especially north of the railroad from Enilda to High Prairie.

In other parts of the surveyed area where the topography is especially flat with small depressions the natural drainage is not adequate to take care of the waters during periods of heavy rainfall. This condition has made it possible for the growth and development of muskegs (Plate III), which in certain areas cover a fairly large proportion of the district.

TIMBER.

The greater part of the surveyed area is or has been covered by trees (Plate II, Fig. 1). At present many areas are found where fires have partly or completely destroyed the forests (Plate II, Fig. 2). There remains, however, a large proportion of the forest covering on the unsettled parts of the area. In some instances the tree covering consists chiefly of poplar. In others it may be chiefly willow and alders, spruce or pine, or mixtures of the above. Again there are areas where birch is relatively abundant. Over the greater part of the unoccupied areas there occur patches of timber sufficient to meet the local requirements, but the area as a whole does not contain extensive forests of merchantable timber. However, a few important units of merchantable timber were encountered. The most important of these are listed below.

The best area of merchantable timber found in any of the surveys is the one in Tps. 72 and 73, Rgs. 18 and 19, W. of the 5th. This timber is mature and should be harvested at the earliest possible date as the danger of fires is always a menace in such areas, and in the past fires have destroyed large tracts of valuable timber. The best tracts of timber found were confined to the areas which had escaped forest fires. The above timber is located about 20 miles southwest of High Prairie. Some very fine timber was also found immediately east of Snipe lake.

North of Sturgeon lake in Tps. 72, 73 and 74, Rgs. 23 and 24, belts of good timber also occurred.

In the northwestern corner of the mapped area scattered patches of merchantable spruce were encountered, the most important of which was the one found on the north slope of the Clear hills in Tps. 85 and 86, Rgs. 24 and 25.

Some fair spruce was found along the Rat lake-Little Prairie trail. Most of it occurs north and east of the proposed park (Tp. 83, R. 18) with the bulk of the timber in Tp. 84, R. 18. Another small area of good spruce easily accessible from Little Prairie was found in the northwestern part of Tp. 80, R. 18. This probably does not exceed four square miles in area. Although somewhat sparse in stand it was up to 30 inches in diameter.

An area of spruce and pine lying east and north of Kimiwan lake and south of Bearhead creek has been exploited to some extent. Some ties have been taken out as well as some spruce logs for a small mill at McLennan. The stand here is not exceptionally heavy and the spruce growing is under 24 inches in diameter.

Some scattered patches of spruce up to 20 inches in diameter were found along L'Hirondelle's trail between Grouard and Lubicon lake. The best stand was in Tp. 78, R. 13. Birch trees up to 15 inches in diameter were also found here.

Various small areas were scattered over the surveyed territory, and while they are too small at present to be economically cut they will in the future supply lumber for local as well as outside trade. In addition to the areas above mentioned, stands of half-grown spruce were found which have considerable promise of potential timber areas.

A good stand of pine is found in Tp. 83, R. 18, W. of the 5th. It is proposed that this township be reserved as a Recreation Park (Plate IV, Fig. 1). It is accessible by car from the Peace River-Little Prairie highway.

GAME.

Big game such as moose, deer and bear were plentiful in the least settled areas with the exception of the recently burned districts. In many cases these animals were found relatively near the thickly settled districts.

The following areas contained considerable numbers of moose: West and south of Nampa; on the north of Little Prairie; along the Benjamin creek and east; near the Swan hills south of High Prairie; Snipe lake and Little Smoky river areas.

Deer were most abundant in the open or parklike areas, especially around Little Prairie, Benjamin creek, Salt Prairie, Snipe creek, and again along the river breaks.

The greatest number of bear inhabit the heavier timbered areas. These areas were almost identical with those above referred to as possessing the greater number of moose.

According to reports of the trappers the fur bearing animals were not very plentiful. This, no doubt, is due to intensive trapping, as well as numerous forest fires.

Ducks were found on the numerous lakes and were particularly thick at Utikuma lake. A large number of pelicans were also noticed here. Prairie chicken were found in the more parklike areas and partridges and spruce hens were numerous in the more wooded parts.

Most of the lakes and many of the streams contained jackfish. Lesser Slave and Utikuma also contained whitefish. In addition to the jackfish a number of the streams contained grayling.

WATER SUPPLY.

The conditions affecting water supply throughout the Peace River country are so varied that only general statements can be

made. The surface of the mapped area is about 4 per cent. water consisting of 235,712 acres in lakes and 18,048 acres in river areas. Of this water area approximately 200,000 acres occur in the eight larger lakes. That portion of the Lesser Slave lake inside the boundaries of the mapped area contains 122,342 acres. The included portion of Utikuma lake has an area of 18,890 acres. The six other larger lakes have areas varying from about 8,000 acres to 12,000 acres (see Table 1). There are probably forty other lakes which have areas ranging from 250 to 2,500 acres. In this latter group the most important lakes named on the map are Cadotte, Rat, Mink, Pelican, Magloire, Iroquois, Puskwaskau, Goose, Lost, Flood and Lake St. Germain.

In some districts no difficulty is experienced since the local supply of water is adequate. The settler immediately adjacent to one of the lakes will have no difficulty providing the water is fit for use. In some instances the settler adjacent to the larger streams may have difficulty unless he is located on the river flats. It is quite a problem to transport water from streams occupying deep valleys like those of the Peace and Smoky. Many of the smaller streams will dry up and cease to be a source of water supply after the country has been cleared of its woods. Even if these streams would continue to furnish water for the settlers during the spring and early summer months they are not so located as to be convenient to the greater number of future farms.

Water supplies at present are obtained from streams, reservoirs, ice and wells.

While a few of the streams crossing the surveyed area flow throughout the entire season, many of them are so shallow that they do not furnish water after the freeze-up. Some of the streams furnish running water only during the spring and early summer months. The streams constitute a source of water sufficient only for their immediate vicinities and are by no means adequate for the entire area. Only a limited number of homesteaders can be supplied with water from the streams.

Wherever the topography is suitable, reservoirs may be constructed to store the water from surface run-off. Usually they do not carry sufficient water to meet the summer demands, and are either dry or frozen in the winter. The water is not desirable for household use, but has its value chiefly as a source for livestock. Reservoirs having a capacity sufficiently great to meet the year's demand are expensive to construct, and in many areas the topography would not permit the construction of such reservoirs. At best reservoirs could be used to satisfy only a small part of the needs of the area.

Where suitable bodies of water are within hauling distance, ice may be harvested and stored during the winter months. This method of storage involves considerable labor and expense, but will, with care, supply household requirements. It is entirely inadequate for livestock. One important supply of ice is Magloire lake, situated about 10 miles north of Falher.

The water supply for livestock is retained from the melting snow and rainfall by placing dams across natural depressions, or by excavations, varying in size according to the needs of the individual farmer.

In certain localities shallow wells have been dug in convenient muskegs or swamps. These wells have proven fairly satisfactory so long as the muskegs or swamps have not been modified. As the forest covering is removed, these swamps have a tendency to dry and in turn become a prey to succeeding fires. For this reason shallow wells which draw upon the water reserves of muskegs or swamps can be considered only temporary in nature.

Observations relative to the water supply have been made for the most part in the more settled areas which are those within the districts as shown to be underlain by the better classes of soil. The following brief remarks indicate the conditions prevailing in some of these districts.

In the small area bordering the Little Prairie district, the Harmon and some of the tributaries furnish the main water supply. In the eastern half of Tp. 82, R. 19, W. 5th, a branch of the Harmon furnishes the water supply. The south half of Tp. 81, and north half of Tp. 80, R. 19, W. 5th, is fairly well supplied by the Bearhead and Benjamin creeks. East of this in Tps. 81 and 82, Rgs. 17 and 18, the only area of potential agricultural land consists of a narrow strip along the Benjamin creek. As this creek flows throughout the entire summer, there should be no difficulty experienced in obtaining a supply of water suitable for household and livestock needs.

Heart River District: This district includes Rgs. 15 and 16, W. 5th, and Tps. 76 to 80. The area in general is fairly well supplied with water by the Heart river and its tributaries, besides numerous small lakes scattered throughout. Some reservoirs are constructed on the areas of upland in the Big Prairie district. The remainder of the better part of the district lies to the north of the Big Prairie settlement, which includes the recently settled area locally known as Peavine Prairie in the north half of Tp. 77. Some few shallow wells have been dug throughout the Peavine Prairie district, but local report indicated that the water was not desirable for drinking purposes.

Salt Prairie district: This district is situated north of Grouard, in Tp. 76, R. 14, W. 5th. The Salt creek and its numerous tributaries furnish sufficient water for the area. Shallow wells are dug close to the creeks and these furnish water for cooking and drinking purposes. Alkali spots and soap holes are numerous in the southern part of Salt Prairie district. A mineral spring on Sec. 28, Tp. 76, R. 14, W. 5th, is locally reputed to have medicinal properties.

In the outlying areas of third class wooded (W3) soils there are numerous creeks and lakes which should supply the needs of the areas as the only soils of agricultural value in general lie along the creeks.

From the above statements it is seen that the methods now employed for securing water are entirely inadequate for the needs

of the greater part of the unsettled area. It would seem that the solution of the water problem would, to a certain extent, be dependent upon the ability to secure desirable sources of well water.

As already pointed out, in some districts no difficulty is experienced, while in others it is practically impossible to obtain a supply sufficient to meet the requirements of the settlers. In regard to the latter, some extracts from Report No. 21, Research Council of Alberta, Geology and Water Resources in Parts of the Peace River and Grande Prairie Districts, Alberta, by Dr. R. L. Rutherford, present briefly the situation.

"Harmon River District: This district includes several small, somewhat separated areas adjacent to the Harmon river. One lies between the Peace and the Harmon, and is usually referred to as the Judah district. This is only partly settled along the flat areas between the two deep stream valleys. Several partly settled areas lie east of the Harmon river from Peace River south to Nampa. These include what is known as the Little Prairie district, situated within the north half of Tp. 81, and the south half of Tp. 82, Rgs. 19 and 20, W. 5th Meridian, northeast of Nampa and Reno."

"Some difficulty in obtaining water has been experienced in parts of this district. Many of the wells around Judah are dry or contain very hard water. Most of the supply of this part of the district is obtained from accumulations of surface water. Similarly, surface water is used in partly settled areas between the highway and the east side of the Harmon."

"Falher-McLennan District: This district extends from the east bank of the Smoky to McLennan, and from the Little Smoky north of Tp. 80. Falher and Donnelly are situated about the center of the more settled part, while newer settlement is extending to the south along the Little Smoky, to the west and north up the banks of the Smoky, and to the southeast from McLennan along the railway."

"The water supply for most of this district has been derived from individual reserves of surface water, supplemented by rainwater and ice, the latter being used almost exclusively for cooking and drinking. A few shallow wells occur at separated points, and within the last year and a half some wells over 600 feet deep have been drilled at McLennan and Falher."

Dr. J. A. Allan has contributed the following comments on water supply in general and in part with reference to this area:

"Water supply may be obtained from:

(a) surface water in lakes, rivers, etc.;
(b) surface waters in dug wells and of local origin;
(c) water in dug or drilled wells extending into water-bearing rocks;
(d) artesian water from drilled wells several hundred feet in depth. This water is not of local origin."

"It is natural that an attempt to get water will always be made first from one of the first three sources. If the surface water contains impurities, such as alkalies and the like, then if this water

gets into a dug well or a drilled well the water will be impure. If the surface water is impure, then it is most important than this impure surface water must be sealed off and kept out of a well. It is sometimes possible to obtain good water from water-bearing rocks even though the surface water is impure."

"The supply of water from surface sources within this area has been outlined on previous pages. The greater part of the area is covered to varying depths with recent and glacial deposits and it is from these deposits that most of the shallow wells receive their supply of water. With the increased development of many of the districts accompanied by cultivation and drainage, it will be necessary in places to attempt to obtain water from bedrock sources. In this respect some general statements may be made relative to the area covered by the accompanying map. In those districts lying between the two main branches of the Smoky river and south of township 74 there should not be in general any difficulty in obtaining a reasonable adequate supply of good water from wells drilled into the bedrock immediately underlying the surficial deposits. Similar conditions should prevail east of the Little Smoky and south of township 73."

"North of township 73 the conditions are different, and in general there would not be much chance of obtaining supplies of good water from wells drilled into the bedrock underlying the surface deposits."

"Rutherford has indicated that artesian water might be found in the Dunvegan formation, the top of which occurs at about 600 feet below the surface in the Falher district, and at a greater depth to the south. The Peace River formation also contains sandstones suitable for the accumulation of water, but the formation occurs at about 2,000 feet below the surface in the vicinity of Falher and McLennan. The deeper formation has never been tested by drilling, and in any case the cost would be prohibitive to the individual. The water possibilities in the Dunvegan formation have not been adequately tested, but this source of water supply would also be expensive to develop, so that the shallower sources of water or the surface water in natural or artificial reservoirs must be relied upon."

ACCESSIBILITY.

The area is served by the Northern Alberta Railway which divides at McLennan, the main branch going west through the Donnelly-Falher district and the branch line going north to Peace River and then westward to Fairview. The present outlet for produce for this area as well as for the entire Peace River country is over the Northern Alberta Railway through Edmonton. The distance from McLennan to Edmonton is 267 miles, that from Bluesky to Edmonton 360 miles.

The Peace River highway passes through the area closely paralleling the railroad. This highway is a graded dirt road. From the junction about 10 miles west of High Prairie one road proceeds north through McLennan to Peace River and then westward through Bluesky. The other highway continues from the above

junction southwest to cross the Little Smoky river, thence south and west to serve the Valleyview settlement, and then westward through the Sturgeon Lake and Debolt settlements and on to Clairmont. A second branch highway leaves the main highway at Grimshaw and proceeds northward to the Notikewin settlement. The locations of these highways, together with the railroads, are shown on the accompanying map.

The older settled areas are well supplied with roads. Secondary roads also serve to connect most of these older settlements with the main highways. Such roads connect Grouard, the Salt Prairie and the Peavine settlements with High Prairie, also Grouard and the Big Prairie settlements with McLennan, the Little Prairie settlement with Nampa and Peace River.

The settlement at Sunset House near Snipe lake has no adequate summer road. During this season the journey has to be made with pack outfits. The construction of from 20 to 25 miles of road would connect this settlement with the highway extending westward through Aggie. The area between the Little Smoky and Smoky rivers does not have close access to the railroad. From the Valleyview settlement to High Prairie the distance is about 50 miles. The Sturgeon lake settlement has an additional 10 miles to the railroad. The Debolt settlement and the western edge of the mapped area are about 35 miles from the railroad at Clairmont. The extreme eastern and northeastern part of the mapped area and the section between the two Smoky rivers north of the highway are accessible only by pack trail.

These trails serve the needs of the trappers and hunters. Some of them can be used as roads during the winter. The old Grouard-Peace River trail is still open to light travel and is used mainly by the Indians hunting and trapping, in the area between the Heart and the Harmon rivers. This trail is in fair shape except for a few small holes and bridges.

Wagon trails run to Utikuma and Lubicon lakes from Grouard. These trails are passable, although soft in places. Some freighting can be done on these trails during the summer months, but the load per unit is seldom more than a thousand pounds. A wagon trail is also found between Little Prairie and Lubicon lake, but this is passable only in the drier parts of the season.

SETTLEMENT.

The major portion of the settlement in this area has taken place in the last twenty years, or since the building of the railroad. Steel was laid into McLennan in March, 1915, and extended to Peace River and Spirit River within a year.

Previous to the building of the railway the main line of traffic was from Athabaska, by way of the Athabaska and Lesser Slave rivers and across Lesser Slave lake to Grouard. A wagon road connected Grouard and Peace River Crossing or Landing, as it was then called. This was the route used by the fur traders, steam boats being used on the Athabaska river and Lesser Slave lake and scows on the Lesser Slave river. The scows were hauled up

stream by tow line and floated down. When the steam boat service on the Athabaska was discontinued, a trail was cut from Athabaska to Slave Lake following the north banks of the Athabaska and Lesser Slave rivers. From Slave lake trails extended to Grouard on both sides of the lake.

A trail was also cut from Edson to Grande Prairie by way of Sturgeon lake. This route was extensively used for a few years just previous to the building of the railway.

The first permanent settlements were established around or near the old trading posts. The Lesser Slave and Big Prairie settlements near Grouard and the Shaftesbury settlement across the river and up stream a few miles from Peace River were the first lands settled in this area. These first settlers did not farm extensively, for they had only a local market for their produce. Sufficient grain and vegetables were grown to supply the needs of the settlers and the trappers who made their headquarters at the trading posts. The excellent quality of the grain and vegetables was commented on by early travellers, and the fame of this country was known for many years before extensive settlement took place.

The opening of the Edson-Grande Prairie trail was followed by a large influx of settlers, who located on the more open country west of the area under consideration. The first rush of settlers following the completion of the railway was also mainly toward the open country north of the Peace river and west of the Smoky river. However, the open country around High Prairie was soon taken, and small settlements were started around most of the stations along the railway.

The Donnelly-Falher district was settled by a colony of French-Canadians. This area was more or less wooded and rather low and wet in places, but despite these difficulties it has been developed into the most extensively cultivated district east of the Peace and Smoky rivers. During the years of 1925, 1926, 1927, approximately 20,000 acres were cleared and broken.

Settlers have gradually pushed back from the older settlements to areas of easily cleared land where the soil was good. As the better areas have been taken up, the movement has been to areas more difficult of access and of heavier clearing.

The opening of the government highway which permitted the prospective settler to drive his own car into the district, reduced the difficulties of the land-seeker to a considerable extent. In many cases a homesteader has been able to locate suitable land on, or within a few miles of, a good road.

Previous to the opening of the High Prairie-Sturgeon lake highway a settlement had been established at Valleyview east of Sturgeon lake. These settlers had pushed in from High Prairie. Another settlement had been started around Debolt by settlers coming in from the west. The opening of the highway linked these settlements with the railroad and also gave access to other areas throughout the district.

Settlement is also extending into the area across the Little Smoky river south of Falher. This area was reserved for settlers

from the drought area, but has recently been opened for general settlement.

The population of the area as given by the 1931 census was approximately 15,500. The area has been divided into various districts according to settlement and trading or shipping centres. The approximate population of these districts is shown below.

Area north and west of the Peace river	4,330
Area east of the Peace river adjacent to Peace River, Nampa and Reno	2,730
McLennan west to the Smoky river and south to the Little Smoky river	3,838
Area adjacent to High Prairie including Enilda, Grouard, and Heart River	2,487
Sunset House on Snipe lake	109
Valleyview	320
Debolt	513

Sunset House and Valleyview settlements have their shipping point at High Prairie. Debolt ships west to Grande Prairie or Clairmont.

There are also local settlements adjacent to Faust, Driftpile and Joussard.

Peace River is the largest town with a population of approximately 860. This town is the distributing point for a fairly large area, being the connecting point for rail and river traffic. Considerable freight is shipped down stream to the settlements farther north. When the railway was extended west from Grande Prairie to Dawson Creek, the upstream river traffic was practically eliminated.

McLennan with a population of approximately 500 is the second largest town, and is a divisional point of the railroad.

Municipal or community hospitals are maintained at Peace River, McLennan and High Prairie.

WATER AREAS.

The surface of the mapped area is about 4 per cent. water, consisting of 235,712 acres in lakes and 18,048 acres in river areas. Of the total water area approximately 200,000 acres occur in the eight larger lakes.

The water areas of the most important lakes are shown in the following table:

TABLE 1.—Areas of most important lakes in the Peace River-High Prairie-Sturgeon Lake area.

Lake.	Areas in Acres.
Lesser Slave (part)	122,342
Utikuma (part)	18,890
Cardinal	12,032
Sturgeon	10,560
Winagami	10,560
Kimiwan	10,368
Snipe	9,536
Lubicon	8,384
Cadotte	2,880
Utikumasis	2,560
Puskwaskau	1,600
Magloire	1,440
Lake St. Germain	1,440
Goose	960
Rat	800
Iroquois	640
Pelican	640
Mink	480
Flood	320
Total	216,432

In addition to the above-named lakes, there are probably forty other lakes, most of which are unnamed on the map, ranging in extent from 100 to 2,500 acres.

SOILS.

The surface area shown within the boundaries of the map is approximately 7,400,000 acres. However, not all of this area has been covered by the soil surveys. None of the area between the Smoky and Peace rivers has been surveyed, and the soil classes of this area are not shown. That portion of the area lying between Peace River and Bluesky has not been surveyed by us, but in the course of field duties we have been able to secure the approximate location of the various soil areas, and as a consequence these are shown on the map. Thus the soil class areas designated on the map cover approximately 6,400,000 acres of surface area.

Attempts have been made to outline the different soil areas from the standpoint of their relative virgin productivity and their possibilities for immediate and future settlement. Except in one instance no attempt was made to map the soils on a textural basis. In surveys of this preliminary nature, conducted in districts where the traverses must be largely made by pack outfit and on foot, it is difficult to always establish the soil boundaries. Thus in a number of instances the boundaries are only approximate. The main soil classes (shown on soil map at end of report), in order of their decreasing value for agricultural purposes, are A, W1, W2 and W3. No attempt has been made to show rather small areas of different soils within the larger classes. However, such small areas do occur within all the soil classes. As an example, there are small areas of W1 soils within the main W3 class, but such areas constitute a very small proportion of the main soil class. Likewise there are areas of W3 soils within the main W1 class and especially areas of W3 occur within the W2 class.

In cases where the larger areas of muskeg were encountered these are approximately outlined on the map. The sum total of such outlined areas as shown on the map is about 107,000 acres. This figure, however, does not represent the total amount of muskeg present, as numerous small areas were not mapped, and in some parts of the mapped area these smaller muskegs constitute a very considerable proportion of the entire surface. It was not uncommon to find certain local areas where an estimate placed the muskegs at from 15 to 35 per cent. of the surface area. Such muskeg areas are found to the greatest extent in the W3 and W2 areas, and are included in the totals for these areas.

The entire surveyed area shown on the accompanying map lies well within the wooded soils belt (Plate 1, sketch map), and the majority of the soils belcng to the wooded group. About 83 per cent. of the total consists of the three classes of wooded soils. The choice wooded soils (W1) constitute 4.6 per cent. of the total area. The second class wooded soils (W2), which are considered marginal, constitute about 28 per cent. of the total, whereas the poorer class of wooded soils (W3) constitute 50 per cent. of the total area. This last class is considered submarginal.

Less than 5 per cent. of the total surface area is mapped as eroded and river bottom lands. The eroded lands consist largely of soils which occur along the main drainage courses and which are too rough to cultivate. However, in many instances they are well suited for pasture. Good bottom land soils occur at certain points along the streams, but it was difficult to determine the boundaries of these areas and consequently they are included with the eroded soils.

There are a few local areas where the soils still retain many of the characteristics of prairie or parkland soils. These have been outlined as parkland (A) soils, and constitute 6.5 per cent. of the total area.

The following table shows the extent of the various soil classes:

TABLE 2.—Various soil classes in Peace River-HighPrairie-Sturgeon Lake area.

	Area in Acres	Per cent.
Parkland	419,040	6.5
First class wooded (W1)	299,520	4.6
Second class wooded (W2)	1,805,920	28.0
Third class wooded (W3)	3,264,685	50.3
*Muskeg	107,424	2.1
Eroded and river bottom	294,912	4.6
Water	253,760	3.9
	6,445,261	

*The per cent. of muskeg figured from the 107,424 acres outlined on the map is 1.7, but the figure 2.1 is used as the remainder after all other classes are subtracted from 100. Even this figure 2.1 is undoubtedly too small . (See discussion under Muskegs.)

Quite a number of areas with open appearance occur within the surveyed area, but a number of them were caused by severe fires burning off the timber from the wooded soils. The soils of such areas possess the characteristics of the wooded soils and not of the parkland soils. However, there are eight distinct areas

where the soils still possess parklike (prairie) properties. The characteristics of these soils will be described at a later point in the report. There are three rather extensive areas of parkland soils located as follows: the High Prairie-Grouard area, the Donnelly-Girouxville area and the area on the north side of the Peace between Grimshaw and Red Star. In addition there are five areas lesser in extent than those above mentioned and located as follows: the alluvial areas along the mouth of the Driftpile river, small similar areas along the East and West Prairie rivers, the Valleyview area, the Sturgeon Lake area, the Little Prairie area, and the area along the Bear creek and the Whitemud river. These soils comprise slightly under 420,000 acres. They are almost completely taken, but not completely developed.

The first class wooded soils (W1) are the second most fertile soils to be found in the mapped area. In general, they occur adjacent to or surrounding the parkland soils or on the better drained plateau lands adjacent to the main stream courses. Nine fairly extensive areas of these soils are mapped at the following locations: Salt Prairie-Big Prairie, Peavine Prairie, Tp. 73, R. 18 area, Sturgeon Lake-Valleyview, Debolt, west of Little Smoky river Tps. 74 and 75, Little Smoky river north to Magloire lake, Nampa-Peace River and northward along Peace river, Whitelaw-Roma and north along the west side of Peace river. In addition there are two small areas along the highway between Sturgeon Lake and Debolt and a third area of several sections near Lubicon Lake. These soils comprise slightly under 300,000 acres, most of which are taken. It is estimated, however, that probably about 20,000 acres still remain to be taken.

The second class wooded soils (W2), in general, occur adjacent to and surrounding the W1 areas. Twenty-eight per cent. of the entire area belongs to this class. The second class wooded soils include certain fairly extensive areas of W3 soils which we were unable to outline. One such area occurs adjacent to and along Snipe creek and northwestward from Snipe lake. Settlement has taken place in a few localities on this class of soil, notably adjacent to the settlements along the main highways and the railroad, and again at and near Sunset House. However, a large proportion of the soils of this class still remain open for settlement. It is estimated that possibly 70 per cent. of these (W2) soils yet remain to be settled. The soils of this class are not as fertile as are the W1 soils. In many areas they are submarginal.

The third class wooded soils (W3) constitute 50 per cent. of the entire area. These soils are comparatively low in fertility and should be considered submarginal and unsuited for settlement except in cases where they occur immediately adjacent to present well settled and developed areas, and even here they will require special management if they are to give satisfactory crop returns. Descriptions of these soils, together with their composition, will be given at a later point in the report.

A vertical section of soil from the surface down into the subsoil, as seen along a cut-bank or ditch, is commonly referred to as a soil profile. The main natural layers or horizons starting at the

surface are designated by the letters A, B and C. These may be subdivided into as many divisions as are visible in the soil profile, and each designated by a numeral following the letter.

The A horizons extend from the surface to the bottom of the layer of greatest leaching; the A_1 horizon being that one which contains the great bulk of the organic matter, while the A_2 horizon is that one which shows the greatest effect from leaching. The B horizons include both the layer in which the greatest accumulation of fine soil particles occur and the lime concentration layer, the former being designated the B_1 and the latter the B_2.

The Parkland Soils.

The parkland areas (Plate V, Fig. 2) contain the best soils in the surveyed area. These soils have, however, suffered some degradation by the timber growth which has or is at present occupying them. They invariably have a surface A_1 horizon which is dark colored, and in which the organic matter is intimately mixed with the mineral matter.

These parkland soils have been formed on the plateaus adjacent to the drainage courses of the main streams, as well as on some of the alluvial plains. They consist very largely of silt and clay material and show the following general profile:

Horizon A_1—black loam to clay loam from 5 to 10 inches deep.

Horizon A_2—light-colored, leached layer, usually 1 to 3 inches thick, silty.

Horizon B_1—darker in color than A_2, heavy clay loam to clay; columnar and granular; from 6 to 15 inches thick.

Horizon B_2—from 2 to 8 inches thick and encountered at depths from 20 to 30 inches below the surface, usually granular.

Horizon C—This is the partly modified parent material, usually heavy textured, sometimes has the appearance of secondary shale. The tree and shrub roots often penetrate this to the depth of several feet.

The above description would apply to the parkland soils encountered near High Prairie, Little Prairie and the Berwyn-Griffin Creek areas. The areas around Falher, Valleyview and Sturgeon Lake differ from the above description chiefly in that the A_1 horizon is not so thick—it varies from 4 to 6 inches. For further details see Table 4.

The Wooded Soils.

In the mapped area almost every degree of variation between the true wooded and the true parkland soils is encountered. The first class and second class wooded soils are actually transition phases between the parkland soils on the one hand and the W3 wooded soils on the other. The first class wooded soils (W1) are desirable, the second class wooded soils (W2) are marginal under our present farming practices, whereas the third class wooded soils (W3) are submarginal. There are large areas within the wooded soils which have suffered severely from fires which at present give a parklike appearance, but the soils in such areas distinctly belong to the wooded classes.

The soil belts of Alberta (see Plate 1) are closely associated with differences in climatic conditions and the natural vegetative covering. The gray or wooded soils belong to the forest area, being covered with a tree growth consisting mainly of poplar, spruce, tamarack and pine, together with the common shrubs accompanying this forest vegetation, as well as a sparse and irregular distribution of the long grasses.

The rainfall of the greater part of the wooded soil belt is similar to the rainfall of the black soil belt; that is, varying from about 15 to 20 inches. However, the extreme northern part of the wooded soil belt or that area found from Fort Vermilion north and east receives a rather low rainfall. In fact, the rainfall of the Fort Vermilion district is slightly less than the rainfall of the Medicine Hat district. However, the cooler climate and lower evaporation conditions existing in the Fort Vermilion district have made possible the growth of a forest vegetation, which in turn has produced soils belonging to the wooded group.

Typical wooded soils in Alberta have the following characteristic profile (see Tables 3 and 4). The upper layer or horizon A_0 consists largely of leaf mould or plant debris, and varies in thickness from 1 to 4 inches. In cases of severe fires this is at times entirely destroyed. Immediately under this there is a very thin layer, A_1 of drab or brown colored mineral soil which varies in thickness from ½ to about 2 inches. The A_1 layer is not always present in the wooded soils. This second layer is underlaid by a light colored, badly leached A_2 layer varying in thickness from 4 to 12 inches. Below the leached, light colored layer is found a somewhat darker colored B_1 layer, which is much heavier in texture than the above layers, and contains large quantities of the finer clay particles which have passed downward during processes of leaching. This layer varies in thickness from 1 foot to 2 feet. The B_2 or lime layer is encountered at depths of from 2 feet to 3 feet in the wooded soils of the surveyed area and in the northern part of the province, whereas it occurs at greater depths in the wooded soils of central Alberta.

The nature of these wooded soils may be somewhat better understood by referring to Plate V, Fig. 1, and Table 4, which show a relatively thin A_0 horizon as well as the leached A_2 and B_1 horizons. It will be noted that the leached horizons occur very near the surface. When such soils are plowed they have a light colored, ashy appearance.

As previously stated the wooded soils have been divided into three classes. This division has been determined mainly by the thickness of the upper horizons. The first class wooded soils (W1) (Plate IV, Fig. 2) differ in profile from the general description above given mainly as follows:

(1) There is invariably present the A_1 horizon, which is about 2 to 4 inches thick and dark brown to black in color.

(2) The A_2 or light colored leached layer is relatively thin (from 2 to 4 inches).

(3) The B_1 occurs nearer the surface.

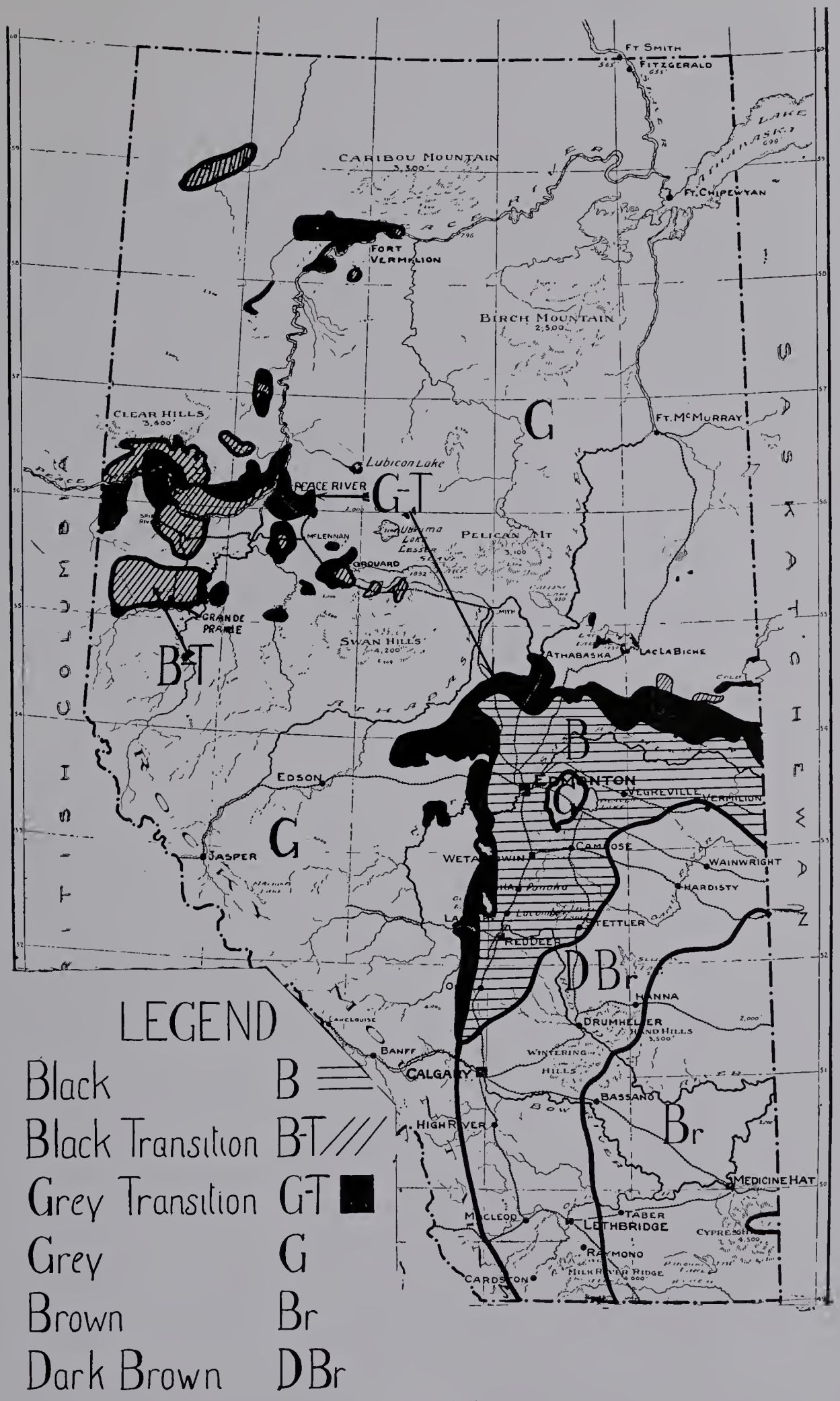

PLATE I.

Sketch map of Alberta, showing locations of major soil belts.

PLATE II.

Fig. 1—Heavy clearing on wooded soil. This type of growth characterizes the W3 and W2 areas, except where the trees have been destroyed by fire.

Fig. 2—Severe burn on wooded soil. Note the fallen trees. Another fire would destroy most of the deadfall and make the area suitable for breaking, with a minimum cost for clearing.

PLATE III.

Fig. 1—Burned over muskeg showing irregular surface and fire killed spruce. Muskegs vary from 1 to 10 feet in length. The one above was 8 feet deep.

Fig. 2—Muskeg showing open area in foreground with scattered to dense tree growth in the background.

PLATE IV.

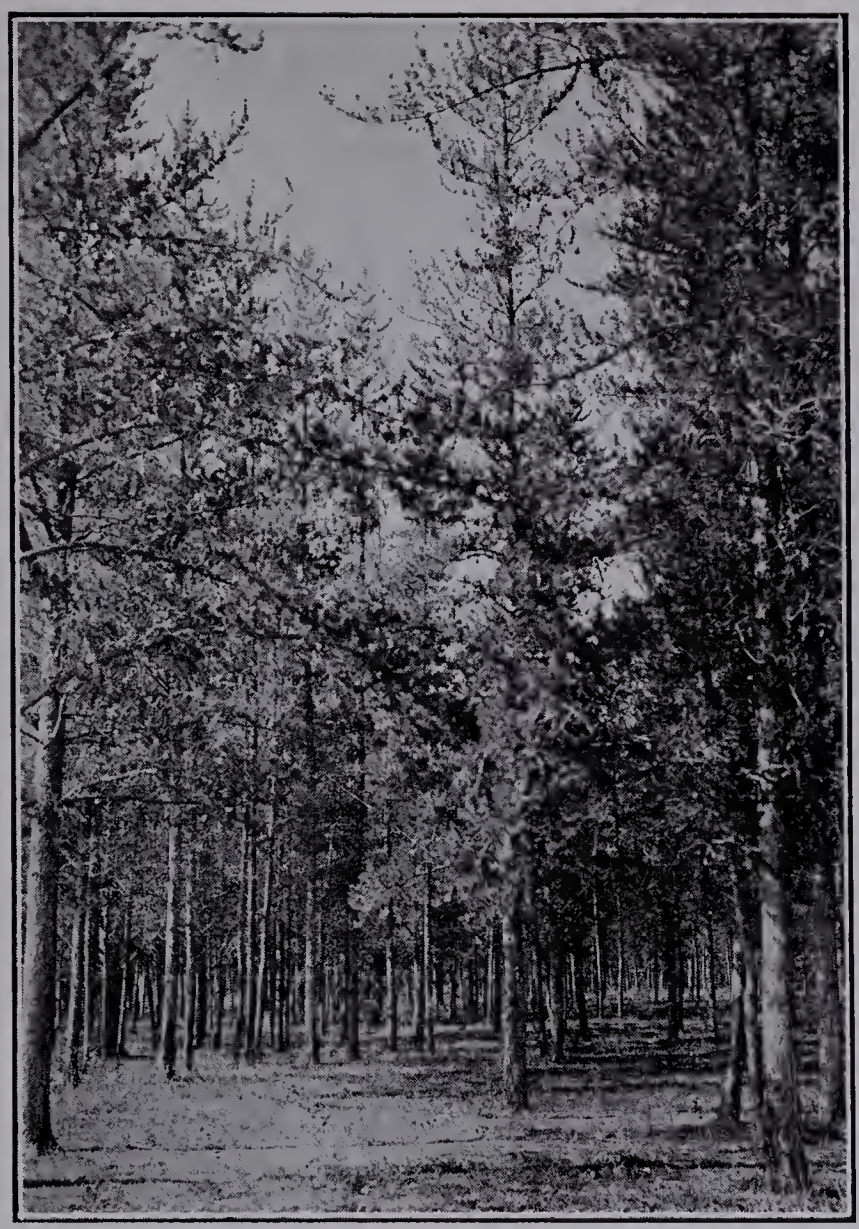

Fig. 1—Scene from proposed Recreation Park Reserve, Tp. 83, R. 18, W. of 5th. This is accessible by car from the Peace River-Little Prairie highway. Blueberries and cranberries grow in abundance. Game such as moose, deer, partridge and prairie chicken were plentiful.

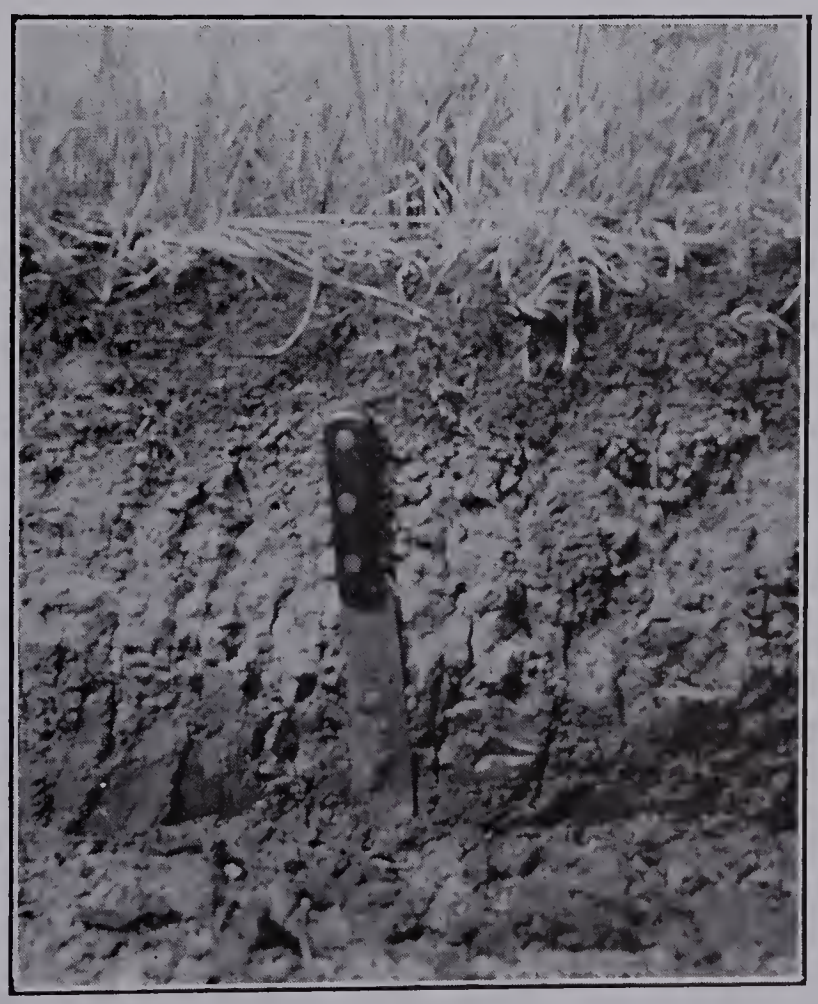

Fig. 2—Soil profile of W1 area. Top black horizon about 4 inches thick, gray or leached A_2 horizon varies from 3-6 inches (not severely leached). When properly farmed this class of soil produces good crops of cereals and legumes.

PLATE V.

Fig. 1—Uprooted tree on W3 area showing leached A_2 horizon adhering to roots (see Tables 3 and 5). Where fires have been severe this light colored horizon is exposed.

Fig. 2—Fertile parkland soils. Note black soil in foreground and wheat stooks in background.

PLATE VI.

Fig. 1—Reward wheat grown on wooded soils, 1933. First crop after clovers. The average yield of the unfertilized plot on right was 18.4 bu., and of the plot on left, fertilized with ammonium phosphate (16-20), was 41.9 bus. (See Table 6.)

Fig. 2—Clovers (sweet and Altaswede) grown on wooded soils. Check plot on left yielded 1,680 lbs. hay. Plot on right, fertilized with ammonium sulphate, yielded 4,430 lbs. hay. (See Table 6.)

The W2 and W3 soils have suffered more extensively from leaching as indicated by the thin or absent A_1 horizon and the thicker A_2 horizon (see Table 3). A better comparison between the different classes of wooded soils may be brought out by arranging the numerous field observations so as to compare the relative thickness of the A_2 and the A_1 horizons as follows:

	Limits of A_2 horizon	Average thickness of A_2
W1 soils	2- 6 inches	3 inches
W2 soils	4- 8 inches	6 inches
W3 soils	8-12 inches	9 inches

In addition to the greater amount of degradation in the W3 soils they are usually devoid of the A_1 horizon, whereas the better classes of wooded soils have a distinct A_1 horizon as indicated below:

	Limits of A_1 horizon	Average thickness of A_1
W1 soils	3- 6 inches	4 inches
W2 soils	1- 3 inches	2 inches
W3 soils	none	0 inches

When the W1 soils are broken, the A_1 horizon makes up about two-thirds of the plowed depth, the remaining one-third consisting of A_2 horizon. On the other hand, when the W3 soils are broken the plowed depth consists almost wholly of the A_2 or badly leached horizon. This ashy appearing horizon is one that bakes severely after rains. It is usually rather difficult to manage in addition to being low in initial fertility. The leached A_2 horizon of the W1 soils usually contains granular structure and indicates a smaller amount of degradation than is found in the W3 soils. The second class wooded soils are intermediate in these respects, and when these soils are broken, about one-third of the plowed depth consists of the A_1 horizon and about two-thirds of A_2 horizon.

The soils of any one class are not identical throughout the different areas of the class. That is, variation is found in the thickness of the respective horizons, and in some instances there is the absence of the A_0 horizon as well as the A_1 horizon. The A_0 horizon is usually absent from the first class wooded soils (W1) and the A_1 is always present, whereas the A_0 is usually present (except where destroyed by fire) and the A_1 often absent in the third class wooded soils (W3). This variation from area to area within a given class as well as the difference between the soil classes is shown in Table 3, where descriptions are given for first class wooded soils from six different points and third class wooded soils from four different points.

Descriptions for the second class wooded soils (W2) are not included in table 3. This class, however, is intermediate between the first class and the third class wooded soils.

TABLE 3.—Description of soils of the surveyed area showing depths in inches of the various horizons.

FIRST CLASS WOODED SOILS (W1)

Horizon	Near Girouxville	Peavine Prairie	Big Prairie	Salt Prairie	North of Falher	Debolt area
A_0	None	None	None	None	None	None
A_1	4 variable, grayish black, granular	4 black	4 to 5 black, silty to sandy	4 black, silty	3 to 4 dark gray	4 black
A_2	2 granular	1 gray with red tinge, granular	4 white, silty	5 gray, slightly granular	1 to 2 light gray, granular	5 gray, silty
B_1	24 bluish gray	14 gray clay, red tinge, granular			30 blue clay	20 brownish gray

B_2 or Lime is encountered at depths varying from 24 to 36 inches below the surface in these soils.

THIRD CLASS WOODED SOILS (W3)

Horizon	Near Kenzie	North of Salt Prairie	Lesser Slave Lake to Utikuma Lake	Southeast of Springburn
A_0	Usually absent	0-4 variable	burnt off in many places	0-5 variable
A_1	1	often absent	trace	0-2
A_2	9 badly leached, silty to sandy	10 badly leached	8 badly leached, sandy in places	6-12 sand and gravelly in places

B_1—darker colored than A_2, generally clay loam to loam. Varies from 12 to 16 inches in thickness and is encountered at from 8 to 12 inches below the surface.

B_2 or Lime is encountered at depths varying from 24 to 36 inches below the surface in these soils.

The abundance and character of the tree growth on the wooded soils is variable. In some instances it has been entirely removed by fires (Plate II, Fig. 2), in other cases it consists of restocking of young trees of various ages, whereas again there are thick stands of mature trees (Plate II, Fig. 1). The abundance, size and kind of trees determines to a great extent the cost required to clear the land before it can be broken. The cost of clearing varies from a few dollars to as much as $40 or $50 per acre.

MUSKEGS (PEATS)

One noticeable feature of the wooded soils belt is the presence of muskegs (Plate III). These muskeg areas vary in size from very small ones to fairly extensive systems, and may constitute from a few per cent. to upwards of 60% of the local area.

Peat areas consist mainly of organic matter, whereas ordinary soils consist mainly of mineral matter. The peats are usually underlaid by clay or other soil material fine enough to hold the moisture in basins or flats, which permitted and encouraged the growth of sphagnum moss and other moisture loving plants. The accumulation of these plants under water-logged conditions resulted in the formation of peat bogs. The muskegs are generally covered by a shrubby growth of Labrador tea (*Ledum groenlandicum*). Frequently there is a growth of spruce and tamarack.

Only the larger areas of muskegs have been outlined on the map (107,424 acres). This figure is but 1.7% of the total; however, the figure 2.1% is used in the table as being the remainder after the total of per cents for the other classes have been subtracted from 100. Even this figure (2.1) is undoubtedly much too small. It is possible to obtain a better idea of the extent of the muskegs by considering the individual reports from each of the field surveys. For example, the district along the east and northeast parts of the mapped area is estimated to contain at least 17% of muskeg (in certain local areas the estimate is over 60%). The district between the Smoky and Little Smoky rivers has an estimated average of 10% muskegs. The muskegs are more numerous and extensive in the third class (W3) and second class (W2) soils. However, if the entire mapped area is considered, it would be safe to assume that the muskegs constitute from 10% to 15% of the total.

Very little experimental work with peats or muskegs has as yet been done in Alberta, and it is still uncertain as to the best methods of reclaiming them or bringing them under cultivation. The first step naturally would be to drain the peat land. Most of the peats of the wooded soil belt are not in an advanced stage of decomposition. It would therefore require considerable time after drainage before they are in proper condition for seeding. If it is not essential that the land be brought under cultivation as soon as possible, it would probably be wise, following drainage, to fence it off as pasture land and allow stock to tramp and pasture it for two or three years. The muskeg will settle considerably, and it can then be broken. The freshly plowed land should be packed to

make a firm seed bed. Greenfeed might be produced at first, and later it should be possible to ripen grain successfully on some of this land.

Peats differ greatly in their ability to produce crops, and for this reason their fertilizer requirements cannot often be predicted without actual field trials. The application of barnyard manure is apt to be highly beneficial, and it is likely that the application of nitrogen fertilizers and lime and probably phosphate and potash will prove beneficial. Where high grade marl deposits are conveniently located, this material may be applied to a part of the muskeg at the rate of one ton or more per acre, and its effects can then be observed. Peats vary in reaction, but many of them are very acid, and should respond to treatment with lime. All fertilizers should be tested on small areas, and if beneficial should be applied to larger areas.

Burning the muskeg after it has been drained may be desirable in some cases, but it should be practised only after a careful consideration of the local conditions, as it may leave the field in a very irregular condition.

Composition of Soils.

Partial analyses were made of representative samples of soil from the various areas. The results are given in Table 4. It will be seen that in some cases only certain horizons from the profile have been analyzed, and while the data are incomplete, they do bring out clearly the differences in composition of the soils from the different classes.

From Table 4 it will be seen that the composition of the upper horizon of the Parkland soil is similar to the upper horizon of the wooded soils. However, there is a decided difference in the thickness of the upper horizons of the different soil classes. For example, the A_1 horizon of the parkland soil is always more than four inches thick, whereas this horizon in the wooded soils of the poorer classes is very thin and often absent. On the other hand the A_2 horizon of the parkland soil is only about 2 to 3 inches thick, whereas in the W3 soils it is from 8 to 12 inches thick.

The wooded soils have suffered more severely from leaching than have the parkland soils, and as a consequence the leached horizons A_2 and B_1 are thicker, show slightly higher acidity and lower phosphorus and nitrogen contents.

The soils of the surveyed area are in general slightly acid to the depth of about 3 feet. It is only rarely that the lime layer is encountered nearer the surface than 3 feet. From Table 4 it is seen that the pH values are in no cases below 5. However, in some parts of the (W3) areas where the leaching has been rather severe, the A_2 and B_1 horizons at times showed pH values between 4.5 and 5. In these severely leached horizons there is usually a rather low phosphorus and in some instances a low nitrogen content. The tendency is for both the phosphorus and nitrogen to be present in greater quantities in the lower part of the B_1 and the B_2

TABLE 4.—Composition of soils of Peace River-High Prairie-Sturgeon Lake area.

Parkland soils (A), Falher district.

Horizon	Depth	pH	Phosphorus %	Nitrogen %	$CaCO_3$ %
A_1	0- 4''	6.6	.102	.486	.....
A_2	4- 6''	6.4	.056	.142	.....
B_1	6-36''	6.2	.064	.141	.....
B_2	36-48''	7.4	.068	.075	3.57
First class wooded soils (W1), Judah district.					
A_1	0- 3''	6.8	.069	.590	.....
A_2	3- 5''	6.4	.031	.078	.....
B_1	5-24''	6.0	.041	.081	.....
B_2	24-30''	7.5	.063	.041	15.55
C	20'	7.4	.075	.084	3.98
Second class wooded soils (W2). W2 averages from 3 districts, Nampa-Falher, west of Kimiwan lake, north of Peavine Prairie.					
A_0	0- 2''	6.3	.093	.332	.....
A_1	2- 4''	6.9	.072	.283	.....
A_2	4-10''	5.0	.040	.089	.....
B_1	10-36''	5.4	.038	.067	.....

horizons than in the badly leached A_2 horizons. It is this A_2 horizon which bakes badly when cultivated.

The first class wooded soils vary somewhat, approaching on the one hand the parkland soils above reported and on the other hand the second class wooded soils. The third class wooded (W3) are slightly inferior in composition to the (W2) soils above reported.

A somewhat better idea of the initial fertility of the various soil classes is relatively shown by comparing the plant foods found in the upper three feet of the soil. Such a comparison is shown for phosphorus and nitrogen in Table 5.

From Table 5 it may be seen that the parkland soils compare favorably with the black soils of the Edmonton district. The first class wooded soils contain about two-thirds as much phosphorus and half as much nitrogen as the parkland soils, whereas the third class wooded soils contain only about three-fifths as much phosphorus and two-thirds as much nitrogen as do the first class wooded soils.

TABLE 5.—Total phosphorus and nitrogen in upper three feet of parkland and wooded soils (pounds per acre).

	Phosphorus	Nitrogen
Parkland soils.		
Edmonton district	7,475	23,365
High Prairie district	7,208	27,525
Falher district	7,448	19,656
First class wooded soils (W1)		
Judah district	5,482	12,873
Second class wooded soils (W2)		
Average of three areas: Nampa-Falher, near Kimiwan lake and north of Peavine Prairie	4,508	9,525
Third class wooded soils (W3)		
	4,076	7,818

MANAGEMENT OF THE WOODED SOILS.

The greatest difference in the quantities of the plant foods found in the various soil classes is shown by the amounts present in the first foot depths. It is this section of the soil which is the most important in the production of crops. There is more phosphorus, nitrogen, calcium and magnesium in the upper foot of the parkland and first class wooded soils than is found in the poorer phases of the wooded soils. The poorer wooded soils are likewise low in active organic matter. This necessitates the growing of legumes to supply the active organic matter as well as to improve the physical conditions. Consequently it is the poorer classes of soils that require special management if they are to produce satisfactory crop yields.

The better phases of the wooded soils usually give satisfactory crop yields, whereas the poorer phases usually give yields which are somewhat disappointing. This is especially so during an unfavorable season, and often very light yields are obtained from the poorer wooded soils, whereas average crop yields are obtained from the better wooded soils and from the parkland soils.

The conditions thus revealed from farming practices on the wooded soils led to experiments in an attempt to explain these differences and, if possible, find a remedy. While these experiments consist of pot culture and field experiments with the wooded soils from that part of the province west of Edmonton, the soils are very similar in appearance and composition to those of the surveyed

area, and the results should be very largely applicable to the latter. Experiments have been conducted on the Breton Experimental Field as well as on various farms for the past six years. A brief outline of these experiments together with the most important results obtained from them are set out in the following discussion.

BRETON EXPERIMENTAL FIELD.

The Breton experimental plots are located on typical wooded soil about two miles southeast of the town of Breton. The regular rotation contains four series: wheat, oats, barley in which sweet clover and Altaswede are nursed, and the clovers. There is also a series on which wheat is grown continually. Each of the above five series consists of 11 plots treated with various fertilizers as shown in the footnote after Table 6. Several smaller series devoted to the growth of legumes, including Altaswede, alsike, sweet clover and alfalfa receive different fertilizer treatments.

The experimental field had been cropped for at least ten years, and had reached a stage where the crop yields were decidedly unsatisfactory. It was laid down to plots and some fertilizers applied in 1929. The major part of the treatment was applied in 1930, and the remainder of the field received fertilizers in 1931 and each year since.

The results obtained from the main rotation experiments for the three years (1932-34) are reported in Table 6.

TABLE 6.—Crop yields from main rotation. Breton Experimental Field. (Three year averages, 1932 to 1934)

Plot	Treatment*	Yield per acre				Increases			
		Clover, Lbs. per acre	Wheat, Bus. per acre	Oats, Bus. per acre	Barley, Bus. per acre	Clover, Lbs. per acre	Wheat, Bus. per acre	Oats, Bus. per acre	Barley, Bus. per acre
1, 5, 11	None	1680	18.4	34.5	16.1	.....	.....	.....	.....
2	M	2800	24.3	45.1	19.1	1120	5.9	10.6	3.8
3	N.P.K.	5535	45.2	49.9	20.4	3855	26.8	15.4	4.3
4	N	4430	34.8	64.8	27.0	2750	16.4	30.3	10.9
6	L	3030	24.8	40.9	16.1	1350	6.4	6.4	0.0
7	LP	4570	33.0	47.8	19.5	2890	14.6	13.3	3.4
8	P	4015	27.5	42.3	15.7	2335	9.1	7.8	—0.4
9	MP	3875	39.2	54.1	27.7	2195	20.8	19.6	11.6
10	NP	5515	41.9	59.5	25.5	3935	23.5	25.0	9.4

*The manure was applied once in three years, the lime once in four years, and all other fertilizers annually at the following rates per acre:

Plot 1, 5, 11—None.
Plot 2 M—Manure 22 tons.
Plot 3 NPK—Ammonium phosphate (16-20) 60 lbs., potash 30 lbs.
Plot 4 N—Ammonium sulphate 60 lbs.
Plot 6 L—Lime (marl) 1 ton.
Plot 7 LP—Lime 1 ton, triple superphosphate 50 lbs.
Plot 8 P—Triple superphosphate 50 lbs.
Plot 9 MP—Manure 22 tons, triple superphosphate 50 lbs.
Plot 10 NP—Ammonium phosphate (16-20) 60 lbs.

Additional results from the use of fertilizers on such crops as alfalfa, Altaswede and alsike clovers showed yields from the check plots varying from about a thousand pounds to about fourteen hundred pounds per acre, whereas the better fertilized plots yielded as much as 2¼ tons.

Co-operative experiments conducted on various farms gave results of the same nature and magnitude as those reported from the Breton field.

The most important points brought out by these experiments are:

1. Decided increases for clovers were obtained from all fertilizers. Most of the fertilizers doubled, or in some cases tripled, the yields obtained from the check plots (Plate VI, Fig. 2). The smallest increases were from the manure alone and the lime alone, each of which was over half a ton. All other fertilizers gave increases varying from approximately one ton to two tons.

2. The wheat crop (first after the clovers) showed greater increases for the fertilizers than did the oats or barley which were the second and third crops respectively after the clovers. The yields from the check plots averaged 18.4 bushels, whereas some of the fertilizers more than doubled this yield (Plate VI, Fig. 1). The increase for manure alone was 5.9 bushels, whereas the increase from the complete fertilizer was 26.8 bushels. Five of the fertilizer treatments gave increases varying from approximately 15 bushels to approximately 27 bushels.

3. The oat crop (second after clovers) still showed the effect of the clovers. The average yield from the check plots was 34.5 bushels and from the highest yielding fertilized plot 64.8 bushels. Five of the fertilizer treatments gave increases varying from approximately 13 bushels to 30 bushels. The increases were in general lower than for the preceding wheat crop.

4. The barley crop (third after clovers) showed increases from the fertilizers, but of a much smaller magnitude than for the first and second crops after the clovers. In only three cases were the increases greater than about 4 bushels.

5. The best fertilizers for both the clovers and the grains were those carrying a high content of nitrogen. (See plots 3, 4, 9 and 10.) The fertilizer carrying only nitrogen was very effective in the production of grains for the second and third year after the clovers. However, greater returns were obtained in the case of the clover and the first crop after clover when the fertilizer contained phosphorus in addition to the nitrogen.

6. The plowing under of clovers alone gave fairly good responses, as indicated by the fact that the clover alone gave yields of 18.4 bushels of wheat, whereas the yields of wheat were only 11.5 bushels where clover had not been grown on the land. Plowing under of clovers was much more effective when in conjunction with the use of fertilizers. The use of fertilizers alone, while giving increases in some cases of the order of about 9 bushels of wheat, was much less effective than when used in conjunction with clovers. The use of fertilizer alone or of clovers alone was not adequate for

the production of maximum crop yields. The practice of plowing under of clovers in conjunction with the use of fertilizers doubled the productive power of the wooded soils, and the value of clovers was of the same degree as that of the fertilizers. It may not be necessary to plow under the entire clover crop, and in cases where the farmer needs the clovers for hay the crop might well be cut and harvested and the land immediately plowed. This practice would be of decided benefit, even though the results may not be quite as great as when the clover crop had been plowed under.

7. As a general statement covering all grains and legume crops the results might be expressed as follows: The increases in yields were from 2 to 4 times as great for both the fertilizers and the clovers when used conjointly as when used alone.

8. The practice of growing legumes and using fertilizers on these wooded soils, however, implies that some livestock must be kept in order to ensure a home market for the extra hay.

In connection with this suggested system of management the farmer might well consider the possibility of producing clover seed as an important item in the income from these soils. The production of seed from the alsike and Altaswede clovers has been very satisfactory in these experiments.

Legumes Suitable for Wooded Soils in Alberta.

From these results it is clearly indicated that both legumes and fertilizers must be included in the management program for the wooded soils if satisfactory yields are to be obtained and the soils made to return continued satisfactory yields.

There are comparatively few kinds of legumes commonly grown as field crops in Alberta. Those most suitable for Alberta's wooded soil belt would include the following: alfalfa, sweet clover, Altaswede, alsike clover, white or Dutch clover, and peas.

Under field conditions the farmer often experiences difficulty in getting a satisfactory stand of legume crops on the wooded soils owing largely to the undesirable physical condition of the soil. This is due to the great tendency of the wooded soils to bake when they become dry. The difficulty above mentioned can largely be overcome by the generous application of farm manure, the use of well prepared summerfallow or clean hoed crop land, and in many cases the application of fertilizers. A firm seed bed is desirable, and the seed should not be planted more than about an inch or an inch and a half deep.

The ordinary grain drill or the press drill may be used quite satisfactorily for seeding alfalfa or clovers if the seed is first mixed with about twice its bulk of cracked grain, of wheat, barley, or rye.

The time for seeding alfalfa or clovers where a nurse crop is not used ranges in Alberta from May 15th to July 1st. The early spring season should be utilized for preparing the proper type of seed bed and for destroying as many weeds as possible by cultivation.

If alfalfa or sweet clover seed is to be sown with an ordinary grain or press drill as described above, from 10 to 12 pounds of good seed are sufficient and about 6 to 8 pounds of alsike or Altaswede.

Good success has resulted from the broadcasting of these crops both with and without nurse crops, but more seed is necessary, and a heavy nurse crop may be injurious or fatal to the clovers.

Alfalfa is probably the best legume, and it has been shown by the experience of a number of farmers that it is well suited to climatic and soil conditions of Alberta's wooded soils. It does not thrive, however, on poorly drained soils, and in such cases the alsike or Altaswede clovers should be used. The application of manures and fertilizers is apt to be necessary and economical in the production of alfalfa and other legumes on these wooded soils.

Detailed information regarding alfalfa growing in Alberta may be obtained by applying to the Department of Extension, University of Alberta, for Leaflet No. 10. Most of the following information regarding alfalfa was obtained from this leaflet.

Certain varieties of alfalfa, such as Grimm, are very hardy, and only such varieties should be grown. It is important to use seed of good quality. Alberta grown registered No. 1 Grimm alfalfa seed represents the highest quality of seed that can be obtained. (To get into communication with members of the Canadian Seed Growers' Association having registered alfalfa seed for sale, write to the Dominion Seed Branch, Calgary, Alberta.) Every lot of alfalfa seed legally offered for sale in Canada is covered by an official certificate, which not only designates the grade, but also lists the kinds and proportions of weed seeds contained in the seed. The farmer should ask to see a copy of this certificate before purchasing. If the certificate is not available, the farmer may send a sample of the seed, either before or after buying, to the Dominion Seed Branch, Calgary, Alberta, and an official certificate listing the weed seeds in the sample will be returned to him. Three samples may be tested free of charge for any one person or firm in one year.

It is strongly recommended that alfalfa be sown without a nurse crop. If the sacrifice of a crop from the land while the stand of alfalfa is being established is felt to be too serious a matter financially, it is advisable to plant small units annually, employing only methods which give the greatest assurance of a successful stand. A good stand well cared for should give a big average return for five or six or more years.

Sweet clover has several undesirable qualities, such as its bitter taste and its coarseness for hay. On the other hand, it is suitable for the soil and climate of Alberta's wooded soil belt; it lives two years, and therefore fits well into a short rotation; it is a heavy yielder and a heavy seed producer. It does well on light soils that are inclined to drift. Commonly sweet clover is grown for hay and pasture, but it may well be used as a green manure crop, plowed down to enrich the soil. Where sown with a nurse crop of grain the rate of seeding of the nurse crop should be reduced by

about one-third to one-half. The use of a nurse crop is recommended following fallow, or on moist land, but is not recommended on land which for any reason is low in soil moisture. The rate of seeding for sweet clover should be about the same as for alfalfa. Seed which has been officially graded No. 1 by the Dominion Seed Branch is recommended, or better still, Registered No. 1 Arctic sweet clover, which represents the highest quality of commercial seed that can be grown. Further information may be obtained by applying to the Department of Extension, University of Alberta, for Bulletin No. 2, "Growing Sweet Clover."

Some strains of red clover recently introduced from northern Europe promise greater hardiness than any heretofore tried. The variety known as "Altaswede" is at least semi-winter hardy, and has given high yields on our wooded soils. Small quantities of Altaswede clover seed for multiplication purposes may be obtained from the University Field Crops Department, and larger quantities may be obtained from other growers.

Alsike clover is fairly hardy, and has given high yields in moist seasons on wooded soils, but it is not drought resistant. It is, however, very readily established on wooded soils, where it is frequently observed growing wild.

In pasture mixtures white or Dutch clover has a place. It is beneficial to the soil and it is very hardy, but it gives too small a yield to be a profitable forage crop.

Peas, so far, stand out as the most important annual legume in Alberta. The pea crop is a very valuable and nutritious forage crop, and for this purpose is frequently grown mixed with oats. Peas require a rather long season for growth, and they are not frost hardy. They grow best in a moderately cool, moist climate, but they are nevertheless fairly drought resistant.

The production of legume seed might be made a very profitable practice, and should be encouraged on these wooded soils. In many cases the value of legume seed would be several times that of the grain crops.

INOCULATING LEGUMES.

Experiments have demonstrated that legumes only assimilate atmospheric nitrogen when properly inoculated with nodule bacteria. On land where the particular legume has been grown before within the past few years, it may not be necessary to inoculate the seed, but when legumes are sown on land where they have not been previously grown the soil or the seed should be properly inoculated with bacteria suitable for members of that group of legumes.

The different varieties of alfalfa and sweet clover all belong to the same inoculation group. Therefore, if alfalfa is to be sown in a field which has already produced a crop of sweet clover, it will not be necessary to inoculate the seed or soil, and conversely, if the field has already produced alfalfa it will not be necessary to inoculate for sweet clover. Similarly the different varieties of alsike clover, white or Dutch clover, and red clover, including Altaswede clover, all belong to one inoculation group, and if, for

example, the small white or Dutch clover grows commonly in the district, it will not be necessary to inoculate the seed or soil when alsike or Altaswede clover is grown. The different varieties of peas and vetches, including field peas, sweet peas, wild peavine, hairy vetch, spring vetch, and wild vetch all belong to one inoculation group. Garden beans and scarlet runner beans belong to still another inoculation group.

For those not familiar with the methods of inoculating legumes a circular may be obtained from the University.

LIST OF PUBLICATIONS

OF

RESEARCH COUNCIL OF ALBERTA

EDMONTON, ALBERTA

ANNUAL REPORTS OF COUNCIL

No. 3 (for the calendar year 1920); pp. 36. **Price 5 cents.**

No. 5 (for the calendar year 1921); pp. 86. **(Out of print.)**

No. 8 (for the calendar year 1922); pp. 64. **Price 35 cents.**

No. 10 (for the calendar year 1923) with 4-color map of Alberta coal areas; pp. 76. **Price 50 cents.** May No. 6 only, **15 cents.**

No. 12 (for the calendar year 1924); pp. 66. **Price 35 cents.**

No. 16 (for the calendar year 1925); pp. 65. **Price 35 cents.**

No. 20 (for the calendar year 1926); pp. 53. **Price 25 cents.**

No. 22 (for the calendar year 1927); pp. 49. **Price 25 cents.**

No. 24 (for the calendar year 1928); pp. 53. **Price 35 cents.**

No. 25 (for the calendar year 1929); pp. 65. **Price 35 cents.**

No. 26 (for the calendar year 1930); pp. 76. **Price 35 cents.**

No. 27 (for the calendar year 1931); pp. 53. **Price 35 cents.**

No. 28 (for the calendar year 1932); in manuscript.

No. 29 (for the calendar year 1933); in manuscript.

No. 32 (for the calendar year 1934); in manuscript.

REPORTS—FUELS

No. 10A (1923); COMBUSTION OF COAL FOR THE GENERATION OF POWER, by C. A. Robb. **(Out of print.)**

No. 14 (1925); pp. 64. ANALYSES OF ALBERTA COALS, with 18 maps and 2 charts. By E. Stansfield, R. T. Hollies, and W. P. Campbell. **Price 25 cents.**

REPORTS—ROAD MATERIALS

No. 18. THE BITUMINOUS SANDS OF ALBERTA, by K. A. Clark and S. M. Blair.

Part I——Occurrence, pp. 74. **(Out of print.)**

Part II—Separation, pp. 36. **Price 25 cents.**

Part III—Utilization, pp. 33. **Price 25 cents.**

REPORTS—SOIL SURVEY DIVISION

No. 23 (1930); PRELIMINARY SOIL SURVEY ADJACENT TO THE PEACE RIVER, ALBERTA, WEST OF DUNVEGAN, by F. A. Wyatt and O. R. Younge; pp. 33 and colored map. Scale 1 inch to 4 miles. **Price 50 cents.**

No. 31 (1935); PRELIMINARY SOIL SURVEY OF THE PEACE RIVER-HIGH PRAIRIE-STURGEON LAKE AREA, by F. A. Wyatt; with colored map. Scale 1 inch to 4 miles. **Price 50 cents.**

REPORTS—GEOLOGICAL SURVEY DIVISION

By Dr. J. A. Allan, Professor of Geology, University of Alberta.

No. 1 (1919); pp. 104—A summary of information with regard to the mineral resources of Alberta.

No. 2 (1920); pp. 138+14. Supplements the information contained in Report No. 1.

No. 4 (1921); GEOLOGY OF THE DRUMHELLER COAL FIELD, ALBERTA; pp. 72, and 6-color map (Serial No. 1). **(Out of print.)**

No. 6 (1922, Part I); GEOLOGY OF THE SAUNDERS CREEK AND NORDEGG COAL BASINS, ALBERTA, by J. A. Allan and R. L. Rutherford; pp. 76 and 2-color map (Serial No. 2). **(Out of print.)**

No. 7 (1922, Part II); AN OCCURRENCE OF IRON ON THE NORTH SHORE OF LAKE ATHABASKA, by J. A. Allan and A. E. Cameron; pp. 40; two maps (Serial Nos. 3 and 4.) **(Out of print.)**

No. 9 (1923); GEOLOGY ALONG BLACKSTONE, BRAZEAU AND PEMBINA RIVERS IN THE FOOTHILLS BELT, ALBERTA, by J. A. Allan and R. L. Rutherford; pp. 48, and 6-color map (Serial No. 5). **(Out of print.)**

No. 11 (1924); GEOLOGY OF THE FOOTHILLS BELT BETWEEN McLEOD AND ATHABASKKA RIVERS, ALBERTA, by R. L. Rutherford; pp. 61, and 8-color map (Serial No. 7). One inch to two miles. **Price 75 cents.**

No. 13; GEOLOGY OF RED DEER AND ROSEBUD SHEETS, by J. A. Allan and J. O. G. Sanderson. Two geological maps in 8 colors. Scale, one inch to three miles. Serial No. 8 Red Deer Sheet and No. 9 Rosebud Sheet. Five structure sections. **(Report in preparation.)**

Map No. 10 (1925); GEOLOGICAL MAP OF ALBERTA, by J. A. Allan. In 14 colors. Scale one inch to 25 miles. **(Out of print.)**

No. 15 (1926); GEOLOGY OF THE AREA BETWEEN ATHABASKA AND EMBARRAS RIVERS, ALBERTA, by R. L. Rutherford; pp. 29 and 3-color map (Serial No. 11). One inch to two miles. **Price 50 cents.**

No. 17 (1927); GEOLOGY ALONG BOW RIVER BETWEEN COCHRANE AND KANANASKIS, ALBERTA, by R. L. Rutherford; pp. 46 and 9-color map (Serial No. 12). Scale one inch to one mile. **Price $1.00, or map alone 50 cents.**

No. 19 (1928); GEOLOGY OF THE AREA BETWEEN NORTH SASKATCHEWAN AND McLEOD RIVERS, ALBERTA, by R. L. Rutherford; pp. 37 and 3-color map (Serial No. 13). Scale 1 inch to 3 miles. **Price 50 cents.**

No. 21 (1930); GEOLOGY AND WATER RESOURCES IN PARTS OF PEACE RIVER AND GRANDE PRAIRIE DISTRICTS, ALBERTA, by R. L. Rutherford; pp. 80 and 6-color map (Serial No. 14). Scale 1 inch to 4 miles. **Price $1.00.**

No. 30 (1934); GEOLOGY OF CENTRAL ALBERTA, by J. A. Allan and R. L. Rutherford; pp. 41 and 10-color map (Serial No. 15). Scale 1 inch to 10 miles. **Price $1.00.**