

GEOLOGICAL AND NATURAL HISTORY SURVEY OF CANADA  
ALFRED R. C. SELWYN, C.M.G., LL.D., F.R.S., DIRECTOR.

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NOTES  
TO ACCOMPANY A PRELIMINARY MAP  
OF THE  
DUCK AND RIDING MOUNTAINS  
IN  
NORTH-WESTERN MANITOBA.

BY  
J. B. TYRRELL, B.A., F.G.S.

*Field Geologist of the Geological and Natural History Survey of Canada.*



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TO ALFRED R. C. SELWYN, C.M.G., LL.D., F.R.S.,

*Director of the Geological and Natural History Survey of Canada.*

SIR:—I beg herewith to submit a preliminary Contour Map, with explanatory notes, of the Duck and Riding Mountains and the adjacent valley of the Assiniboine. The country depicted and briefly described lies chiefly within the province of Manitoba, but a strip of the eastern portion of the district of Assiniboia is also included.

I have the honor to be, Sir,

Your most obedient servant,

J. B. TYRRELL.

NOTES  
TO  
ACCOMPANY A PRELIMINARY MAP  
OF THE  
DUCK AND RIDING MOUNTAINS  
IN  
NORTH-WESTERN MANITOBA.

The present map embraces the area travelled over, examined and surveyed during the summer of 1887. In it are incorporated all the Dominion Lands, Indian Reserve, Timber and Railway Surveys up to the present date. It forms the south-west corner of a larger sheet embracing also the whole of Lake Winnipegosis and part of Lake Manitoba. This sheet it was hoped would have been ready for publication during the present winter, but during the early part of the summer of 1888 the writer was seized with a severe attack of fever while in the vicinity of Fairford House on the Little Saskatchewan River. Two weeks were occupied in carrying him to Winnipeg, where he lay in the hospital for seven weeks, and was unable to resume field work before the winter set in. This checked the progress of the exploration to such an extent that another season must necessarily be spent before the whole map can be ready for publication.

In view of the utterly unknown character of a large part of this region, of its great importance as a source of timber supply for Manitoba, and of the luxuriant fertility of the soil over considerable areas such as those drained into Lake Dauphin and the Assiniboine River, this map is now submitted for publication in advance of the larger sheet.

It has been compiled and drawn by Mr. D. B. Dowling, B. A. Sc., who also acted as my assistant in the field. In its preparation I have received every possible assistance from Capt. Deville and the gentlemen associated with him in the Dominion Lands Branch of the Department of the Interior, and also from Mr. Collingwood Schreiber and

others in the Department of Railways and Canals. Wherever surveys of townships or Indian Reserves have been made by the Dominion Lands Branch, these surveys are marked by full lines. The old locations of the Canadian Pacific Railway, both north of the Duck Mountain and south of the Riding Mountain, have furnished valuable lines through the country. For the rest, the topography is laid down from odometer and track-surveys made by ourselves, frequently checked by latitudes taken with a brass sextant of eight-inch arc reading to 10". The contour lines are laid down from the heights given on the two railway-surveys just mentioned, as well as from numerous heights obtained from observations made with a mercurial barometer and two aneroids, compared with the readings taken thrice daily from the standard barometer at Minnedosa. The height of the standard barometer at Minnedosa is 1689 feet, a height twenty-four feet higher than that given by the railway profiles, an error of this amount having been found by Mr. Warren Upham to have been made in connecting the surveys east of the Red River with those to the west of it.

Extent of country mapped.

The map as now published embraces an area of 12,000 square miles, but of this, Lake Winnipegosis is merely sketched in from former surveys to show the discharges of the various streams, and the Porcupine Mountain, in the north-west corner of the map is as yet unexplored. This leaves an area of 8,500 square miles, or 5,440,000 acres, a tract larger than that of the State of Massachusetts, which has been more or less carefully examined. It embraces Duck and part of Riding Mountains, with the included and surrounding valleys and the more level country east of these mountains, lying between them and lakes Winnipegosis and Dauphin. It is drained on the north by Swan River, which flows north-eastward through Swan Lake into Lake Winnipegosis, its main tributaries being the Bear's Head, Favell, Rolling and Sinclair rivers, flowing northward from the north face of the Duck Mountain. On the west, it is drained by the Assiniboine, with its tributaries Little-Boggy and Big-Boggy creeks and Shell River. On the south, some of the small upper tributaries of Bird-tail Creek drain a limited area in the Riding Mountains. On the east, Turtle, Ochre, Vermilion, Wilson and Valley rivers pour their waters into Lake Dauphin, flowing across the fertile plain south and west of this lake. Fork, Pine and Duck rivers flow from the face of Duck Mountain, the former into Mossy River and the latter into Lake Winnipegosis.

Drainage

General physical features.

In its general physical features it presents very great diversity of character. The mountains, or rather the one mountain cut in twain by the great depression of Valley River, cross the country in a north-north-westerly direction, forming a high, rugged ridge rising in different places from thirteen to nineteen hundred feet above Lake Winni-

pegosis. To the eastward these mountains descend in a steep, wooded slope to an even, almost unbroken, alluvial plain, which inclines gently to the lake shore. Westward it descends much more gradually, and, except in the vicinity of lat.  $51^{\circ} 30'$ , without any abrupt escarpment, towards the Plains.

Over a great portion of the higher lands, the surface is dotted with beautiful little lakes of clear, fresh water, those in the more open country being encircled with green wreaths of small poplar and willow, while in the more thickly wooded tracts in the higher parts of the mountains, tall spruces are growing to the edge of the water. Many of these lakes are drained by permanent brooks, but most of the smaller ones are isolated during the greater part of the time, and overflow only in rainy seasons or when the water is at its highest stages. They are all of glacial origin, lying in the depressions of the irregular surface of the till or unstratified glacial deposits. Many small lakes.

The whole land surface is more or less thickly timbered, the woods varying, however, from a few scattered clumps of willows in the townships in the south-west corner of the map, through groves of poplar severed by open glades in the country bordering the Assiniboine, to coniferous forest on the summit and northern and eastern flanks of the mountains. In the valley of Swan River, and in the tract of country south-west of Lake Dauphin, the forest again gives place to a partly wooded country, the open areas of which are often covered with a luxuriant growth of rose bushes and other small shrubs. Timber.

Lake Dauphin is a shallow body of water twenty-eight miles long and ten to twelve miles wide, with an approximate elevation above the sea of eight hundred and forty feet. Mossy River flows from its northern end into the south-west angle of Lake Winnipegosis. Its shores, where seen along its southern boundary, were either low and marshy, or bordered by beach-ridges of well-rounded limestone gravel, behind which stretched extensive meadows of rich, tall grass. In high water these meadows are doubtless flooded, but at present they are quite dry, and will be so in all ordinary seasons. Behind these meadows, a wide and apparently flat plain stretches back to the foot of the Riding Mountain. Instead of being level, however, it rises gradually and regularly, being generally well drained by the numerous small clear streams that flow through it in narrow, winding channels. These streams are skirted with rows or narrow belts of timber consisting of elm, oak, birch, and cottonwood. Between these wooded belts, the plain is dotted with groves of poplar and willow. The soil is a rich alluvial clay loam, on which abundant crops of wheat, oats, barley, maize, as well as all the ordinary garden produce grown in eastern Canada and the central and eastern United States, can be raised. On the Lake Dauphin.  
Rich alluvial plain.

third of August, 1887, barley was ripe and being cut, and the fields of wheat were quite tinged with yellow. On the 17th of August the settlers were reaping the dead ripe wheat, which gave promise of a very heavy yield.

Absence of  
summer frosts.

Reasons.

Luxuriance of  
herbage.

Sheltered  
position.

Presence of  
trees.

The summer frosts, too, which have occasionally proved prejudicial to the crops in some parts of Manitoba and the North-West Territory, appear to avoid this favoured district. This is, no doubt, in part due to the slope of the surface, the cold air sinking down the gentle incline till it reaches the lake, where it is warmed by radiation from the surface of the large body of water which has been warmed by the hot sun of the day before, and which, on account of its shallowness, gives out its heat rapidly to the overlying air. The great luxuriance of the grasses and herbage in this district has also much effect in hindering the occurrence of summer frosts. By increasing the amount of water evaporated in the day time it renders latent a large amount of heat, which again becomes sensible when this moisture is deposited in the evening in the form of dew. Growing grain would also have precisely the same effect. Its sheltered position is also very much in its favour. A wind blowing from the east across the great lakes of the Winnipeg basin will be loaded with moisture, which, if it does not fall as rain, will form into clouds or be deposited as a heavy dew, and will avert a frost either by hindering the radiation of the heat from the lower stratum of air, or by raising its temperature. If the wind is blowing from the drier plains to the west it will be partly diverted to the south-west along the Duck and Riding mountains, and what crosses the mountains, though very dry, will be so much warmed by condensation in descending thirteen to eighteen hundred feet that little danger of frost need be feared from it. In this connection, it may be remarked that it appears very probable that the planting of trees around the fields on the plains of Manitoba and the North-West Territory would have considerable influence in preventing the occurrence of summer frosts by breaking the winds and hindering the free circulation of air. The moisture that was evaporated from a field of growing or ripening grain or other crop would then, to a considerable extent, remain over the field, whereas now it is often replaced by dry air from the plains, which offers no obstruction to the rapid loss of heat from the earth by radiation. The circumstances under which frost occurs are often as follows:— During the day a stiff wind is blowing from a westerly direction, carrying off the moisture as fast as it is evaporated. In the evening the weather becomes very calm, and on account of the absence of any moisture in the atmosphere the stars shine with exceptional brilliancy. The earth is warm from the heat of the day, but radiation

proceeds so fast that by one or two o'clock in the morning its immediately available supply of heat is exhausted and the overlying air falls below the freezing point. The presence of a greater amount of moisture in the air will prevent this rapid dissipation of heat, and one of the means of insuring the presence of this moisture is by constructing wind-breaks in the form of rows of trees in order to retain the damp atmosphere over the fields rather than to allow it to be replaced by the drier air of the plains.

Smudges, the smoke from which on those quiet, bright nights will settle down over the land, would doubtless also have a very beneficial effect in hindering the occurrence of frosts.

The breaking up and tilling of the soil will also have a great effect in <sup>Breaking of the soil.</sup> reducing the diurnal variations of temperature. The direct rays of the sun during the day do not raise the temperature of ploughed land as high as that of the unbroken plains, but they warm it to a greater depth, a fact which may readily be observed in walking across the drier plains on a hot day in summer. The dry sod, covered with short withered grass, will be felt to be very hot, but if ploughed land is reached, the ground will at once be found to be much cooler. By taking a spadeful of earth from the two places the lower part below the sod will be found to be very much cooler than that under the ploughed land. The effect that this will have on the night temperature of the air will be that the radiation of heat from the ploughed land will be much slower than from that which is unbroken, but which is practically bare on account of the withering of the short grass. The temperature will be lowered comparatively slowly, and while in the latter case a frost might have set in at four or five o'clock in the morning, in the former the air will be kept above freezing point till the sun rises again.

But to return to the alluvial Lake Dauphin plain, the surface is so level or evenly sloping that lakes or ponds are very scarce, but plenty of good water can easily be obtained in wells ten to fourteen feet deep. In ascending from the lake to Riding Mountain, the surface rises by low steps to the foot of the more abrupt escarpment. The steps are occasionally replaced by ridges of rounded gravel, both the steps and ridges representing old shore lines of the ancient lake which formerly occupied the whole of the basin of Lake Winnipeg and the valley of the Red River, a lake the former existence of which was first clearly pointed out by Prof. H. V. Hind in 1859 and which was afterwards named by the late General Warren, Lake Agassiz, in honour of Louis Agassiz, the first great exponent on this continent of the force of glacial erosion and of the former distribution over the northern portion of America of a great ice-sheet in glacial times. The full comparison of these ancient shore lines with the shores of the present adjoining lakes must be left to the final report on this area.



Ancient const-cliff. Most of the steps are low, seldom reaching a greater height than ten or twelve feet, but one of the higher ones, which is crossed on the Vermilion River trail, and the bottom of which may be considered the foot of the mountain, rises to the height of one hundred feet. Its face is now a steep slope wooded with poplar and small bushes, but when the waves of the ancient lake beat against it, it rose above the water as a naked cliff of white Cretaceous chalk-marl. Following the shore-lines northward to beyond the Valley River, the low coast-cliffs almost entirely disappear, and the ancient shores are represented entirely by gravel beach-ridges. This change of conditions is caused by the fact that the base of the escarpment of Duck Mountain is much higher than the foot of Riding Mountain, and higher than the highest level to which Lake Agassiz appears to have risen. From this escarpment the land slopes gently down a long easy grade to the level of Lake Winnipegosis.

Gravel beaches. The beaches consist of more or less rounded gravel, the pebbles, which are chiefly of limestone, though a few are of granite, varying from the size of pigeons' eggs down to that of No. 6 shot, but however fine, they are still distinct pebbles, mixed with little or no quartz sand. The ridges follow in a long sweeping curve the general direction of the face of the escarpment. The highest of these ridges seen on Shanty Creek has an elevation of 1,365 feet above the sea, and as far as one could judge is about two hundred feet below the level of the base of the mountain escarpment. The pebbles in it have their angles worn off by water action, but are not at all well rounded, and between it and the next lower ridge there is very little alluvial deposit, showing that the water stood at this height for a, comparatively, very short time. Above the ridge the surface is lightly undulating and composed entirely of unstratified glacial till scattered over with irregular pebbles and boulders, it having never been buried under the waters of this great post-glacial lake.

Natural roads. The northward extensions of these ridges form remarkably straight natural roads through the otherwise level and often swampy or marshy country. One, having an elevation of 1,084 feet at Valley River, was followed northward with buckboard and carts for twenty-three miles, to beyond Shanty Creek, while another, about seventy feet above the last, was followed from a little south of Wilson River northward for twelve miles to a branch of Valley River, where the extension of the forest across the ridge obliged us to descend to its lower neighbor. At Shanty Creek we returned to the higher beach, and continued to follow it northward for nineteen miles, at which point it was still quite well marked. Half a mile to the eastward the lower beach was also typically developed. Thus these two ridges were found to extend, the lower one at least forty, and the upper one forty-four miles.

A few miles further north, near Duck River, similar gravel ridges are found to obtain, though here, instead of being generally open and grassy, they are covered in part with a scattered growth of small Banksian pines. Looking southward from Duck River along a ridge, the height of which is given on the profile of the old location of the Canadian Pacific as 1,201 feet, a high knoll is seen to rise above and just to the westward of it. This knoll, when reached, was found to be the northern end of a gravel ridge running off to the southward, and rising sixty feet above the ridge immediately to the east of it. Its face is steep, the slope being apparently as great as that at which the gravel would stand. The point is bent around to the westward in the form of a knob or hook, the whole appearing as if it had projected out into the lake as a gravel spit or hook, as the land behind as well as in front of it is from fifty to sixty feet below its summit. Beaches pine-covered.

This point was somewhat peculiar in being scattered over with a great number of large gneissoid boulders, lying on a surface of sand filled with rounded, waterworn pebbles of gneiss, limestone, ironstone, etc. As a rule, the ancient beaches are composed entirely of small rounded pebbles, in this particular differing very materially from the beaches of the lakes which now occupy the lower levels of the Winnipeg basin. On the existing lakes the shores are very thickly strewn with gneissoid boulders, which in winter have been, and are still being, frozen into the ice, and then shoved outwards by its expansion till they are placed up beyond its reach, or packed into a very regular wall. Many of the boulders on the above mentioned ancient gravel bar or spit have probably been placed there in a similar way, the bay to the westward having doubtless been frozen over during the winter, while the general absence of boulders on the long straight beaches would seem to indicate that the whole lake was never covered with ice. End of beach.

North of Duck River the higher ridges, which alone have been followed here, bend sharply round the north-east corner of the Duck Mountain into the valley of Swan River. Abrupt change of direction.

The presence of these ridges influences in a very marked degree the character of the country they traverse. Although they furnish magnificent natural highways they also act as dams in preventing the ready drainage of the country down its easy natural slope, except in a few places where these dams are broken through by streams such as the Duck and Fork rivers. There is very commonly a marsh or marshy lake just above or west of the ridge, or a little sluggish stream may flow northward or southward beside it. The country in the latter case is somewhat better drained and generally supports a close growth of small black spruce and tamarac. The lower side of the ridge is drier and sometimes supports a growth of poplar, but Ridges serve as natural dams.

generally is thickly covered with small black spruce. Some fine groves of large white spruce are met with close to the banks of the larger streams. Stunted oaks on the ridges in the more open parts and some beautiful groves of tall, stately elms were seen, a very noticeable one of the latter being a grove near the foot of the Duck Mountain, a few miles south of Duck River. A few pleasant prairies here and there occur, but they are not numerous, and the country may be said to be generally thickly wooded. Forest fires in recent years have, however, destroyed the greater part of the timber that could have been converted into lumber, and instead there is now a close growth of small sticks as yet comparatively valueless. As was stated above, large areas are now covered with swamp or marsh, but this wet land could be drained with very little difficulty, since the surface everywhere slopes gently towards the east, except where the incline is broken by gravel ridges from fifty to one hundred and fifty yards in breadth. Drains could be readily cut through these at intervals sufficiently close to allow the water to flow off freely to the lake.

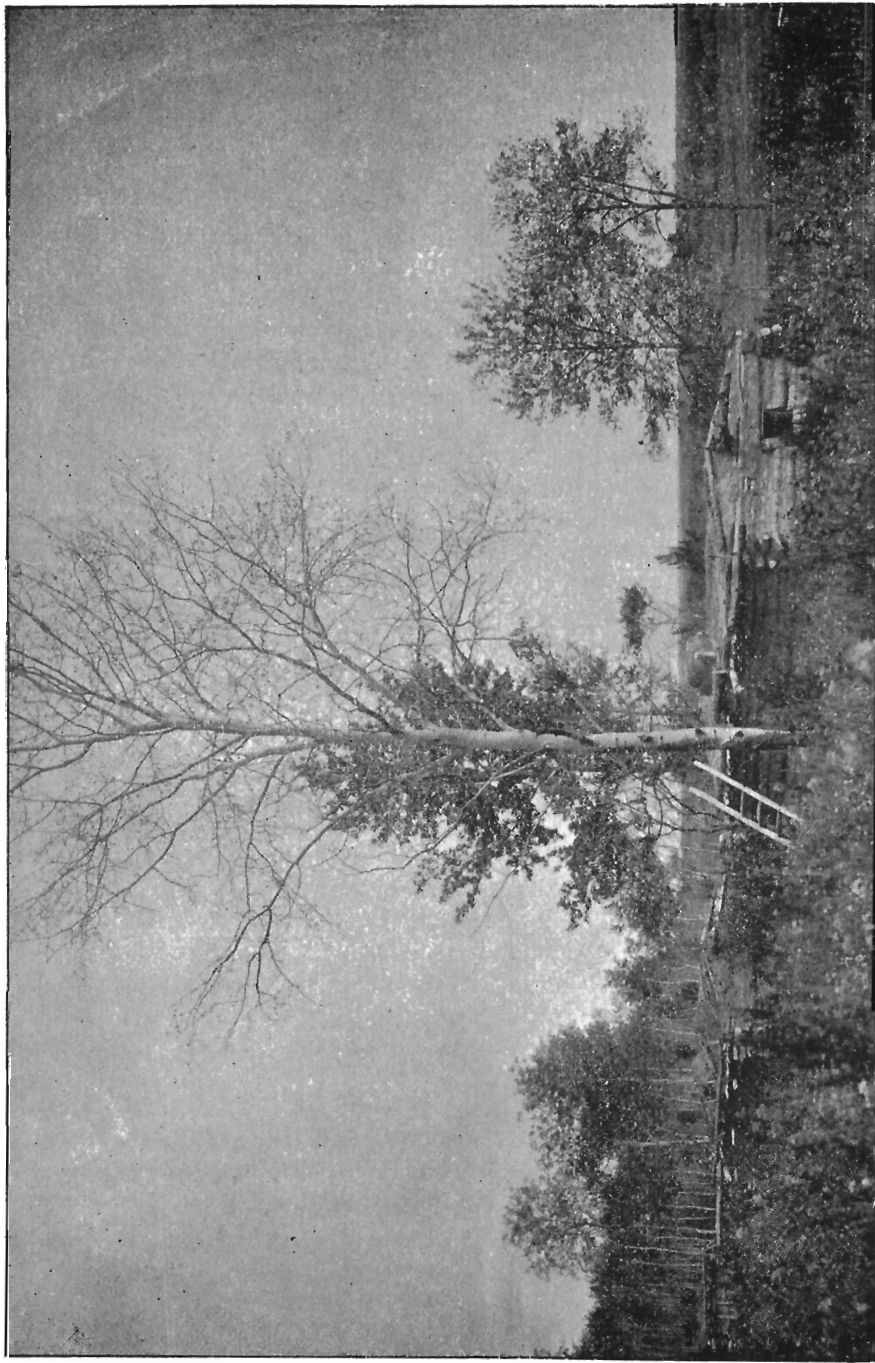
Valley river.

Of the two largest streams that flow eastward within the district, the Valley River winds in a beautiful sloping valley which doubtless represents an ancient drainage channel in pre-glacial times. Above or west of the gravel ridges that cross this valley is a wide sandy plain, representing an old delta deposit when Lake Agassiz was at its highest stages and when a stream flowed into it through the valley of Short Creek from the west side of the Duck Mountain. The Swan River valley is much wider and is cut down to a much greater extent. The lower part, below what is locally known as the "Coast Ridge," is covered with alluvial deposits of sand or sandy clay, while further west are some rough morainic tracts, among which lie extensive flood plain deposits. In both of these valleys, Indians and Metis have at different times had thriving little villages, the soil being very rich and fertile. On the latter there is now a Metis settlement about a mile or two beyond the northern limit of the present map. Two Indian reserves were formerly occupied on the banks of this river and on them the Indians raised grain and the ordinary root crops. Lately, these Indians have been removed to the vicinity of Fort Pelly for the greater convenience of communication and trade.

Swan river.

Old Indian settlement.

On Valley River there was formerly an Indian settlement in township 25, range 24, west, and now there is a thriving village at the mouth of Short Creek, at the point where the River leaves the Duck Mountain. A good cart-trail runs from Russell on the Manitoba and North-Western Railway to this village, and carts can also pass eastward from it to the Lake Dauphin settlement. Here in the summer of 1887 some good crops of the ordinary grains and roots were being raised.



J. B. TYRRELL, PHOTO., 15TH AUG., 1887.

OLD INDIAN HOUSES, NEAR VALLEY RIVER.  
Township 25, Range 24 West Manitoba.

G. E. DESBARATS & SON, ENGRAVERS & PRINTERS, MONTREAL.



West and south-west of the alluvial plain of the ancient Lake Agassiz, the Duck and Riding mountains rise to from two thousand to two thousand seven hundred feet above the sea, in most places faced by a steep escarpment, but between Vermilion and Valley rivers the slope is gradual, no appreciable escarpment being seen during the ascent. This slope is generally well drained and in places supports a strong growth of poplar and spruce, but unfortunately much of it is fire-killed and useless.

The higher parts of the mountains are very rough and uneven, being composed of drift hills and ridges from one to three or four hundred feet high, among which nestle beautiful lakes of pure clear water, or sparkling brooks flow to the main water courses, most of which have a general north or south direction. Many of the hills are thickly clothed with spruce and balsam fir (*A. balsamia*) mixed with birch and poplar, and in the more southern portions with maple (*Acer spicatum*) and more northerly with an occasional tree of mountain ash. Some of the knolls in the northern and north-eastern areas are so thickly strewn with large gneissoid boulders, that the land is almost barren, supporting but a short stunted growth of Banksian pines, and where these have been burned, as they have been over considerable areas, the ground is almost entirely uncovered by either grass or herbage of any kind. Between these rough hills stretch considerable areas of level swampy country covered with a close growth of black spruce, in most cases too small to be of any general economic importance.

The northern face of the Duck Mountain has formerly supported much excellent forest, but most of this area has now been burnt over, and is being overgrown with poplar. A fine grove of white spruce however yet remains near the head of Favell River and between Favell and Rolling rivers.

The thickly wooded areas of these mountains are the favourite hunting grounds of Indians who have their reserves by the lakes or along the Assiniboine. One of these latter bands, under Chief Côté, has cut a good cart trail from its reserve north of Little-Boggy Creek to Angling Lake, where it has built a number of substantial log houses. These houses are deserted during the summer, but in the autumn, when the season for hunting and trapping returns, a portion, if not the whole, of the band moves here from the village and farms on the Reserve and supports itself during the winter on the proceeds of the chase.

West of Duck Mountain stretches away to the westward the rich alluvial plain through which the Assiniboine River flows in a direction 25° east of south. The eastern side of this plain between Lac la Course and Little-Boggy Creek is a steep slope or escarpment from two to five

Duck and  
Riding  
mountains.

Rough  
morainic  
country.

Some spruce.

Good hunting  
grounds.

Assiniboine  
valley.

hundred feet high, but south of Little-Boggy Creek this escarpment soon disappears, and the plain rises through a gradual though generally undulating or rolling, incline to the summit of the mountains. The soil in this plain or valley bottom is exceedingly fertile, being composed of a rich alluvial dark sandy loam, which produces abundant crops of grain.

Its peculiar  
character.

The course of the river itself is a very peculiar one. Just above Fort Pelly it flows in an almost northerly direction, making straight for the wide valley at the bottom of which at present a small stream, Shake Creek, rises in a quagmire just north of the Fort and flows into Swan River. Instead of following this valley northward, however, the Assiniboine turns abruptly and flows a little east of South in the bottom of a shallow and indefinite valley. This valley, however, gradually becomes better defined and increases in depth lower down, and though the country on either hand becomes higher, the river maintains its direction, at length cutting a valley about four hundred feet deep. The land on either side of the valley north of the mouth of Shell River consists of alluvial deposits which appear to have been laid down in the bottom of an ancient lake which stretched westward from the western base of the Duck Mountains. Its further shore has not yet been determined.

Lake  
Assiniboine.

This lake, as well as Lake Agassiz, is closely associated with the former glacial conditions of the country, and a brief statement of the conditions then probably existing may be here given.

Conditions  
during glacial  
period.

During the continuance of the glacial period, a huge glacier moved in a south-south-easterly direction in the great valley east of the Duck, Riding and Pembina escarpment, while another flowed parallel to it down the valley of the Assiniboine on the western side of these mountains. At times these glaciers doubtless coalesced into one vast ice sheet, while at other times they were separated by the mountains either in part or entirely and along the tops of the mountains threw up a median, or rather what has been called by Professor Chamberlin an "interlobate" moraine consisting almost entirely of boulders and debris of the Archæan rocks to the north. This is what has given the mountains their rough, rugged and broken character, a character which is most pronounced in the more northern portions. Where the Indian trail crosses the north-eastern corner of the Duck Mountains much of the country is so completely a mass of boulders that it supports but a few small stunted Banksian pines. At length a rise of the land took place in the southern or central portion of the continent, which rise is doubtless accountable in part for the high elevation of some of the plateaux of the Western states and of the Rocky Mountains.

The glaciers now rapidly receded down the valleys, leaving large bodies of fresh water occupying the depressions along their fronts. It was apparently in this way that Lake Agassiz, the ancient lake of the Red River valley, and the lake which occupied the upper part of the Assiniboine valley, were originated. The ice front at last receded to a point where it again became relatively stationary, the flow of ice from the higher lands making up for the portions that were being melted off and carried away. Recession of the glacier.

Whether this ice front formed the northern or north-eastern shore of the above-named lakes it is impossible as yet to say, but the fact that the old shore lines of Lake Agassiz rise by a very gradual and even incline to the north as far as they have as yet been traced, showing a northern elevation of the land since the lake stood at its higher level, rather than a very considerable northern depression or southern elevation of the land, which must have occurred if the northern border of the lake was any of the land lying to the northward, lends great strength to this theory. However, for the complete determination of this question, further systematic investigation is necessary, but the existence of the lakes themselves admits of no doubt whatever. The relation of the two lakes to each other is somewhat difficult to make out completely, having doubtless been quite different at different times. At one time Lake Assiniboine was possibly only a bay of Lake Agassiz, being perhaps connected with it through the valley of Swan River, but if this was the case the alluvial deposits in the upper part of the Swan River have been covered by succeeding glacial deposits. At all events at one time a glacial dam appears to have stretched across the north end of this portion of the Assiniboine valley, and the superfluous waters of Lake Assiniboine flowed into Lake Agassiz through the deep valley which is now in part dry, and in part drained by Short Creek into Valley River. Gradual incline of beaches.  
It was at this period that the delta plains of the Valley River were formed. Valley of Short Creek. When Lake Assiniboine receded towards the north a considerable stream still flowed through the valley of Shell River, fed in all probability by local glaciers on the Duck Mountain, while other streams flowed in from the south in the lower part of the same valley, and in a deep valley to the east of it now abandoned. After this time the valley of Snake Creek was formed and Lake Assiniboine was doubtless drained. The glaciers on the mountains, however, now gradually extended, closing all these valleys and the water from the ice front was obliged to find some other outlet, which it did down the valley of the Assiniboine below the mouth of Shell River, this valley having in all probability been first marked out, in part at least, by a stream flowing from the foot of Riding Mountain northward into Lake Assiniboine. These glaciers have left marks of their presence in Recedence of glaciers.



## Moraines.

morainic dams stretched across the valleys of Short Creek, Shell River and Snake Creek, &c. The flow of water was thus established towards the south, and a valley was worn out through which the Assiniboine River continues to flow up to the present time, though it is probable that now the amount of sediment carried away by the river exceeds by very little, if it exceeds at all, the amount of sediment brought down into it by small affluent streams, and consequently it has ceased to deepen its valley.

The geological structure of the country will be discussed in the final report, but it may be here stated that the floor underlying the whole country is a white or cream-colored Devonian limestone. Its surface is somewhat undulating, but on the whole it exhibits a slight slope towards the west or south-west. On this floor are heaped up successive beds of sands, marls and shales of Cretaceous age, constituting all the older rocks seen in this area west of the lakes. These form, under the glacial deposits, the entire mass of the Duck and Riding Mountains, and extend from them westward across the Assiniboine and under the Great Plains to the foot of the Rocky Mountains.